THE RECORDING AND ANALYSIS OF ANIMAL HEALTH DATA ON NEW ZEALAND DAIRY FARMS

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by Bryan Joseph McKay

Significant progress has been made in the last three decades in reducing the prevalence of animal diseases that cause mortality. However, there is an increasing concern with significant losses associated with diseases that cause a reduction in production efficiency, especially in western countries. In response to this the disciplines of epidemiology and economics are being applied to animal health problems to evaluate causal relationships between contributing factors and health problems, predict the economic benefits of control methods, and prescribe the optimal preventive and/or control measures for these problems.

In order to measure the impact of a disease, one has to be able to identify the effects it has on the animal. This is not a simple task because disease effects a) are not always obvious and pronounced; b) are influenced by factors such as management, environment and others; c) have a temporal dimension which adds to the complexity of evaluating their impacts at different stages in time; d) often manifest themselves as part of a complex involving other diseases. In an attempt to overcome the above problems, and to produce an aid to veterinarians promoting health management services to New Zealand dairy farmers, a computerised information system, DairyMAN, was developed with the specific requirements of the New Zealand dairy scene in mind. This thesis is a report of the development of the program DairyMAN, the philosophy behind the design structure and field operation of the program. The results of the use of the program to analyze records, and in combination with an advisory service, are reported for a particular farm. Over an 18 month period the return on investment made by the farmer on this service was conservatively estimated at 175%. The author concluded that the program, although still evolving as additional features are added, effectively supports the activities of veterinarians involved in health management services. It also produces a valuable data base on which epidemiological research may be carried out.

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TABLE OF CONTENTS

LIST OF FIGURES

Figure		Page

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

Stein (1986a) reported that the rate of growth in agriculture's productive efficiency has declined in the previous two decades. The reason given was that there had not been a lack of discoveries but rather a failure to effectively apply them. A possible reason suggested for this situation has been the lack of investment in the methods of applying such new discoveries. As the infectious health problems have been brought under control new types of important production limiting factors have emerged.

In modern livestock production systems such limiting factors are associated with lower feed conversion efficiency, smaller litter size or lengthened calving to conception intervals. Morris (1982a) suggested there are likely to be three or four health and management factors which interact to produce these problems, and the classical clinical approach falls short, as there is seldom a single factor alone producing the health problem. In addition such an approach is unable to result in a suitable plan for correction of complex situations.

The service provided by veterinarians, that has been developed to deal with reductions in production efficiency, has been given many titles, the most recent being "animal health management".

Morris (1982) has described the central features of research on health management:

1. The development and implementation of monitoring systems to continuously evaluate herd performance and productivity.
2. The development of diagnostic methods for deducing causal relationships from a combination of monitoring data, clinical

observation, and laboratory findings.

3. The use of these methods to identify components of productivity which merit research investigation. Screening studies or health and productivity profiles may be useful methods to identify these constraints.
4. The evaluation, under field conditions, of expected response to various interventions which research shows may be effective against complex problems.
5. The integration of these features so that strategic decisions to improve productivity may be made in the context of their biological and economical feasibility. Computer models may be required to effectively integrate these data.

Radostits and Blood (1985) suggested that the primary justification for initiation of a health program is that the productivity of a dairy herd is substantially lower than that which is economically optimum. Also that the lowered productivity was caused by factors that a veterinarian can improve such as disease, nutrition, and animal management problems. The primary objective of a dairy herd health program is to manage the herd in such a way as to achieve predetermined biological targets of performance. The assumption must be made that achieving the biological target is synonymous with achieving the optimum net return for the enterprise. An essential procedure in developing a herd health program is to produce evidence that this association is a valid one. The achievement of these objectives is being met by making regular veterinary visits to the farm, by effective herd management, and by the use of a simple, reliable data recording system.

Elmore (1987) reported that probably the main deficiency of management that costs dairymen the most in lost income was the lack of good records. He suggested that complete and accurate records are essential for operating dairy farms profitably. The use of adequate records to make management decisions could turn many deficit operations into profitable ones, and would almost certainly make an already profitable operation more profitable. Such records should include data on production, reproduction and health.

In veterinary medicine the research and design of health care delivery systems using the animal health management approach have yielded a high return on investment by the farmer (Barfoot et al, 1971; Moller, 1978a; Williamson, 1980).

The provision of a such a service has been reported in New Zealand, by Moller (1978a). However the service has not been promoted by veterinarians or adopted by farmers with any enthusiasm since that time. McKay (1988) suggested a number of possible reasons for the lack of adoption of the service in New Zealand.

1. The seasonal nature of New Zealand enterprises prevents direct comparisons with the extensive overseas trials on the service efficiency.
2. The uncertainty of market prices.
3. The failure to demonstrate repeatedly under New Zealand conditions the economic gains made possible by the control of production limiting diseases, or the adoption of certain management techniques. In order to promote such a service it is important to be able to justify the expense of it economically, both for the advisor and the farmer. Knowledge of such matters needs to be increased and disseminated effectively to the people in the field.
4. The lack of a data management system able to fulfil the task required.

The above views are in agreement with those expressed by Radostits (1987) who suggested that the factors which have impeded the delivery of a totally integrated herd health service to cattle producers included the following: The desire of the farmers to adopt a regularly scheduled herd health service, the economic viability of the herd, the market price for beef and milk, the enthusiasm and competence of the veterinarian, and the data recording system. The widespread use of the veterinarian in a herd health program will depend on the development of species/industry veterinary specialists. Such veterinarian specialists, as well as being competent, must actively promote the development of an integrated animal health and production management service from their practice.

Computers programs are able to assist the veterinarian in the provision of a health management service. They are the machinery which can quickly and accurately analyze information which is essential in an efficient animal health and production management service.

It was concluded by the Veterinary Clinical Science Department at Massey University that there was a need for an information based system able to be used in New Zealand dairy herds. No program had been developed that could meet the requirements of the seasonal calving pattern of New Zealand dairy herds and the dependance of these herds on pasture availability for production. A program was needed which could improve the precision of currently accepted performance indicators, and in addition had a reliable and effective diagnostic problem-solving component.

The development of a computerised information system, DairyMAN, will be discussed in this thesis. The program is designed for use on New Zealand dairy farms by veterinarians, advisors and farmers. The operation of the program will be dealt with only superficially, the thesis will describe the techniques used to develop a useful animal production recording system.

An example of the use of the program in combination with an advisory service will be given to demonstrate the usefulness of the system under field conditions.

Chapter two is a literature review of the historical development of the animal health management service, the data management systems which support the service, and a brief description of the use of epidemiological techniques in the solving of the multi-factorial problems encountered in such a service.

Chapter three sets out in detail the objectives of this project. The objectives listed are those of an ideal system, these are subject to change as experience grows in this area.

Chapter four deals with issues raised in the collection and entry of the data necessary for an information system such as DairyMAN. The program design features which are vitally important to the successful operation of the program are covered in this chapter as well.

Chapter five presents the performance reports used to monitor the areas of reproduction, health, production and the removal of cows from the herd.

Chapter six briefly reviews issues known to influence reproductive performance. The review is limited to issues of direct concern to New Zealand dairy farms and to the design of the reports produced. The diagnostic reports for reproductive performance are presented, together with a description of the technique of using within-herd cohort comparison to help in problem solving.

Chapter seven covers the area of health, production, and herd demography in more detail. The reports produced are shown and the diagnostic indicators used are explained.

Chapter eight covers the production of management aids from Dairy-

MAN, which may be used in the day-to-day running of a dairy enterprise. The three types of aids produced are cow histories, management guides, and lists of cows that require a veterinary examination.

Chapter nine covers an example of the use of DairyMAN on a particular farm, and the results obtained on the farm when records analysis was combined with an advisory service.

Chapter ten concludes the thesis with a discussion of the achievements of the project and areas for future improvements.

CHAPTER TWO

THE DEVELOPMENT OF DAIRY HERD HEALTH PROGRAMS

A LITERATURE REVIEW

INTRODUCTION

A planned animal health and production program, commonly known as "herd health" or more recently as "health management", is a combination of regularly scheduled veterinary activities and herd management designed to maintain optimal animal health and to achieve efficient production (Radostits and Blood, 1985). Secondary objectives include the prevention of zoonoses and the production of wholesome meat and milk free from drug residues (Radostits, 1987).

This chapter will deal with the historical development of this approach to veterinary medicine, and the change in emphasis that has occurred as a result of the development of computerised monitoring, and diagnostic interpretation of computer summaries of herd performance. The parallel development of the use of epidemiological techniques in the area will also be covered. Although occurring concurrently it will be presented in a separate section.

THE HISTORY OF THE VETERINARY SERVICE TO THE DAIRY INDUSTRY

Radostits and Blood (1985) suggested that the historical development of the modern veterinary profession could be divided into four phases of activity.

Phase One

In phase one national and state governments were involved in the control of diseases, such as brucellosis and tuberculosis, that were transmissible from animals to man (Radostits, 1987). Major infectious diseases which caused serious economic effects in animals, such as foot and mouth disease, rinderpest and contagious bovine pleuropneumonia were also subject to control procedures. These control programs were successful because the diagnostic tests and vaccines used were reliable, control measures were compulsory and the financial resources necessary came from public funds.

Phase Two

In phase two, which began about 1940, the meat-, milk-, and fibre-producing animals increased in value as their produce became more valuable. This occurred in response to increasing demands for meat and milk in western countries. When animals became ill it was economical to call the veterinarian to treat the animal on an individual basis. During this period veterinary knowledge increased rapidly and in combination with the introduction of antibiotics and chemotherapeutics, and the principles of aseptic surgery, the treatment of ill animals produced spectacular results. This phase produced significant successes: the eradication and control of some major infectious diseases, the development of bacterins and vaccines, the development of antibiotics, and the understanding of the fundamental pathogenetic mechanisms (Stein, 1985). The veterinarian in this role has been referred to by Neubauer (1987) as a "disease specialist", and is seen by the herd owner as a necessary operating expense. Thus, demand for the services of the veterinarian grew rapidly. The majority of the veterinarian's time was taken up with responding to farmer requests to treat sick animals. Because of this lack of time, and because the service was only provided in response to a specific request, only limited effort was made to control disease on a herd basis. Efforts to control or prevent disease consisted mainly of large scale testing programs for diseases such as brucellosis, and vaccination against some diseases, but again on a limited scale.

Phase Three

In phase three, which began about 1965, veterinarians and farmers began to appreciate the value of taking positive action to maintain a high level of animal health on a herd basis. Veterinarians during this phase were confronted with structural changes in the industry which resulted in a substantial increase in the number of animals on an average farm, and a decrease in the total number of farms under their care, as farms were amalgamated (Morris, 1976; Stein, 1985). There was a growing recognition of the residual production limiting problems that were not responding to traditional veterinary techniques. Initially the herd approach consisted of recommendations for the control or prevention of specific diseases likely to occur in the herd. As involvement increased with the farms it became apparent that the effects of subclinical disease and inadequate management were the major causes of economic losses in food-producing animal herds (Radostits and Blood, 1985; Williamson, 1982). Diseases such as infertility and subclinical mastitis responded to the strategic prophylactic procedures implemented or to the changes in management suggested.

During this phase the use of the word disease was expanded to include not only clinical and subclinical disease but also management inadequacies or limitations, all of which can result in sub-optimal performance. New definitions for "health", "disease", "veterinary purpose", and "population medicine" have arisen. Each is based on the growing recognition that there is a synergistic relationship between health management and improvements in enterprise productivity (Morris, 1982; Stein, 1985).

The recognition that economic benefits could be derived by taking positive action against subclinical disease was then followed by the development of planned herd health programs. Veterinarians began making regular visits to farms to examine the animal health and production of the herd and to make recommendations for improvements. The veterinarian was now becoming a "health specialist" and was seen as an essential investment for the farm enterprise (Neubauer, 1987).

Phase Four

In phase four, which is currently taking place, the veterinarian makes regularly scheduled visits to the herd, examines animals and records for evidence of subclinical disease, and collects and analyzes the herd data with the assistance of a computer. The veterinarian and the farmer agree on targets for performance, and the veterinarian compares actual performance with the targets chosen. If the performance is not up to the targets chosen the veterinarian then identifies reasons for failure to achieve these targets (Morris, 1982; Radostits and Blood, 1985; Williamson, 1982). With the assistance of agricultural advisors the veterinarian will make recommendations for improvement in animal health and production so that "the whole farm approach" to animal health is implemented. The total welfare of the farm is of paramount importance. This includes the financial well-being of the enterprise and the welfare of the animals within the enterprise.

Summary

It is now generally accepted that subclinical disease or production inefficiencies, many of which are not shown as obvious clinical signs, are the most important contributors to reduced productivity. Radostits and Blood (1985) suggested the development of a totally integrated animal health and management system is seen as the most important need for dairy cattle practitioners today. Epidemiological methods will become additional essential tools used in clinical examination and problem analysis by the veterinarian in the practice of preventive veterinary medicine (Radostits and Blood, 1985; Stein, 1985).

There is still evolving an approach to clinical problem solving at the population level. This approach is based on a fundamental requirement for information, which acts as the centrepiece for the health management model. When the veterinarian gains the skills required to give expert advice in all areas of the dairying enterprise he becomes a "species specialist", where the herd owner with the aid of his advisor strives to achieve maximum possible return on the investment made (Radostits, 1987).

THE HISTORICAL DEVELOPMENT OF SPECIFIC HERD HEALTH PROGRAMS

Introduction

As early as 1967 Morrow suggested that the two main areas in dairy herd health management are in reproductive efficiency and mastitis control. This has been further supported by the results of a survey on the incidence of disease problems by Morris (1971) which again has shown that the main problem areas were poor reproductive performance and diseases of lactation.

Literature is scarce on the commercial success, or failure, of the programmed herd health approach. This is because of the difficulties encountered in producing reports of herd health work, which is statistically based. By its nature, the herd health approach is used on commercial enterprises for which it is difficult to provide comparative models. The average practising veterinarian is neither trained in the required technology nor has the inclination to conduct sophisticated trials on the use of animal health programs. However it would be fair to say that many people have visualised the advantage of a whole herd approach to health management and this is important to see how modern philosophies have developed.

The Early Years

In this respect it is interesting to note that the earliest formal herd health program was in essence little different to the whole herd health management approach promoted today as the modern health management technique. Plocher (1959), in California, reported on a herd health program in a herd of 220 cows operating over a five year period. His recording system was manual and consisted of a cow card system marked with different colours for each stage of the cow's reproductive cycle. He made weekly visits to the farms covering the areas of mastitis, reproduction, herd health, and nutrition. At these visits he examined each cow before she was allowed to commence breeding, conducted early pregnancy diagnosis, and examined repeat breeders. He reported an increase in yearly milk fat produced per cow from 401 lbs to 512 lbs over a four year period. He considered the detection of oestrus by the herdsman to be the main factor limiting efficient reproduction and emphasised the necessity of good record keeping.

Wagner and McEntee (1960), reporting on the results of examination of fertility problems in 87 herds over a 9 year period, also emphasised the value of good records and noted that poor detection of oestrus was a major contributor to the problems investigated.

Herschler et al (1964), at Purdue University, described a program, operating for three years, on a farm with 55 Guernsey cows using an individual cow card system. They carried out 20 to 60 day post-natal examinations, early pregnancy diagnosis, and examination of virgin heifers and problem cows. A report was sent to the herdsman after each visit with suggestions for the treatment of each cow examined. Over the three years the average intercalving interval was reduced from 433 to 386 days and the average age at first calving was 77 days younger than it had been at the start of the program. The improvement in reproductive performance resulted in an increase from 7,500 lbs of milk produced per cow per year to 11,750 lbs of milk produced per cow per year. This translated into a yearly economic gain of $7,150 less veterinary costs of $911 giving a return of $6,239 per year.

Belling (1964), in New Mexico, conducted a similar program in a herd where 1,200 cows were milked daily. Using control groups within the herd, he reported in the groups with the reproductive health program, that the interval from calving to first service was reduced by 3.7 days (P.<0.05), the interval from calving to conception was reduced by 9.2 days (P.<0.01), and the number of services per conception were reduced by 0.06 (P.<0.001). Although he quoted average values he presented the figures as a histogram, this showed very clearly the overall pattern of the intervals that was not portrayed adequately by the average values alone.

<u>New York State Veterinary College</u>

Roberts and DeCamp (1965), at Ithaca New York, reported on the economic success of a two year herd health program. This controlled study showed that 659 milking cows, in 14 herds, on a complete regular veterinary preventive herd health program when compared with 430 milking cows, in 13 herds, on "when-called" emergency veterinary service alone, returned $25.58 more per cow per year, from increased milk production. Every dollar invested in the scheme returned $5 to the dairyman. No report was given of the methods used or the change in biological measures of performance that occurred. Emphasis was given to the importance of a good recording system and he suggested that the success or failure of the planned herd health approach depended largely on these records.

In the early sixties, the ambulatory clinic of the New York State Veterinary College established a dairy herd health program. Morrow (1963a) discussed the reasoning behind the service. The forces on the farmer mentioned were the cost-price squeeze during the post World War II period, the decrease in the total number of farms involved with the dairy industry and an increase in the average herd size. He suggests that the "fire brigade" work, carried out by the majority of practitioners, took up much of the veterinarian's time and clients were not getting the full benefit of veterinary services available. The lack of planning and organization wasted a lot of the veterinarian's time. The programmed herd health plan offered a way to help good clients stay in business and receive a fair return on investment. The program also provided an opportunity for students to gain an understanding of herd health programs first hand. He suggested that the economics of the program should be explained to the client; a return on every dollar invested of $5 to $10 was quoted. The education of the client was determined to be an important factor in the development of the service, this included the early recognition of disease, correct timing of procedures and the importance of a simple, reliable records system was emphasised.

The methods used in the program are described in detail by Morrow (1963b). The program covers a wide base of the dairy enterprise from calf rearing, heifer health, bull soundness, to the feeding of the lactating cow. He suggests the most gain is to be made in the control of reproductive disorders, aiming to calve cows as close as possible to 12 monthly intervals. Cows were examined at strategic times to achieve this goal. The examination categories are listed here:

A pre-breeding examination 30 days after calving.

Cows with an abnormal discharge should be examined at the next visit.

Cows not showing heat by 45 to 60 days after calving.

Cows with abnormal heat cycles.

Cows bred 2 to 3 times and not in calf.

Cows bred 45 to 60 days should be pregnancy tested.

He suggests the program requires good records in addition to the monthly dairy herd improvement records to cover the following areas:

Daily milk weights as indicators of cow health.

Heat expectancy charts to alert the dairyman to cycling cows.

Breeding records including dates of service and the sires used.

Individual cow lifetime health records.

The recording system revolved around the barn sheet and the individual cow lifetime record.

Evaluation of the herd health program is covered by Morrow (1966), here he objectively assesses the value of the program in a client's herd. He compared the results in the first year without the program, with the results in the year during which the program was implemented. The number of services per conception (the total number of services divided by the number of cows which conceived) dropped from 1.70 to 1.21. The 30-day non-return rate (dividing the number of cows which conceive at first service by the total number of first services in the herd) rose from 65% to 84% and the 60- to 90-day non- return rate (dividing the number of cows bred during the year by the total number of services in the herd) rose from 59% to 80%. The culling rate dropped from 30%, and an average of 3.3 lactations completed for each cow, to 14% and seven lactations per cow. The culling in the first year was primarily due to breeding problems (16%) but in the second year culling took place on grounds of behavioural vice and chronic disease, as breeding problems were no longer a problem. The calving interval was divided into the gestation period and the calving to conception interval, as the latter was easier to calculate. The calving to conception interval dropped from 118 days to 85 days; it was appreciated by Morrow that the actual situation was much worse than the average values suggested in the first year, and this was shown by a histogram of calving intervals for the herd. In the second year only one cow had a calving to conception interval in excess of 120 days compared with 11 cows in the first year. The return on investment was calculated to be $6.47 for each dollar invested. It is interesting to note that Morrow appreciated the necessity to objectively prove the worth of the program to keep the dairyman interested, and that the average values so often quoted, although useful, did not portray the entire picture.

Morrow (1966) discusses further "efficiency factors". The return interval analysis is mentioned as a way of measuring heat detection thoroughness, using a high number of long returns (>40 days) as indicating poor detection of oestrous or embryonic death. He introduced the figure of "percent cow-days in milk" as a measure of herd profitability, but pointed out that a large number of management or disease factors may influence this factor so its use as a diagnostic indicator was limited. It was also reported that veterinary income in providing the service to the herd in question rose by 50% to 100% percent, and the greatest part of this income was from professional fees rather than drug sales.

<u>Ontario Veterinary College, Guelph</u>

A similar herd health program was started by the farm service clinic of the Ontario Veterinary College at Guelph, in Canada. The program started in August 1960 in two herds and increased to 30 herds by 1971. Cote (1963) described the methodology of the program. The program consisted of monthly visits to each herd and the following groups of cows were examined at each herd visit.

Cows bred six weeks earlier were examined for pregnancy.

Cows calved more than 30 days were examined for adequate uterine involution.

Cows not showing heat by 90 days after calving were examined.

Cows bred 3 or more times and not conceiving were examined.

Monthly California Mastitis Tests were collected from composite milk samples and quarter samples were collected from dry cows and treated where it was found they were infected.

Brucella vaccination, dehorning and removal of extra teats on heifer calves was carried out.

Feed rations were evaluated.

Individual cow card systems were maintained on each cow.

The results of a comparison between herds on the program and a sample from 130 herds using emergency veterinary care only were reported by Barfoot et al (1971). The final analysis divided the program herds up into five categories based on the level of veterinary involvement with the herds. Group A was the control group, group B had minimum involvement with the health program while group E had maximum involvement. Five measures of performance were deemed to influence the economic performance of the enterprises and were used as measures of the success of the programs; they were milk production, calving to conception interval, calf mortality, cow mortality, and culling rate. The culling rate included only compulsory culls. All the data were used in the creation of a computer model. Using the computer model the economic effects of the university health program was assessed under each level of participation, and for different values of cattle and milk prices.

The authors concluded it was economic to change from emergency care only to the preventive program at levels C,D or E. It was economic to change from emergency care only to the preventive program at level B, only if the value of cows and/or the milk price was above average. Returns to investment in the program were 95% to 576%, with return on investment at the average level of participation of about 350%.

The Late Sixties And Early Seventies

Sippel (1969) described his methods of herd health management. He emphasised the same advantages as described earlier, of financial, organizational and personal satisfaction to be gained from this type of work. He stressed that the education of the veterinarian and the farmer was important; keeping up-to-date with new developments, and becoming an information broker was important to the success of the practice. Drewry (1967) reported on his practice moving into preventive herd health programs. Although he believes that nutrition is the starting point for the herd health approach, the philosophy of increased profits and satisfaction for both parties is still paramount.

Linerode (1972), in Texas, presented his version of programmed herd health. He suggested that preventive medicine for the dairy herd must cover the five major aspects of sanitation, nutrition, fertility, mastitis control, and newborn animals. The methods employed are similar to previous ones mentioned, although emphasis is placed on sanitation in all areas of the program. Predicted financial return on investment in a 100 cow herd for each dollar invested was about 300%.

Two of the earlier computer programs reported were by Kelly and

Holman (1975), at Clemson University South Carolina, who developed a Modified Herd Reproductive Status program, and Lineweaver and Spessard (1975), in Virginia, who developed a Reproductive Management Profile program. These programs were developed for use on a mainframe computer. Using card punching and monthly data entry, reports produced contained information on the reproductive status of the herd along with a number of diagnostic measures of performance. The programs restricted their involvement to the reproductive analysis on the herd.

The University Of Melbourne, Australia

In Australia work on dairy herd health programs was initiated by the Veterinary Clinical Centre of the University of Melbourne at Werribee. The principles and techniques developed here are important as they became the basis for a large number of related programs that have been developed since. Morris (1969) discussed the importance of evaluating the economic contribution of veterinary services to the agricultural industry. He suggested to think of disease control as a method to increase profitability rather than reduce losses. Diseases were classified into three categories; certain to cause economic losses if not controlled; sporadic, where the possibility of occurrence should be balanced against the cost of prevention; unlikely to occur, where the cost of prevention of the disease is all that is considered. The eradication of disease may not be, economically, the most efficient path to pursue. Morris and Blood (1969) elaborated by saying that there should be planned prevention and control services to maintain specific diseases at a lower level of incidence than would occur without controls in place. The planning and programming should allow for assessment of the effects of the service numerically and economically.

Blood (1977) and Blood et al (1978) suggested that herd health programs should identify the health problems on a farm, rate them in order of economic importance, institute control techniques and measure their numerical and financial results, hence indicating which measures should be stepped up and which ones stepped down. All aspects of the program must be carried out within the limits of the overall financial situation on the farm. The success of the program must be demonstrated to the farmer in economic terms so that he is happy with the service and willing to pay for the cost of the service. Three requirements were identified which must be satisfied before this type of program can be effective:

1. The farmer must be convinced he that has a problem that can be solved to his economic advantage. In order to do this, current performance levels must be determined and monitored so shortfalls are brought to the farmer's attention. Biological measures of activity having a close relationship to productivity are used as performance measures, and compared against target values considered appropriate for the farm in question. Health programs seek to replace intuitive judgments with arithmetical and financial ones. The statistical analysis is done by a data analysis unit and appropriate economic values are applied to the results. The farmer is then in a position to make decisions based on economic criteria.
2. The veterinarian must be capable of carrying out a successful service.
3. A data service must be available to provide the numerical information on which the judgments of the farmer and the veterinarian may be based. The first attempts to do this were by hand and proved unsatisfactory. Once a data analysis system was operating, in which the statistics and economic assessments were done, it was found they had an operational system. The data analysis laboratory is most simply described as a diagnostic laboratory which uses performance

data to diagnose degrees of productive efficiency.

The idea of "performance targets" was introduced by Blood et al (1978) and the approach to the health service was centred around this idea. The relating of this biological measure to economic ones is discussed and the difference between herd targets and individual cow targets is explained and values are given. The use of standard deviations in performance values is introduced to measure the degree of variation about the herd mean value, for example it is suggested an intercalving interval of 375 days is optimal for the herd with a standard deviation of less than 45 days. The use of performance-related diagnosis is also introduced. This was the first report of formal data management in dairy herd health management programs.

Cannon et al (1978) describe the development of the dairy herd health data system used by the Melbourne team. Initially the scheme was similar to that described by Morrow (1963), but in 1970 a computer was first used to perform the task previously done by hand. The system developed over a ten year period into a computer-based system with minimal labour requirements, increased accuracy, and improved diagnostic power. A records collection visit to the farms was discontinued in favour of an event diary filled in by the farmers as events occurred, the diary pages were periodically sent in to the data centre for updating of the computer files. The file structure, for the herd, is such that each lactation is treated as a separate record. There are two files per herd, one for current lactations and one for past lactations. Information in the file is stored as events, each event has a code of four letters or number followed by a date. Data is checked, as entered, to ensure it is correct. Reports produced include lists of cows to examine, monthly performance reports, annual performance reports and planning guides. The data handling system has been developed to provide the farmer with a current record of each cow in the herd, the data aids management by providing information about cows at times when a decision is to be made concerning them. The veterinarian is aided by having cows requiring examination selected for him, disease and performance indices are presented, thus time is spent in the interpretation of the information and in the formulation of ways of correcting problems rather than in the calculation of the indices.

Blood et al (1978) describe the areas which are involved in the herd health service. They are those of reproductive performance, control of both clinical and subclinical mastitis, control of other diseases which impair productive efficiency, achievement of satisfactory calf survival and replacement stock growth rates, prevention of death in adult cows and regulation of cow disposal to minimise compulsory culling for disease, thus allowing a higher level of selection for productive traits. In addition advice is given in the areas of herd management, nutrition and in the control of zoonotic diseases. The program as it develops on a farm changes its emphasis from specific disease control to efficient management of the enterprise.

Visits are organised on a monthly basis, in year round calving herds, and at strategic times during the season in seasonal calving herds. The data collection described is a new innovation to health management programs and is based on the client sending in copies of cow records in diary form to the University's Veterinary Clinical Centre each month just prior to the scheduled veterinary visit. Cows are automatically selected for examination at the next visit if their histories suggest it. Findings during the health visit are recorded and this information is fed into the computer files. The computer analyses the information and summarises the herd performance. The veterinarian is then able to concentrate on determining the causes for inadequate performance and on formulating methods for improving performance. The automatic selection of cows for examination is a new approach to herd health programs, and removes the requirement for manual evaluation and selection. The categories of cows examined are similar to previously existing manual systems. It is impled that this procedure has the added advantage of ensuring that the records are correct and up-to-date.

A pilot study, to develop and evaluate the Melbourne program, was undertaken on ten herds in the local service area from 1968 to 1975. Morris et al (1978a) reported a decrease in the mean intercalving interval by 27 days and a reduction in the calving to conception interval of 24 days in herds involved in the program over the study period. This was attributed to an improvement in the calving to first oestrus interval, by correction of nutritional deficiencies, attention to detection of oestrus, and in the prompt detection and treatment of problem cows. It was noted that the first service pregnancy rate declined but this did not prevent the herds from improving their reproductive performance. Mastitis, measured by the percent of infected quarters at drying off, reduced in treated herds from 23% of quarters infected in the first year of the program to 8% in 1975. The incidence of clinical mastitis and disposal of cows because of mastitis dropped to low levels during the study period. Other diseases, apart from those of reproduction and mastitis, did not alter during the study period although the volume of veterinary activity on the farms increased substantially during the study period (Williamson et al, 1978a).

It was decided to test the program in commercial herds on a larger scale, in a controlled trial. The trial began in 1973 with 20 farms in each of 3 dairying areas, the herd health service being provided by government veterinary officers. A further 20 farms had the service provided by private practitioners. A similar number of control farms were selected in each area, giving a total of 160 farms in the trial. Herds were randomly allocated to treatment and control groups, and during the first season no veterinary input was attempted, the period was used to collect data on the farms.

Williamson (1980) reported on the findings from the Victorian trial. The trial was completed in 1977, by which time there were 59 program farms and 47 surveillance farms left in the trial. The results dealing with efficiencies of production showed relative gains for program herds when compared with surveillance herds, these gains were significant for milk fat production per hectare (P.=0.001) and milk fat produced per man (P.=0.005) but not for milk fat produced per cow (P.=0.455). Financial efficiency was significantly better in the program farms for gross margin per hectare (P.=0.001), per man (P.=0.003) and per cow (P.=0.007). Over the three years the difference in gross margin per hectare in favour of the program farms was $23.58, $65.56, and $90.30 respectively. There was reported a significant improvement in the intercalving interval, and an improvement in the proportion of cows calving in the first eight weeks of the calving period from 68.5% to 74% in program herds and from 73% to 74% in surveillance herds. There was a greater improvement in the bulk milk cell count of program herds, but at the end of the study period there was a significantly higher quarter infection prevalence in program herds when compared with surveillance herds. Unfortunately no comparable level was determined in the surveillance herds at the start of the project. The conclusion drawn from the project was that the dairy health and management program tested in the study represents a highly profitable investment for dairy farmers.

Veterinary Services Council, New Zealand

A similar study to the Victorian one was conducted in New Zealand, in which 20 like pairs of farms were chosen from a pool of 100 farms. One of each was randomly allocated to the program group, the other to the control group. The program began in 1973 and finished in 1976, with 18 program farms completing the project. The project was carried out and reported on by Moller (1978b). The farms were all seasonally calving farms and the methodology of the service was similar to previously mentioned programs, with some modifications to accommodate the seasonal nature of the enterprises. The service concentrated on four areas: pasture management, feeding efficiency, breeding efficiency and disease control. A lead up period of six months existed during which time the advisor familiarised himself with the farm. Pasture management was assessed by regular farm walks and it was suggested that this was crucial during the winter period of minimal pasture growth and during the spring when peak pasture growth occurred. Feeding efficiency was assessed and monitored by observation of stock, by weighing, by analysis of milk production levels per cow, and by measuring levels of anoestrus. Cows were examined at the start of the breeding period and 28 days into the breeding period. At the first examination cows which had been calved more than 42 days but not detected in oestrus were examined, at the second examination all cows not mated were examined. Breeding efficiency was assessed by analysis of calving and mating records and monitored at the visits mentioned above. Further visits were carried out, when required, at 36 and 42 days into the mating program. Pregnancy diagnosis was carried out on selected cows in February or March of each year. Emphasis was placed on timing of the calving pattern to match feed supply and on detection of oestrus techniques. The submission rate of the herd was considered to be the important measure of performance in determining the success of the breeding program. This value is the percentage of cows submitted for service during the first 28 days of the breeding program. During the program the submission rate showed a significant increase in the program herds when compared with the control herds. The contribution of breeding efficiency to improved productivity is thought to have been due to better timing of calving in relation to pasture growth, and fewer late calving cows, thus easing herd management. Disease control procedures were instigated against the production-limiting diseases of mastitis, facial eczema, bloat, and hypomagnesaemia. Control of young stock disease was based on adequate parasite control, good nutrition and vaccination against the common infectious diseases of leptospirosis and blackleg/malignant oedema. The results of the project showed little change in the compulsory culling of cows; it was suggested the trial was not run for long enough to evaluate the program's effect on this area of herd management. Production levels increased significantly in program herds during the experiment. The economic gross margin per hectare of the program herds had the following increases over control herds for the three years of the project: -$3.25, $26.56, and $61.17 respectively; the last value was the only significant year difference. Analysis of the herd records was done manually (Moller, 1978b).

Early British Experiences

A pilot veterinary preventive medicine scheme was conducted in the United Kingdom from 1964 to 1967, by the Mid-West Division of the British Veterinary Association in association with other service organizations. The scheme reported by Grunsell et al (1969), involved 16 farms. Using margin over costs of concentrate fed, both purchased and home-grown, as an evaluation method, there was an increase in performance on all farms, but unfortunately it was not possible to judge the relative effects of the preventive medicine scheme on the results obtained.

Another trial stimulated by the first, involving 114 farms, was run by the same group of advisory organizations over the period from 1970 to April 1974. This project was known as the Joint Exercise in Animal Health and Productivity, or Jointex (Anon, 1976). The results from the 83 dairy herds in the project showed an improvement in herd gross margin of 80% compared with a 56% improvement in herds on the Agricultural Development and Advisory Service (ADAS) dairy management scheme run concurrently. There was no reporting of the biological measures of performance that produced the economic outcome or the changes in them. There was a high dropout rate of farms, 30 failing to complete the exercise. Of the withdrawals, 50% did so because of the burden of record keeping. All record keeping and analysis in this trial was manual.

Reading University

The University of Melbourne's program was used as the base for another trial in Britain, involving a number of practitioners and 22 dairy herds from 1972 to 1974. Eddy and Esslemont (1973) described the operation of the program and suggested that the advice given in such schemes is only as good as the information on which it is based. They cited that the main requirements of farm information are that it should be accurate, current, comprehensive, and economic to produce. The service was based on the Melbourne scheme and the computer program developed in Melbourne was used. It was termed MELBREAD when used in England.

Esslemont and Eddy (1977) reported on the results of the service in 22 herds that had been on the scheme for two years. They showed that the scheme had reduced the intercalving interval from an average of 100.3 days to 96 days and each day's decrease gave an extra 61 pence profit per cow.

The MELBREAD system was implemented at Reading University and when reported by Stephens et al (1979) was being used on more than 60 large dairy herds. Farm records were entered onto a computer-generated input document (the NEXTLIST) and sent to the data centre to be added to the files. A report was returned giving a comprehensive list of management aids, cow histories and herd summaries. Two further programs were developed to complement MELBREAD. DANDAIR was designed to deal with the areas of milk yield and quality, cow live weight, condition score and feed groups, and YOUNGSTOCK was designed for the dairy heifer replacements. These programs were intended to complement the MELBREAD program but the interchanging of data and variable data collection times proved to be too large an obstacle to overcome on a mainframe computer. This led to the development of DAISY 1 (The Dairy Information System) which is an integrated suite of programs which produce all the reports that were produced by MELBREAD, DANDAIR and YOUNGSTOCK programs with new programs being added as the system developed. Daisy 2, which is a substantially enhanced version derived from Daisy 1, contains nearly 300 sub-programs in the complete system (Pharo, 1982). Esslemont (1984) reported that DAISY 2 was operating on microcomputers at 25 different sites on about 400 dairy herds around the world. He reported on some of the features of DAISY 2 which included a very flexible fertility and health coding system, a revisit facility, and pregnancy diagnosis recorded as carried out by one of three methods. Any number of cows may be entered with any number of events entered per season. There is a facility for entering milk production and milk components, body weights and condition score data as well. Cows may be grouped within the herd and any number of changes between groups can occur.

Reports from DAISY 2 are varied, and may be produced in three different sized formats, with incorporation of graphs, histograms or Q-sums (a graphical presentation of the success or failure to achieve a set target) if desired. The basic report areas include:

Action lists, including a veterinary visit list.

Performance analysis.

Overall fertility performance.

Lists of cows.

Weekly management reports including feed reports.

Esslemont suggested that the limiting factor of DAISY 2 was the user's ability to run the correct reports, and in the correct interpretation of the reports. He gives guidelines on expected returns on investment in the DAISY program. For a cost of five pounds per cow per year returns of minus fifteen pounds per cow, twenty five pounds per cow, and fifty pounds per cow can be expected in the following three years. A number of reasons were suggested to explain the limited uptake of software of this type. These included a lack of awareness of what is available, poor marketing skills, failure to recognise need, unwillingness to innovate, lack of appreciation of what is important in a program, fear of computers, the dazzling nature of printouts, and the lack of management training. He concluded that the most cost efficient method of improving dairy herd efficiency was using dairy herd health techniques.

Recent British Developments

Other monitoring services have developed independently or indirectly from the Reading group. The CHECKMATE program, reported on by Booth and Warren (1984) and Warren (1984), services herds through the national milk recording service, the farmer has the option of a monthly copy of the reports to be sent to his veterinarian. At the date of the report 445 herds were using the service throughout England and Wales. Smith et al (1982) reported on a Dairy Herd Health and Productivity Service (DHH&PS) operating on 250 herds from the University of Edinburgh. This system runs on a minicomputer and the emphasis is on monthly recording of basic information with no coding. It is suggested that this is the reason they have maintained a high number of cooperating herds. Reports are sent to the farmers and their veterinarians quarterly. Boyd et al (1982) described a herd health service and program (DAIRYCOW) which is used in the Glasgow University dairy practice. The aims of the program were to operate at low cost, to be easily understood, and to be useful for both the farmer and the veterinarian. Simplicity was emphasised in the recording procedures, and the areas of fertility, cow health, culls and deaths are covered. The program runs on a microcomputer and reports are generated concerning action lists, fertility performance, and disease analysis. Considerable scope exists in the program for diagnostic analysis; for example cows with specific disease entries may have their fertility performance compared with non-diseased cows. Graphical presentation was suggested to be an appropriate form in which to report the data.

Recent American Developments

As expertise grew in the development of dairy information systems they were able to be used on microcomputers, could be transported about freely, and were capable of linking up with local Dairy Herd Improvement Association centres. They had considerable diagnostic ability, covering increasingly larger segments of the dairying enterprise. Some programs, though still restricted themselves to reproductive analysis.

Lehenbauer (1987), in California, described the development of The

Dairy Herd Management Program (DHMP) which was developed by the School of Veterinary Medicine at the University of California, Davis and a group of five local dairy practitioners. This is a menu driven program and data is stored for each cow on reproduction, health, and production. Over 14 different types of reports may be produced from the system. The reproductive reports allow variable time periods to be analyzed. Reports include veterinary check lists, cow cards, and reproductive summaries. The summaries include individual target values and a structured diagnostic component for more detailed investigations. Conception rate summaries may be produced to evaluate the performance of the sires and technicians while controlling for the confounding effects of each one upon the other. Management evaluation reports produced cover incidence of disease problems and recovery evaluation for treatment of these diseases. Management aids include cows to dry and freshen, cows to vaccinate, and a cow inventory and identification report. A weakness described of the program was the lack of a custom report generator and a link to the Dairy Herd Improvement Association centres.

Etherington et al, (1987) describe a software package, The Dairy Herd Management System (DHMS) currently being used at Guelph. The system is designed for use either on-farm or as a bureau service. It runs on microcomputers equipped with a hard disk. Data collection is carried out using a diary pad with carbon-less copying paper, the first of each pair of sheets is handed to the bureau at regular intervals. Information from the Dairy Herd Improvement Association (DHIA) was entered by hand, the total time taken to enter data per week per cow was 60 minutes. Data entry is by menu choices and no coding of data is required. No description of the report formats was given. Space required per cow was quoted at seven megabytes for a 250 cow herd after 30 months - the author feels this is very inefficient usage of disk space. The program does allow for the generation of custom reports as well as menu selected reports. A program described by Goodger (1987), working in California, called Dairy Comp 305 is an on-farm management information system, it is entirely driven by command codes entered at the command line. The program is able to link with the local DHIA centre to directly transfer information saving considerable data entry time. The production of customised reports was considered an important feature of the reports programs - the author feels this could be a problem as it assumes the user has an understanding of each of the critical measures of performance and which to include in the reports produced.

The Melbourne program also provided the base for another set of programs, this time in Minnesota. Williamson (1987) modified the original Melbourne program to meet American requirements, but at first kept the program on a mainframe computer. He is currently developing DairyCHAMP a microcomputer herd health and management program for use on dairy farms. The system is based on an event oriented data structure with a very versatile event coding system that does not require any coding of data as it is entered. Synonyms exist for each code and if desired the system may be adapted from English to other languages. The areas of reproduction, health, production, body weight and condition score are covered. The program can produce management aids as required and a monthly performance report. More detail is possible if the performance report indicates a problem. The program runs on microcomputers either on-farm or from a bureau. DairyCHAMP may receive information directly from the local DHIA centre.

Research Oriented Programs

The systems mentioned previously were developed primarily for use by farmers and their veterinarians, this tends to keep the systems simple and the information produced of direct use to the users. There have also been developed software programs to facilitate the collection of data by farmers and veterinarians, which not only allows these people to make use of the data, but also allow a large data bank to be developed for epidemiological research purposes. Some of the previously mentioned programs will allow this, for example Daisy II and Dairy Comp 305 are two such programs.

One such specialised program, COSREEL, was designed to handle data from birth to death for about 3000 cattle, sheep, goats, and pigs used for either experimental or commercial purposes at the Institute for Research on Animal Diseases, Compton (Rowlands, 1982; Russell, 1979). It is designed to run at a computer terminal using a remote mainframe computer to store the data. It uses a versatile letter and numbering system of coding to record management and veterinary events. The latter is very extensive with combinations of codes forming the event stored for each cow. Combinations may be selected from a list of codes for 140 organs, 25 locations on the animal, 75 abnormalities and 291 causes; the causes comprising 23 of a general nature and 168 bacteria, viruses and parasites.

Report generation is considered at three levels; routine, occasional, and research. Routine reports include cows to be examined by a veterinarian, cows due to cycle, cow history lists showing current fertility status, and graphical presentation of milk yield. Occasional reports provide performance analysis in the areas of fertility and disease occurrence. The final report type is research. The data base is used for epidemiological studies; for example Russell (1982) reported one such study on the coincidence of two or more diseases which showed that, in the population looked at, mastitis was 6.1 times as likely to have occurred in cows which have also had ketosis than in those which did not. The emphasis of this project is on a centralised data base with information freely available to the veterinarians and farmers who need access to it thus allowing inter-herd comparisons and epidemiological research projects to be carried out.

Another program with similar goals to COSREEL is The Food Animal Health and Resource Management System (FAHRMX), developed at Michigan State University (Bartlett et al, 1985; Gibson, 1982; Mather et al, 1982). The program was developed to meet the need for a comprehensive, integrated record-keeping system for use by veterinarians who provide a herd health service to their clients. FAHRMX operates on microcomputers in veterinary practices that are linked by a variety of methods to a mainframe computer. Bartlett et al (1985) reported that the program was being used on 31 dairy farms in 6 veterinary practices. The data is collected and entered into a locally based microcomputer for subsequent printouts of weekly management reports. The terminal is based at the veterinarian's office and dairy managers post the data in, hand deliver it, or enter it on their own terminal and then transfer the data, by telephone data transmission or via mailed disks. Once a month the data is transferred electronically to the central data base and, along with records from the Dairy Herd Improvement Association, combined with data already on the files. The central data base is used to produce monthly reports to assist in performance analysis. One unique report is the "complications at calving report" which list the health problems occurring from 5 days before calving to 14 days after calving and compares the rate per 100 calvings with the mean of the other herds in the program. One of the goals listed for the project is to establish a large data base for epidemiological research on the economic impact of production diseases and the cost-effectiveness of various disease control and management methods.

Programs For Seasonal Calving Dairy Herds

Of the planned herd health programs covered above only one has been developed specifically for use in seasonally calving dairy herds (Moller 1978b). The remaining programs have been designed principally for use on year round calving herds, although the Melbourne and Daisy programs are able to be used on seasonal calving herds, and have modifications to the programs to allow this. The principles underlying the herd health approach still apply to the seasonally calving herd; the maintenance of the 365 calving interval, the minimising of the influence of disease and maximising of management and feeding efficiency are still the aims of the exercise. However in New Zealand there is an extra demand on the system: that calving of the herd should be as synchronised as possible, so that the peak in feed demand will coincide with the peak in the supply of pasture on the property.

Wilcockson (1981) describes a manual system he developed for analysis of the reproductive performance of a seasonal calving herd. The analysis has advantages over the system used by Moller (1978b) because it is easier to do, and takes on average about 60% less time to carry out. However he reported that time was still restricting the number of herds a single veterinarian could handle effectively. The system provided performance values with limited scope for diagnostic capabilities. Grimmett (1983) described a modification of the system proposed by Wilcockson and outlined a series of preplanned veterinary visits to the herd during the breeding season timed to ensure that the farmer was achieving the goals required to maximise production efficiency. The program included veterinary visits at strategic times in relation to the planned start of mating (PSM) date for the herd:

Induction visits to restrict the calving period and allow cows time to recover from calving before mating begins.

Commencement of management activities known to increase the submission rate during mating, such as pre-mating recording of heats, using tail-paint on the herd to aid in the detection of oestrus.

Examination of cows with a history of post-partum problems or vaginal discharge, before mating begins.

Examination of cows not detected in oestrus by the planned start of mating date and have been calved at least 42 days.

Examination of all cows not mated by 21 days into mating.

Examination of odd cyclers and repeat breeders.

Pregnancy testing of part or the whole of the herd.

The visits were combined with strategically timed analysis of records to monitor performance.

Grimmett (1984) also developed a computer program to replace the task of manual analysis. The program operates on a microcomputer and analyses the reproductive performance of the herd. It has a moderate range of diagnostic capabilities. A modified version of the initial program increases the diagnostic powers of the program by including calving dates, cow age and codes for cows with reproductive problems. This allows a cohort analysis to be carried out on the herd if the performance measures are not up to expected levels.

Williamson et al, (1980) describes some modifications to the Melbourne program to accommodate seasonal calving herds. The program, in addition to previous selection criteria, selects cows for examination that have not had a heat recorded for 30 days preceding the planned start of mating date and those cows which have no heats recorded for 30 days after the planned start of mating date. Submission rates in ten day periods were also added to the herd performance analysis reports.

The Melbourne program was rewritten and adapted to run on microcomputers at Maffra. The program (ADVICE) is able to be used on seasonal calving herds, although the program does not meet the objectives of New Zealand seasonally calving dairy herds particularly well.

Larcombe (1985) describes a software package designed at Melbourne University, specifically for the seasonally calving dairy herd. The program called The Retrospective Mating Analysis Package (RMAP) is run on a microcomputer and, as the name implies, it produces a retrospective analysis of reproductive performance of the herd. The program uses as data the fertility events of each cow, farm management events, such as the planned start mating date, and period of time the bull was running with the herd. The file structure is field-based and no health events may be added, although each cow's age may be entered. The reports produced cover the following areas:

Pre-mating cycling rates

Submission rate reports

Conception rate reports

Analysis of conception pattern

Interheat reports

Interservice reports

Predicted calving dates

The individual reports may be stratified by age alone or by both time since calving and age. This allows considerable diagnostic use to be made of the program. A unique feature of the program is computer interpretation of the reports. Once a report has been produced the computer asks a series of questions which lead to a list of abnormal findings and subsequently to the proposed causes of the problem being investigated. The questions relating to the herd's performance may be answered from the keyboard, or the answers can be taken directly off the disc containing the herd's data. Once finished the program produces a report which includes proposed diagnoses, possible causes, possible courses of action which might be taken and some suggested references which will expand on the topic.

THE DEVELOPMENT OF THE EPIDEMIOLOGICAL APPROACH TO HERD HEALTH

The veterinary practitioner, before he can offer a health management service, must possess the skills required to implement a successful program. The rural veterinary practitioner in the past has responded to farmer requests for help to treat individual sick animals, little time was spent involved with herd health programs. A large part of his income is now derived from drug sales and more farmers are now treating their own animals as knowledge concerning the treatment of common problems has grown considerably in recent years. Veterinarians have been slow to take on herd health work, even though they realise that traditional veterinary work is decreasing in volume. A large part of the problem has been the lack of the development of the skills required to deliver herd health programs. There do not exist training opportunities for further post-graduate education in the field of herd health management. The new graduate is generally concerned with developing the skills of the traditional rural veterinarian and has little time, or experienced people to turn to, to develop the skills required to provide a health management service.

Today it is generally accepted that most diseases are the result of multiple contributing factors, that clinical signs are poor indicators of the significance of disease in livestock, and that a preventive approach to animal health and production offers much larger benefits than treatment alone (Morris, 1982). Diseases which were susceptible to straightforward systems of control at the farm level have been greatly reduced in importance over recent decades, there has been a change of perspective in the understanding of the true causal relationship in complex diseases, so that over simple views have evolved into more comprehensive conceptual models of disease processes (Blood, 1985; Morris, 1982; Schwabe, 1982; Williamson, 1982). The previous techniques in veterinary medicine were being challenged as they did not provide the answers to a growing number of questions, and in many ways the specific aetiological agent theory proved an insufficient explanation for the observed patterns of disease occurrence (Morris, 1976; Schwabe, 1982). While remaining effective for the individual animal, in many cases veterinary action has been biologically or clinically ineffective for the population (Morris, 1982). This ineffectiveness has been highlighted by the increasing size of a typical livestock enterprise and average investment in it. Traditional veterinary services are also no longer perceived as being cost effective (Blood, 1973; Morris, 1969).

The tools needed to analyze the residual herd health problems and arrive at a plan of action which is effective and economically efficient were not available initially, and are still not available to the average rural practitioner (Willeberg, 1979).

Willeberg (1979) segregated the rational approach to solving multi-factorial health problems into four chronological phases:

1. A description of the disease situation relative to the frequency of occurrence, and possible differences in time, geographical units, and host characteristics.
2. An analysis for disease determinants, including estimates of the

disease-enhancing effects of causal factors involved in the particular disease situation.

3. A cost-benefit analysis as a basis for decisions on a suitable control program.
4. Surveillance of the on-going campaign to monitor efficacy, costs, and side-effects.

What has been developing during latest phase of the evolution of veterinary medicine is the epidemiological approach to problem solving; its hallmarks are the art of decision-making, under conditions of uncertainty, and multi-factorial causation of disease. It relies on continual flows of information which describe the frequencies and patterns of disease occurrence in populations (Schwabe, 1982; Stein, 1985). The science of clinical epidemiology has provided the veterinarian with powerful mathematical tools required to determine the cause and effect relationship of diseases or inadequacies in management which are an integral component of the problems facing the practising veterinarian (Blood, 1985; Radostits, 1987).

The definition of epidemiology used by Morris (1982) is:

> "The systematic characterization and explanation of patterns of disease, and the use of this information in the resolution of health problems".

Morris (1982) suggested that the preventive veterinary practice of the future would be based on monitoring, and encompass an essentially scientific approach. Diagnosis would be aided by production and health monitoring systems in which herd data is assessed using statistical and epidemiological methods. There is an emerging trend towards productivity diagnosis in which normality is defined in terms of an expected level of performance consistent with individual herd characteristics. Previously clear cut divisions between health and production has become very blurred and indistinct (Morris, 1982).

With the development of the concept of performance-related diagnosis normality and abnormality came to be defined in terms of expected levels of performance (Blood et al, 1978; Morris, 1982). Whereas the clinical approach is based on making a diagnosis, a prognosis for the animal and then deciding whether action should be taken and if so what course of action, the herd management approach operates differently. It is based on the following points as portrayed by Morris (1984):

1. The definition of overall goals which are appropriate to the individual herd.
2. The translation of these long-term objectives into performance targets for each facet of herd performance that is considered likely to be limiting efficiency of production in this specific herd.
3. Regular monitoring of selected epidemiological herd indicators and comparison with target values.
4. Where performance does not meet targets the veterinarian works with the producer to modify management and other practices to rectify the problem.

Stein (1985) defined production disease as "the interaction of production and disease responsible for failure to achieve an expected level of herd performance, called a target". The impact of production disease can be measured objectively by comparing potential results with actual results. Disease in this sense has been used to describe a deviation of actual performance from expected performance caused by the interaction of management, environment, and specific pathogens. Therefore health is the level of production that the animal's owners have set as their objective and which is consistent with humane practices (Stein, 1985).

Morris (1982) developed the performance related diagnosis theme and suggested differentiating between two types of indicators of performance based on numerical epidemiological indicators derived from herd data:

Performance indicators which are used to assess whether or not performance is adequate in broadly defined areas.

Diagnostic indicators which are used to help identify the cause when performance is judged to be inadequate. In complex cases this can be a multi-stage process, in which epidemiological methods are used to gradually eliminate possibilities until a firm conclusion is drawn.

Initial reliance is placed on average values for herd performance but this may disguise the true situation, for example a large standard deviation may exist about an acceptable mean, but the distribution is such that it does not coincide with economic efficiency. There is a need for more subtle indicators of performance such as frequency distributions and comparing performance between sub-groups and cohort groups in the herd over time to find trends, and the use of patterned diagnosis among multiple indicators to narrow the possibilities (Morris, 1982).

SUMMARY

A major factor influencing the rate of development and the success of herd health programs has been the lack of reliable animal and production records that can be analyzed regularly (Gould, 1974; Morris, 1982; Radostits, 1987; Radostits and Blood, 1985). The success of a herd health program depends upon the competence and enthusiasm of the veterinarian, the management expertise of the farmer, and the ability of the program to demonstrate progress through improved performance.

One of the major benefits of veterinary epidemiology has been the development of herd health recording systems which provide objective measures of productivity, and therefore the impact of disease (Stein, 1985). With the increased importance of decision-making by veterinarians about herd and flock problems the factor which has created the greatest difficulty has been the need to incorporate health matters and production matters within the one advice program (Blood, 1985).

The purpose of data is to enhance or maintain the efficiency and profitability of the enterprise. The principal uses for this data should be to direct action and set priorities; the data must indicate where and when action is needed (Stein, 1985).

In the simplest form of recording, used for health management work, there is an individual lifetime card for each cow. All events of the reproductive cycle and incidents of clinical disease are recorded on the card when they occur. At regular intervals (monthly or less frequently) the veterinarian analyses the data and prepares a summary of the reproductive performance and disease incidents. This kind of card system has been successful for small dairy herds and the occasional large herd. The emphasis has been on reproductive performance and the manual system has been satisfactory. Manual systems are adequate for simple reproductive analyses but as herds become larger the computer becomes necessary to minimize the number of errors and to obtain rapid analysis of the data. As livestock farmers become more cost-conscious they require the rapid analysis of a wide range of data which cannot be done manually, at a reasonable cost. This has led to the use of the computer, which can store and analyze large amounts of data and provide useful performance statistics for decision making on a daily basis (Radostits and Blood, 1985).

Initially information was mailed to the computer centre, processed, and the report mailed out to the farm. One problem was the long turnaround time which often made information too historical. The introduction of farm-based terminals linked to the central computer by telephone eliminated the turnaround problem. The recent development of microcomputers has now made it possible for farmers to own and operate a computer completely independent of outside agencies. There are two problems with this technique, the development of software has not kept pace with the development of hardware and the lack of access to comparative data isolates the on-farm operator.

One interim measure is the operation of a bureau from the veterinarian's office. Thus the veterinarian and the farmer are kept up-to-date with events on the farm. The data is collected from available sources on a regular basis and entered into the computer which analyses the data and produces useful information. Unfortunately the physical collection of data to monitor the herd still remains a major stumbling block in many health management programs (Cote and Andersen 1987). Once the data has been analyzed the veterinarian must then interpret the information and make recommendations for action to improve performance. The results of the action to improve performance are monitored over the next few farm visits, and the cycle is repeated. It is a constant self-analyzing surveillance system.

The data can be collected from several different sources. In order to collect information efficiently and as inexpensively as possible it is necessary to be able to link with existing data banks, for example herd testing or the artificial insemination records from breeding cooperatives.

The most important aspect of the analysis of the data is to select the most useful indices or measures that are required to accurately monitor performance.

Regular reports must be sent to the farmer after each visit, this is to maintain farmer interest and involvement in the program. They should contain the following kinds of information:

1. A list of clinical examinations and treatments carried out during the visit.
2. An updated list of the individual animals in the herd containing the data relating to disease and reproductive performance.
3. An analysis of the parameters used to evaluate reproductive performance, disease occurrence and animal wastage.
4. Recommended actions based on management aids produced from the program, for example cows due to cycle, due to calve or be dried off.
5. A summary of predicted events to allow for adjustments in management to accommodate these events, for example a predicted calving report allows the calculation of feed demands to be made on the farm over the calving period.

The emphasis of the herd health approach has evolved progressively as the technique has matured. Initial programs were generally involved with reproduction or mastitis control. There then developed the whole farm approach, which incorporated other diseases, cow wastage, herd management and nutrition, as it was found that this technique produced the larger financial returns to the farmer. The improvement of monitoring techniques by the use of computers has changed the emphasis to one of the whole farm approach combined with intensive monitoring of performance indicators as measures of farm efficiency. This technique does allow the advisor to concentrate efforts on resolution of problems rather than on calculation of performance indices and increases the number of farms to which it is possible to provide the service.

Morris (1977) listed a number of benefits of the planned approach to herd health. To the livestock owners benefits arise from more effective control of subclinical disease problems, a reduction in the likelihood of serious disease outbreaks, more rapid and effective implementation of new research findings at the farm level. Modification of management procedures occur to improve animal productivity, and when combined with specific disease control measures further enhance productivity. For the rural practitioner he points out that the work dovetails well with the seasonal demands on time, the income per work-hour increases and the work type makes better use of learned veterinary skills producing improved job satisfaction. He argues that government veterinary services could easily use health program services to obtain better information on existing disease problems, by assisting and supporting practitioner involvement in such programs. He concludes that the planned approach to animal health provides a core concept around which may be built a more effective system for delivery of veterinary services to agriculture. This in turn would contribute substantially to achieving the desired improvements in farm productivity and incomes.

Radostits (1987) suggested a number of factors that affect the willingness of a farmer to adopt the herd health approach; a farmer who wishes to improve his current level or to maintain an optimal level of animal health and production, an economically viable farm and a market which will provide a fair economic return for his produce, an enthusiastic and competent veterinarian, a simple and reliable system of recording and analyzing animal health events and production performance. In summary he suggested a lack of education of the farmers on the effect that subclinical problems were having in his herd, the failure to realise the value of good recording procedures, and the lack of awareness of the services offered by the veterinary profession reduces the speed of uptake of herd health services by farmers. Other factors affecting the uptake included small farm size and the current depression in the market place.

There are positive pressures existing to encourage farmers to make use of the herd health approach. They develop in response to an appreciation of the need to maintain a sufficient margin between costs and income, in order to enhance their standard of living or simply to meet their very high financial commitments. The large fixed investment costs which occur with larger enterprises make optimum productive efficiency essential for adequate earnings, debt repayment, stable cash flow, and maximum return on investment (Stein, 1985). When this attitude prevails there is a tendency for advisory input to be used more. As farms increase in size they tend to become business-like in their approach and the demand for advice increases. There is ample evidence that the average herd size is increasing and particularly the numbers of animals per labour unit is also increasing, thus increasing the demand for a more financially based, profit motivated veterinary service (Morris, 1976). There is some debate as to which came first; the service offered by the veterinarians for this type of enterprise or the demand by the enterprise for this type of service. Either way, as economic pressures increase on the farmers, so too will the demand for a service based on the financial well-being of the enterprise.

Valid significant questions about the implementation of a health management approach remain: how are veterinarians to be compensated for their services, what place does the individual animal have in this scheme, how are these new services to be given credibility and marketed, why have previous attempts at their implementation been incompletely successful, and how are traditionally trained veterinarians to incorporate this new approach (Stein, 1985).

CHAPTER THREE

THE AIMS AND OBJECTIVES OF THIS PROJECT

INTRODUCTION

Herd health programs are designed to foster the maintenance of good health in individual flocks and herds in such a way as to gain maximum economic advantage (Blood, 1977). With the increase in production costs and the decrease in returns for product, the profit margin on New Zealand dairy farms has diminished. There has been, of necessity, an increasing awareness of the importance of efficiency of operation in dairying enterprises. This has produced a demand for accurate, information-based advice from advisors and veterinarians, that is specifically related to a particular farmer's dairying enterprise. The purpose of health management and production programs is to be able to tell a farmer on an individual farm, with his own set of managerial, financial, geographical, climatic and marketing constraints, what is his best management and health strategy to make the best income from his enterprise. The service should also provide advice to him on solving short-term problems which arise on the farm (Radostits and Blood, 1985).

Poor management is one of the major production-limiting factors in the dairy farming. Be it a failure to control disease or the missing of opportunities to improve efficiency.

A brief review of management as defined by Conlin (1974) is given to highlight the decision making process. Management refers to the act of controlling, guiding, directing or administering. The basic steps involve:

1. Establishing realistic and meaningful goals for performance, both short and long term.

2. Designing a production plan to achieve these goals.
3. Implementing the plan.
4. Continually monitoring and evaluating results and making adjustments for changing conditions and new technologies.

Good records provide the basis for establishing realistic goals and designing an effective production plan. Making decisions is a major aspect of management and the information supplied by records is central to the task. Good records also provide the basis on which decisions are made.

A successful records system depends on simplicity, accuracy, completeness and ease of use. The computer provides valuable and efficient assistance to organise, summarise, analyze, and legibly put the facts before the dairyman. Production records are as fundamental to management as is the herd identification system. They provide an obvious means of evaluating the management response on a herd, string or group, or on an individual cow. They provide the basis for measuring progress toward achievement of goals (Conlin, 1974).

There are few businesses as large as a modern dairy herd which do not have accurate monitoring systems which can be used to assess the performance of the business. The farmer needs performance measures which correlate highly with the long-term economic health of the enterprise, and for each of these measures he needs goals with which to compare his own results. The emphasis of a monitoring system must therefore be on assessing productivity and related aspects of performance such as health and reproduction. Such a system must allow the results obtained to be compared with those which it is believed can be achieved on the particular farm. Chapter two reviewed the range of computer programs around the world which aim to achieve this, however few of the programs developed over the last twenty years are suited to the specialised needs of the New Zealand dairy industry (Morris, 1987).

Without recording and analysis informed decisions can not be made, and hence the decisions that are made are subjective.

OBJECTIVES

The general objectives of this study were:

1. To design a health and production recording and analysis system for use on New Zealand dairy farms by farmers, veterinarians and advisors as a management aid to increase the profitability of the enterprise. The program has been named "DairyMAN".
2. To develop a system to be of assistance to the farmer in the day-to-day management of his enterprise.
3. To design a program to assist veterinarians in the analysis of reproductive, health and production problems on dairy farms.
4. To design a program that would act as a data collection mechanism for a regional data base on which field-based epidemiological research could be carried out.
5. To implement the use of the program on a small number of farms in the Manawatu region.
6. When combined with advisory input to demonstrate the ability of the program and service approach to meet the clients objectives in the field.

In order for the program to meet the above objectives it had to fulfil a number of more specific requirements which will be dealt with under the headings of data capture, program design, and the reports produced.

Data Capture

This covers the physical collection of the data from the farm, to the entry of the data into the program's data files. The following is a list of ideals derived from the literature, acknowledging however that the attainment of these ideals will be a gradual process.

1. The data recording on the farm must be simple, practical and easy to do (Cannon et al, 1978; Larcombe, 1985; Lineweaver, 1975; Morris, 1987; Radostits and Blood, 1985; Smith, 1985; Stein, 1985). It is of utmost importance to minimise the effort required to collect sufficient accurate data. The physical collection of the data has been a major stumbling block in many dairy health management programs. There is a great diversity both in the ability and willingness of dairymen and veterinarians to keep records, and in the record-keeping systems used on most dairy farms (Harness, 1987). It has been suggested by Lineweaver (1975), that the reason some farmers discontinued the health management service was they found the data recording too burdensome.
2. The recording system must by designed to be compatible with current recording methods used on the farm (Larcombe, 1985; Morris, 1987; Stein, 1985).
3. Ideally each event should be recorded only once, at the time of occurrence, and all those who wish to use the information can do so without the chore of duplicate recording (Cote and Andersen, 1987; Stein, 1985).
4. The amount of data to be collected in order for the program to run effectively should be kept to a minimum. Expectations and uses of the program grow as a user becomes familiar with the program. The program must be able to accommodate this increasing demand on its

capabilities as a user gains experience. In other words the program should allow a user to grow painlessly into the program (Morris, 1987; Stein, 1985).

5. It should not be necessary to code events in the field, at the point of capture. Any coding required should be performed by the program (Cannon et al, 1978; Larcombe, 1985; Morris, 1987; Stein, 1985).

6. The data structure should be based on individual animal events to allow maximum flexibility, and therefore every animal will be required to be individually identified (Morris, 1987; Radostits and Blood, 1985; Stein, 1985).

7. The program should be able to check the data being entered for consistency errors, comparing the newly entered data with the known cow history. There should preferably be two levels of error detection; rejection of an entry which is clearly inconsistent with past history of the cow, and a warning that an entry is unexpected but not impossible (Morris, 1987; Stein, 1985).

8. The data in the files should be able to be edited simply and quickly if a previous entry must be changed.

9. The program should be capable of running on standard microcomputers. The speed of the key-board operator should determine the speed at which the data is entered rather than the speed of the program (Morris, 1987). There should also be a facility for batch entry of identical events which occur for a number of cows, to speed up data entry (Esslemont et al, 1985).

10. Electronic transfer of data between the program and other systems using the same data should be possible to reduce the likelihood of duplicate entry of the same data into two different systems (Morris, 1987).

11. There should be a facility to add new event types to the program at a later date (Esslemont et al, 1985). The program should be able to store all information likely to be needed to make management decisions (McKay, 1988).

Program Design And Structure

The program should be designed to be able to meet the following criteria:

1. The program must be able to handle data from different farms using different management systems. In New Zealand 85% of dairy farms have seasonal calving patterns, 10% have biseasonal calving patterns and 5% have traditional year round calving patterns. The program must be able to handle all the different dairy farming systems found in the country.
2. The file structure must be kept as compact as possible to allow the program to run on dual-drive floppy disk computers as well as computers fitted with a hard disk.
3. The system must be able to meet the different user requirements likely under New Zealand conditions. That is, it must have the flexibility to be able to be tailored for individual farmers' requirements.
4. The system must be able to be used under the following situations:
    - i) On individual farms operating on an on-farm computer to aid farm management.
    - ii) In a bureau service for herds using the program operated by a veterinarian or a bureau agency.
    - iii) By research agencies as a data collection mechanism for field investigations.
5. The program must be able to handle all the data relating to health and production the user thinks will help in the management of his

enterprise, in whatever form it is presented.

Reports Produced

The aim should be to distill from herd data a relatively small number of facts which will help to make informed decisions (Cannon et al, 1978; Morris, 1982).

The program should also provide early warning of deteriorating performance in sufficient detail so that the causes can be identified (Cannon et al, 1978). The number of indices it is possible to derive is enormous and can be confusing to the untrained user. Morris (1982) differentiated between two categories of indices derived from computations. One group comprises the "performance indicators" which are used to assess whether or not performance is adequate, and the other group comprises the "diagnostic indicators" which are used to help identify the cause when performance is judged to be inadequate. This is a suitable definition and has been adopted in this project.

The following points were obtained from the literature on the attributes of reports able to be produced.

1. The computation time must be kept to a minimum and the results must be accurate (Esslemont et al, 1985; Morris, 1987).
2. The reports must be easy to read and understand, with a minimum of codes and jargon present (Lineweaver, 1975; Morris, 1987; Stein, 1985).
3. The reports should be able to assist with the day-to-day management of the herd regarding such things as cows to calve, cows to cycle, and cows to be examined by a veterinarian (Morris, 1987; Stein, 1985).
4. Targets of performance must be set for each individual farm and must be set at a level consistent with maximum economic advantage (Cannon et al, 1978).

5. There must exist biologically sound rules to decide which animals are included in particular analyses and to ensure the ways the indices are calculated are technically sound. This will permit valid comparisons to be made between herds and between groups within the herd (Morris, 1987). This must apply to all herd types, that is seasonal herds as well as year round calving herds.
6. The variables used in the calculation must be able to be changed to meet the needs of the different likely users, for example the time periods used in the analyses must be able to be defined by the user.
7. The turnaround time for the data entry and report generation must be rapid to ensure continued farmer support, and that the information is as current as possible.
8. There should be produced a single page report on which the performance indicators are listed. The indicators should cover all the relevant areas on one page. This removes the problem of a large amount of confusing information for the users (Cannon et al, 1978; Morris, 1987; Stein, 1985).
9. Diagnostic reports should be produced only when performance is found to be inadequate. These reports should be able to make maximum use of existing data to produce the comprehensive range of reports necessary in some investigations to give an accurate diagnosis (Cannon et al, 1978; Larcombe, 1985; Morris, 1987; Stein, 1985).

CHAPTER FOUR

DairyMAN: DATA HANDLING AND FILE MANAGEMENT

INTRODUCTION

Before the advent of suitable computers and programs, analysis of herd records was a tedious and very frustrating task. The time required to organise records into a useful format, and the complexity of records analysis once the data had been organised, prevented all but the most enthusiastic of farmers from performing the task, and restricted the number of herds a single veterinarian could analyze manually.

As a simple performance monitor the manual analyses performed by most veterinarians using the techniques described by Wilcockson (1981) were satisfactory. However there were occasions when they were less than diagnostic, and they often fell short of requirements in herds with complex problems.

For these reasons, and the fact that New Zealand veterinarians had not extensively promoted herd health services to dairy farmers, the development of DairyMAN (a Massey Animal MANagement program) was undertaken. It is believed that DairyMAN will fulfil the need for a comprehensive, easy to use program capable of handling all the perceived requirements of an information system for New Zealand dairy herds.

DATA AVAILABLE

The amount of data potentially available on a dairy farm is vast. It can come from a variety of different sources, and in varied formats. The information available is separated into one of three types for convenience and ease of handling within the program. It is unlikely that all the available data will be collected for every farm. It is intended that the data collected will vary from farm to farm to suit the level of service provided for the farm in question.

Farm Data

This includes the name and address of the enterprise, including the name and address of either the herd manager or share-milker. The farm topography, labour units carried, management system adopted and numbers of paddocks is also included (figures 4.1 and 4.2). The results of soil and pasture analyses (figures 4.3 and 4.4), and details on the date, type and amount of fertilizer applied are also included in the file (figure 4.5).

The economics of the enterprise are dealt with briefly so that the gross margin can be estimated for the enterprise. The farm accounts specifically relating to income and operating expenses can be collected and entered. DairyMAN does not include personal drawings, debt servicing, development or taxation expenses. DairyMAN is not intended to provide a sophisticated formal analysis of accounts. Such programs are available on the market (figures 4.6 and 4.7).

The present program does not deal with animal nutrition, which under New Zealand conditions relates to pasture growth rates and the budgeting of feed supply and feed demand. The data requirements of feed budget programs that can be met by DairyMAN are the stock on hand and future feed demands determined by the predicted calving spread.

The data source for the major part of this section is the farmer himself, and because of the use made of this data the collection method has only been formalised to the point of the user filling out an introductory form when he begins the program. Occasionally soil and pasture analyses may be provided by analytical laboratories or farm consultants.

The collection of farm data is relatively straightforward, a large portion of the data need only be collected once when the farmer begins using the program. The collection of the dated events in this section (fertilizer application, soil and pasture analysis results) may be done as the event occurs but there is no time requirement for this as it is not used in the day-to-day management of the herd. Such data is used in assessing long term changes in management policy.

```
6/12/87                    FARM PROFILE 1                    Farm: MASSEY1   87/88

Farm code  MASSEY1                          NZDB Participant code  CCBN

       Owner Massey University
    Address1 No.1 Dairy Unit
           2 Supervisor
           3 Gerard Lynch
                                                Telephone No.  25733
                                                Exchange       Linton (258)

 Sharemilker David Hislop
    Address1 No.1 Dairy Unit
           2 Massey University
           3 Palmerstom North
                                                Telephone No.  76547
                                                Exchange       Palmerston Nth
Sharemilkers agreement  Manager

Factory          Manwatu Milk Producers            Factory supply No.  1160
Milking management (Seasonal/Yearly)  Y               Labour units        3.0

Farm district  Massey                              Distance from clinic   2 km

                                       RETURN to enter data, ESC to ignore,
```

Figure 4.1 Farm profile 1 - Data input screen.

```
6/12/87                     FARM PROFILE 2                   Farm: MASSEY1   87/88

   Property 1

        Effective area      117 ha           Annual rainfall    900 mm

        No. of paddocks      60              Altitude            35 m

        Milking area        113 ha

        Soil type 1 Rangitikei Loamysand   Soil type 2 Manawatu Sandyloam

        Soil type 3 Manawatu Silt Loam     Soil type 4 Karapoti B.sandyloam

   Property 2

        Effective area        0 ha           Annual rainfall      0 mm

        No. of paddocks       0              Altitude             0 m

        Soil type 1 ___________________    Soil type 2 ___________________


                                         RETURN to enter data, ESC to ignore.
```

Figure 4.2 Farm profile 2 - Data input screen.

```
6/12/87 -    1                                                 Farm: MASSEY1   87/88
                             SOIL ANALYSIS


                          Date            Paddock
                          / /             ____________


          pH     Phosphorus   Calcium   Potassium   Magnesium   Sodium   Sulphur

 Units           ______       ______    ______      ______      ______   ______

         0.00       0.00        0.00       0.00        0.00       0.00      0.00



                                         RETURN to enter data, ESC to ignore.
```

Figure 4.3 Soil analysis - Data Input screen.

6/12/87 - 1 | PASTURE ANALYSIS | Farm: MASSEY1 87/88

Date	Paddock
/ /	________

Major Elements
Units ______

Calcium	Phosphorus	Potassium	Sodium	Sulphur	Magnesium	Nitrogen
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Trace Elements
Units ______

Copper	Molybdenum	Iron	Manganese	Cobalt	Selenium	Zinc	Boron	Iodine
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RETURN to enter data, ESC to ignore,

Figure 4.4 Pasture analysis - Data input screen.

6/12/87 - 2 | FERTILIZER USED | Farm: MASSEY1 87/88

Date	Material used	Quantity applied	Area covered
/ /	________	0 kgs	0 ha

RETURN to enter data, ESC to ignore,

Figure 4.5 Fertilizer - Data Input screen.

```
6/12/87              FARM ECONOMICS          Farm: MASSEY1   87/88

                         page 1/3

                          INCOME

      Milk income                          $_______0
      Bobby calves                         $_______0
      Cull cow sales                       $_______0
      Other cattle                         $_______0
      Stock change                         $_______0
      Other                                $_______0



                           RETURN to enter data, ESC to ignore,
```

Figure 4.6 Farm economics, income - Data input screen.

```
6/12/87              FARM ECONOMICS          Farm: MASSEY1   87/88

                         page 2/3

                        EXPENDITURE

      Animal health  1 Vet fees                  $ _______0
                     2 Animal remedies           $ _______0
      Breeding & Herd testing                    $ _______0
      Dairy shed                                 $ _______0
      Electricity                                $ _______0
      Supp feed (hay,silage,meal)                $ _______0
      Grazing                                    $ _______0
      Fertilizer & Lime                          $ _______0
      Wages (casual or permanent)                $ _______0
      Contracting (spreading,cropping,weed etc)  $ _______0
      Freight                                    $ _______0
      Vehicle expenses                           $ _______0
      Repairs and maintenance                    $ _______0
      Administration (A/cs,tx,mail,bank etc)     $ _______0
      Other                                      $ _______0

                           RETURN to enter data, ESC to ignore,
```

Figure 4.7 Farm economics, expenses - Data input screen.

Herd data

Herd data, and events, relate to each of the different stock classes on the property treated as a group. The management systems used on New Zealand dairy farms are such that the stock are dealt with on a herd basis for a number of procedures such as drenching and vaccination. This means that although calves are actually born at different times they are treated as having the same age. This enables drenching and vaccinations to be administered to the group on the same date, rather than to individuals on different dates.

The sources for data on the herd as a group are the farmer, the veterinarian and the local dairy factory.

The farmer may supply information on the following; vaccinations (figure 4.8), disease prevention procedures (figure 4.9), herd health problems involving the non-milking herds (figure 4.10), drenching dates (figure 4.11), herd body weights (figure 4.12) or condition scores (figure 4.13), trace element supplementation (figure 4.14) and non-milking herd stock transactions (figure 4.15).

The veterinarian may supply results of herd health investigations such as serum pepsinogens for parasite monitoring (figure 4.11), trace element investigations and metabolic profiles (figure 4.14). Drug sensitivity results (figure 4.16), and preventive measures may also be entered (figures 4.9).

The dairy factory can supply information on the quantity and quality of milk sold via production records from the factory sheets (figure 4.17).

Daily submission of this data is again not essential for the efficient running of the program as the information is not used in the day-to-day management of the farm. It is required however for medium term decisions, so it is advantageous if the data is submitted on a regular basis.

6/12/87 - 1 VACCINATIONS Farm: MASSEY1 87/88

Date	VF	Class of stock	Number	Vaccine	Sens/booster	Booster due
_/_/_	_	____________	___0	________	S	_/_/_

RETURN to enter data, ESC to ignore,

Figure 4.8 Vaccinations - Data input screen.

[illegible] - 1 DISEASE PREVENTION Farm: MASSEY1 87/88

Date	VF	Class of stock	Number	Treatment
_/_/_	_	____________	___0	________________

RETURN to enter data, ESC to ignore,

Figure 4.9 Disease prevention - Data input screen.

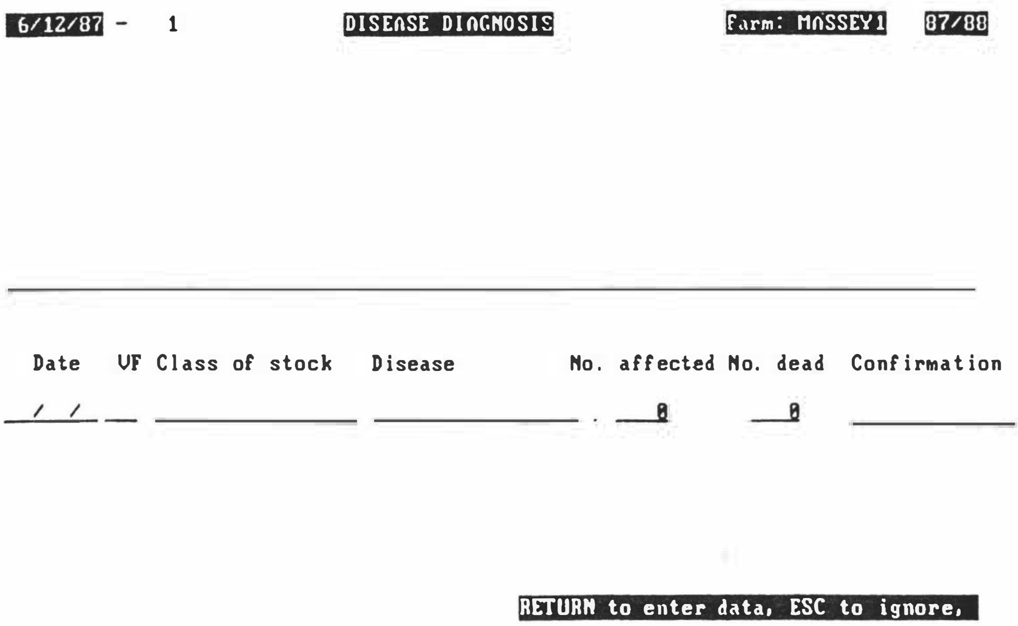


Figure 4.10 Disease diagnosis - Data input screen.

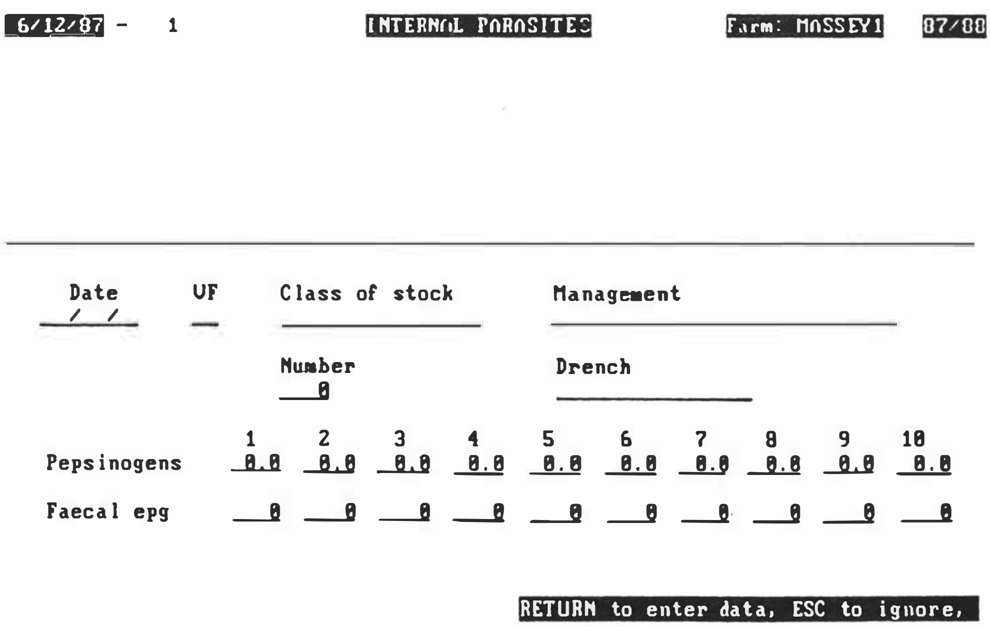


Figure 4.11 Internal parasites - Data input screen.

6/12/87 - 1 CATTLE BODYWEIGHTS Farm: MASSEY1 87/88

Date	Class of stock	Average kg	Minimum kg	Maximum kg	St.dev kg	Number weighed
/ /		0	0	0	0.0	0

RETURN to enter data, ESC to ignore,

Figure 4.12 Cattle body weights - Data input screen.

[illegible] - 1 CATTLE CONDITION SCORE Farm: MASSEY1 87/88

Date	Class of stock	Average	Minimum	Maximum	St.dev	Number scored
/ /		0.00	0.00	0.00	0.00	0

RETURN to enter data, ESC to ignore,

Figure 4.13 Cattle condition score - Data input screen.

```
 6/12/87 -   1            TRACE ELEMENTS          Farm: MASSEY1   87/88

-----------------------------------------------------------------------
  Date        VF          Class of stock
  / /         __          ________________

SUPPLEMENTATION :         Number      Product              Dose
                             0        ________________     ________

TISSUE   ANALYSIS :       Tissue      Element              Units
                          ________    ________             ________

                          Results 1-5    0.00    0.00    0.00    0.00    0.00
                                  6-10   0.00    0.00    0.00    0.00    0.00


                                   RETURN to enter data, ESC to ignore,
```

Figure 4.14 Trace elements - Data input screen.

```
 6/12/87 -   2       STOCK SALES / PURCHASES      Farm: MASSEY1   87/88
                         Class of Stock codes

 young stock: 87hfrs,calves,bulls,steers,beef,authfrs,sprhfrs

              86hfrs,steers,bulls,beef,authfrs,sprhfrs

              85hfrs,steers,bulls,beef,authfrs,sprhfrs

      adults: steers,bulls,beef,sheep,other,
-----------------------------------------------------------------------

     (Milking herd transactions are entered on a per cow basis)

  Date            Class of stock                Sales      Purchases
  / /             ________________                 0            0


                                   RETURN to enter data, ESC to ignore,
```

Figure 4.15 Stock transactions - Data input screen.

6/12/87 - 1 Farm: MASSEY1 87/88

SENSITIVITY TEST RESULTS

Date ____/__/__ Bacteria isolated ____________________

Antibiotic ___ ___ ___ ___ ___ ___ ___ ___
Result _ _ _ _ _ _ _ _

RETURN to enter data, ESC to ignore.

Figure 4.16 Drug sensitivities - Data input screen.

6/12/87 - 1 HERD MILK PRODUCTION Farm: MASSEY1 87/88

(The date entered is that of the final day of the period being entered.)

Date	Total milk vol for period	Av Fat %	Av Protein %	BMSCC (000) cells/ml
__/__/__	0 litres	0.00	0.00	0

RETURN to enter data, ESC to ignore.

Figure 4.17 Herd milk production - Data Input screen.

Cow Data

This is the largest of the three data sections and is the most heavily used by the program in calculations. The data is based on individual events with an associated date of occurrence. The events may be loosely grouped as reproduction, health, and production in type. This allows raw data to be used in calculations made by the program, and avoids prior manipulation of the data which would result in a restriction of the possible analyses. Each cow also has a signature which contains information on the cow's identification, age, breed, genetic worth and within herd phenotypic ranking.

The farmer can supply the majority of the information relating to cow details, reproductive events, animal health treatments, body weights, condition scores, drying off dates and cow fates (figure 4.18).

The veterinarian can supply information on the results of reproductive and health examinations, and treatments used.

The New Zealand Dairy Board, via the Livestock Improvement Division, collects information on individual cows for its sire progeny testing scheme, the artificial insemination service and the milk recording service it provides. It may therefore be a source of information on cow details, ancestry, breeding index, production index, some reproductive events and cow fate. Also herd test results, both production figures and individual somatic cell counts, may be obtained.

The requirement for cow data will depend on the use of the program. If it is intended to use the management aids and to have current reports on performance then the data will need to be collected on a regular basis. Retrospective analyses at specified times of the year may be undertaken with batch collection and entry of data at these times.

```
                              COW EVENT HISTORY                           12/10/87
                          Sorted by Number

7          0    4yr   F    BI 100   PI 100 Spring cow   Culled        Test Empty

 30/ 8/86   Calved           Heifer      Reared    calf id:       39
 19/11/86   Health Vet       Visit       Anoestrus
                             Repexam     Active ov           C2,UN,F10,I
 11/12/86   Health Vet       Event       Treatment 1         CIDR inserted
  9/ 3/87   Health Vet       Visit       Pregnancy test
                             Repexam     Empty
  3/ 5/87   Dried off
 10/ 5/87   Culled           Empty

8        835    3yr   F    BI 102   PI 105 Spring cow   Dry           Non Return

  6/ 9/86   Calved           Heifer      Reared    calf id:       46
 24/10/86   Mated            Sire        82266               Technician  FGGM
 16/11/86   Mated            Sire        81221               Technician  FGGM
  3/ 5/87   Dried off

9        832    3yr   F    BI 100   PI 109 Spring cow   Dry           Non Return

 15/ 8/86   Calved           Bull        Sold
 19/11/86   Health Vet       Visit       Anoestrus
                             Repexam     Cycled ov           C3,UN,F10,CL10
                             Treated     Prostaglandins      4 mls glandin-N
 11/12/86   Mated            Sire        82263               Technician  DWBL
  3/ 5/87   Dried off
```

Figure 4.18 Cow events history - reports screen.

DATA SOURCE AND COLLECTION METHODS

The method of data collection will depend largely on the source of the data being collected. In summary the major sources of data are listed as follows:

- Farmer
- Veterinarian
- Farm advisor
- New Zealand Dairy Board
- Dairy Factory

The location of the computer will also have a large influence on the collection methods adopted.

Farmer

Most of the data comes from the farmer and the successful adoption of a data collection system is rudimentary to the success of the entire system.

The ideal system would have the data recorded once, at the time of occurrence. The service organizations would each use this information for their own objectives. However until the technology is developed which allows this to occur, compromises will have to be made.

The majority of New Zealand dairy farmers already have some form of record-keeping system. The most common is a field diary into which events are entered as they occur. The diary is carried at all times and serves as a ready source of information in the field. The transfer of information from the diary into another more permanent recording system is commonly done later, at the milking shed or office. This system has stood the test of time and field use, and works well especially in large herds where more than one field diary may be in use supplying the permanent records. In the initial stages of the introduction to the program it is important not to alter existing successful data collection systems.

If the computer is located on the farm a step in the collection process may be missed out, namely transcription of the field diary into a formal records system. The data is entered directly into the program from the field diary.

If the computer is not located on the farm the data has to be collected and transferred to the bureau or veterinarian's office. The data from the farmer may be collected in a variety of ways: field dairies, shed sheets, wall charts, mating wheels or formal diary systems. The last is the most reliable and tends to promote an even flow of data into the program.

A formal diary has been designed to collect farm data, cow and herd events for the project. Events are written into the diary and a copy sent to the computer office at predetermined intervals. The self-carboning paper allows the farmer to keep the bottom of the duplicate sheets for his own records (figure 4.19). So that each event is recorded only once the formal diary would have to replace the existing recording systems. Until the various service organizations can interchange information this is unlikely to happen, and what has tended to happen is that both recording systems are run concurrently.

The information is hand delivered, posted or phoned into the computer centre to be entered into the program. The flow of data is also very seasonal, with the peak of data entry occurring in the spring and early summer periods.

Hand delivery has proved to be the favoured method of data collection; this has developed because the busiest periods for data collection and veterinary activity coincide.

Although the formal diary increases data accuracy and keeps the program up to date it is not an essential requirement for the program to be used effectively. Data may be collected using existing recording systems at intervals throughout the year.

Farmers who have their own computers and keep the information up-to-date remove the burden of data entry from the veterinarian and his staff. The farmer may simply hand-deliver the data disk to the veterinarian, who can then analyze performance on his own computer. This has proven to be successful in the field.

Veterinarian

The information collected by the veterinarian can be loosely grouped into two types:

1. Data that is obtained by reproductive and clinical examinations carried

DAIRYMAN EVENT DIARY

COW EVENT RECORDS

NAME/CODE: Burnett 202

REPRODUCTION

DATE	CALVINGS				HEATS (HNS) MATINGS (SIRE CODE)		
	Cow No.	Sex/Fate	Calf ID	Comments	Cow No	Sire	Tecn Code
3/8	2	BS					
	185	HS					
4/8	64	HR	8708				
	219	BS					
	144	H/B B		Twins			
	42	HS					
	16	HS					
	235	HS					
	228	BS		Breach Assist			
5/8	61	BS					
	111	BS					
	30	HR	8709	Cow Died M.F.			
	156	HB					
	94 ~~95~~	HS					
	82	BS					
6/8	55	HR	8710				
	148	BS					
	121	HB					
	63	HB					
	183	BS					
	147	BD		HFR Died Calving			

ENTERED

HEALTH/EVENTS

Date	Cow No	F/V	Event — Findings	Treatment — Comments	RV (or ♂?)
3/8	11	V	1st Induction		✓
	35	↓			
	43				
	56				
	66, 84				
	86, 118				
	123, 133				
	140, 158				
	178, 187				
	191, 199				
	243.				
2/8	ALL ADULTS 5mls Se Lupo. Injection.				

ENTERED

Figure 4.19 Event Diary Recording Sheet.

out on the farm.

2. Results from laboratory investigative work, on samples collected by the veterinarian in the course of on-farm investigations.

As the examinations are performed the results are generally recorded by the herd manager on to a prepared form. The results can then be entered directly from these forms into the computer, whether the computer is on the farm or in the veterinarian's office. This differs from the collection of laboratory results; these come directly to the veterinarian's office from the laboratory. If the computer is located in the office the results can be entered immediately, but if the computer is on the farm the results have to be sent to the farmer for entry. The latter has not proven to be a satisfactory method of data entry.

<u>New Zealand Dairy Board</u>

The New Zealand Dairy Board uses information which contains a lot of the same items required by DairyMAN. The data is collected manually for the most part, but the Livestock Improvement Division of the New Zealand Dairy Board has an automatic data collection facility for milk recording. Currently no data collection links exist between DairyMAN and the New Zealand Dairy Board; each system has distinct objectives although some overlap does occur. At present data derived from the New Zealand Dairy Board may be re-entered manually into DairyMAN if desired. This has occurred only to a limited degree, because the time taken to re-enter this data is prohibitive.

<u>Dairy Factory</u>

The herd production information from the dairy factory has proved to be useful, and is quickly and easily entered into the program. The shed sheets may be entered in batch format at the end of the season or regularly entered during the season. The mailing of copies of the production sheets by the factory directly to the computer bureau makes the task even easier.

Farm Advisor

Information from the farm advisor such as soil and pasture analyses and financial reports may be collected as required and entered in batch lots. This information is not necessary for day-to-day management and is used for medium to long term decisions.

DATA ENTRY

The users of the program (farmers, advisors, and veterinarians) will have had varying levels of experience with computers. If the program is to gain acceptance it is essential that the use of the program be as simple, as accurate, and as "friendly" as possible. Because of time constraints in any busy enterprise, the time required to enter the data and to run the program must be kept at a realistic level, or the acceptance of the program will be restricted to the enthusiasts.

Menu System

The program is structured such that the requirement for prior computing skills is minimal. DairyMAN is designed around a system of menu choices which allow the user to move to the required area of the program (figure 4.20). Prompts are displayed on the screen to aid the user in these choices. To move to the desired area single letter choices are made from the screen. The data input section of the program is divided into three broad categories relating to the type of data being entered; Farm data, Herd data and Cow data (figure 4.21).

Coding of Events

No coding of events is required at data collection and, because of the data input system, only minimal coding is required at data entry. There are separate input screens for each of the major types of cow events. Because of this the coding required is reduced since the program knows which screen is being used. When entering health events the health codes used to describe the event are abbreviated alpha codes. These codes resemble closely the full code form, so they are easy to remember and hence simplify the data entry procedure. The codes are chosen from a list of 200 possible codes shown in Appendices I to VI.

Flexibility of Event Detail

The structure of the system is such that compulsory data is minimal. This was done intentionally for the author foresees a major use of the program in the solving problems of a reproductive or health nature. For example the problem may be one of a poor non-return rate in the cows, a particular sire may be incriminated, the data required to answer this question are the mating details and pregnancy test results for the herd. The mating details need only encompass the date and the sire of the matings. The system does however allow, and by its nature encourages, the collection of as complete a data set as is practicable, thus allowing a full investigation into the problem. Beginning simply and adding to the program is possible, as the addition of data at a later date presents no particular problems.

Defaults System

The seasonal nature of New Zealand dairy farms dictates that each cow in the herd is at a similar stage of lactation. Therefore the reproductive data being entered into the program is of a similar type. This allows a system of defaults to be used to greatly enhance data entry speed. The system operates by defaulting to the previous entry made into the files. This reduces the number of key strokes required and drastically reduces the time required to enter the data. A 150 cow herd can be created and have the mating dates, sire codes and technician codes entered in about 40-50 minutes, provided the data is presented in chronological order.

Error Checking

The keyboard operator should not need to have detailed knowledge of what data is acceptable and what is not. There has been developed a system of data validation that either rejects the data if it is too absurd or warns the operator that this is unusual but acceptable data. The system operates by comparing the newly entered event with events currently existing in the cow's file, both before and after the added event. If it is found that the new event is not biologically consistent with the cow's history the program notifies the operator at one of two levels. The addition of an unusual but not impossible event to the record will generate a warning message. The addition of unacceptable data will generate an error message and the data, in its current form, will not be accepted by the program. A common example is where a recording error leads to an attempt to enter a second calving for a cow which calved a month earlier.

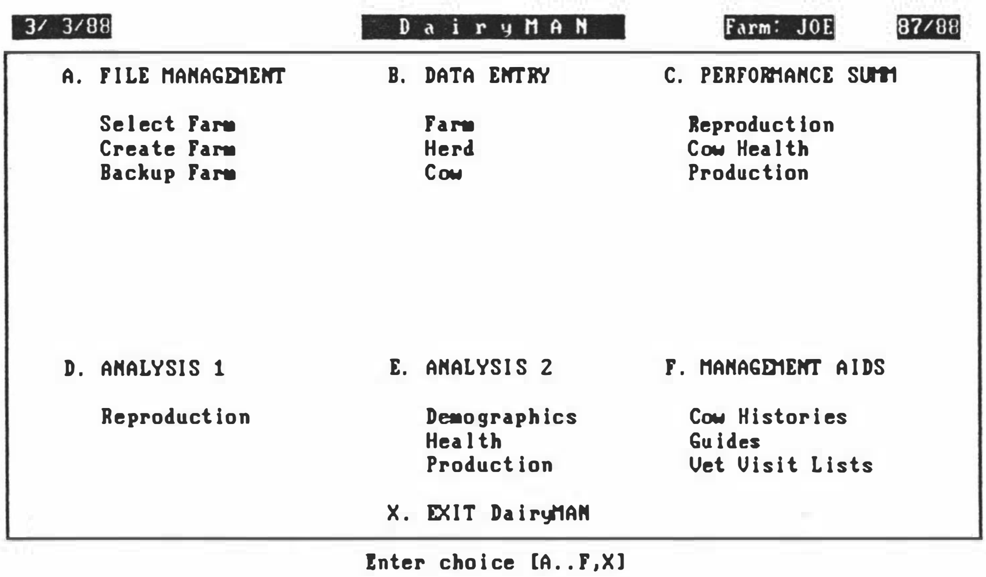


Figure 4.20 DairyMAN main menu.

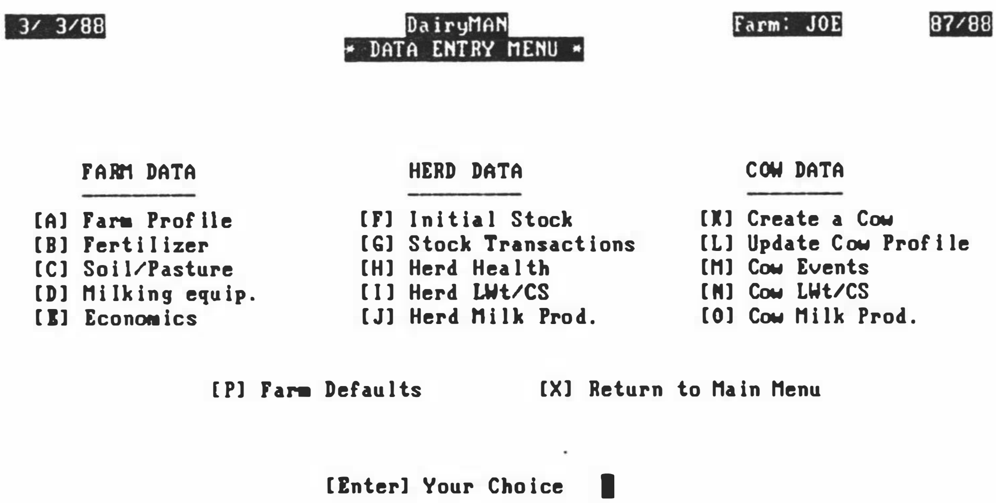


Figure 4.21 DairyMAN data Input menu.

DATA STORAGE AND FILE STRUCTURE

The structural design of the data file is vital to the attainment of the project objectives, and the ultimate success of the program. To meet requirements in all New Zealand dairy management systems and still maintain data validity and consistency, a well designed file structure is required. The file structure should make it easy to solve problems using soundly based epidemiological techniques coupled with clinical reasoning (Stein, 1986).

A brief review of the events that occur on a New Zealand dairy farm is necessary to understand the reasoning behind the file structure initially adopted for DairyMAN.

The average herd is 157 cows run by a one person. The cows calve in the late winter/early spring period, over approximately eight to ten weeks, to coincide with the increase in available pasture during that period. After a set date all cows on heat, regardless of their calving date, are mated. Artificial insemination techniques are used for the first six weeks of the mating program; in most cases a bull is then run with the herd to catch the cows still not in calf, until he is withdrawn at about twelve to fifteen weeks after mating commenced. The cows are milked through to a fixed date and are generally dried off together in late autumn or early winter. The young stock are run as a herd and all procedures are carried out on a herd basis until the heifers calve and enter the milking herd, at which stage they identified by a herd number and treated as individual cows.

This system simplifies the data storage problem as the season is a well defined period, and the milking year is loosely an all-in all-out system commencing on the first of June each year. This system operates on approximately 85% of New Zealand dairy farms. Since the objective was a program able to handle New Zealand dairy farms simply, the file structure was designed with this yearly cycle in mind.

The information is stored in year directories, one year ends and another begins on the first of June each year. Within each year directory the data files for each farm are located. The information on a farm is stored in two data files. The first file contains all information relating to individual members of the milking herd. The data file contains information relating to the farm and to the various herds on the farm as groups.

The farm file contains a large number of fixed fields and also several dynamic records in which dated events are stored. This file is generally fairly consistent in length because of the fixed fields and is rarely larger than five kilobytes in size. It is the structure of the cow file that is crucial to the program as it contains the majority of the data.

Within one season there are a number of events a cow may experience. Some occur only once each season; others may occur more than once for the season. Initially it was felt that it would be simpler to have fixed fields for events occurring once a season and a dynamic record structure for those occurring more than once. Each event type had its own dynamic record. This was considerably easier to deal with from the programmer's point of view. So there existed four variable length records for each cow along with a set number of fixed fields.

Cow Events

The data recorded for a cow during the season are called events. An event has a number of minimum data requirements necessary in order to be entered into the program. Each event must have an animal identification, a date of occurrence and an event type recorded with it; there may also be varying levels of descriptive data with each event. The events are broadly classified according to the following categories; they may be lactational, reproductive, health, productive or Informational in nature. This classification was used to design the file structure for recording cow events.

Each cow has a signature; this consists of an identification (two types can be accommodated per cow), an age In years, a breed category, the breeding index, and the production index (figure 4.22).

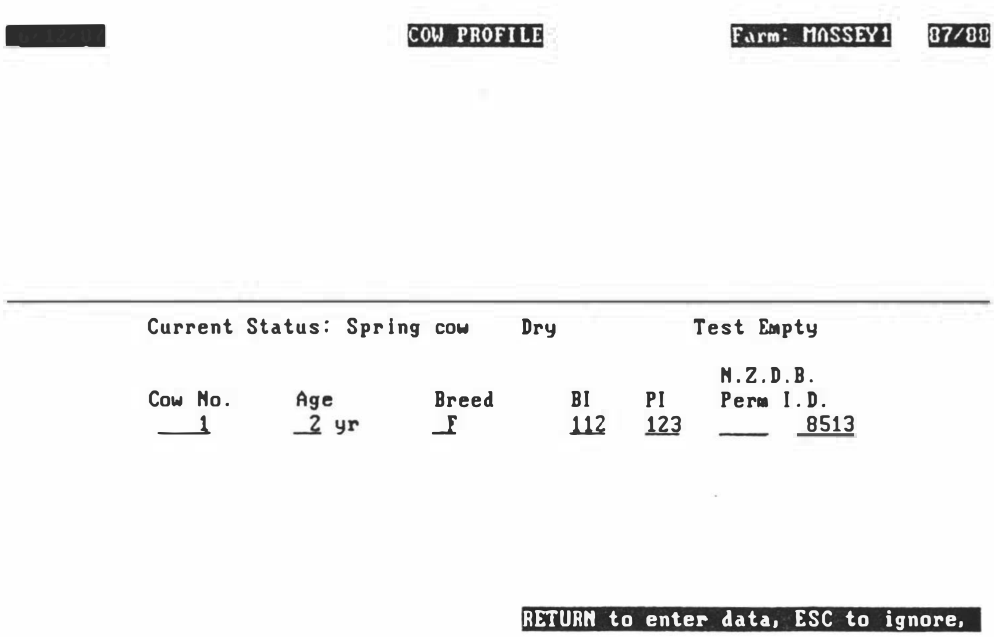


Figure 4.22 Cow details input screen.

The reproductive events are listed as follows:

1. Calving events have a fixed field for each data segment and only one calving event is allowed per cow per season. Because of the fixed field no calving code is required (figure 4.23).

Primary Information	Secondary Information
Date	Sex and fate of calf
Descriptor	Calf identification

```
6/12/87                       CALVING EVENTS              Farm: MASSEY1   87/88

  Descriptor:  N: Normal calving                        Calf sex: H: Heifer
               I: Induced calving                                 B: Bull
               A: Abortion starting a lactation                  HH: Twins
               C: Carryover cow
                                                        Calf fate R: Reared
  Enter 'Y' under Problem takes you                               S: Sold
  directly into the Health Records                                B: Bobbied
                                                                  D: Died
--------------------------------------------------------------------------------
      Current Status: Spring cow    Dry            Test Prgnt

   Cow No.        Date        Descriptor  Calf sex   Fate    Calf id  Problem  Y/N

     1           __/ /__          N          __       __      ____        N


                                         RETURN to enter data, ESC to ignore,
```

Figure 4.23 Calving events - input screen.

2. Mating events have a dynamic record of up to twelve heats and/or matings per cow per season. Because of the separate dynamic record no mating code Is required (figure 4.24).

Primary information	Secondary information
Date	Sire
	Technician

Heats are recorded with a 'HNS ' in the sire field; if anything else is recorded in this field the event is considered a mating. There are no restrictions on entries in the sire and technician fields.

The lactational events are listed as follows:

1. Drying off data has a fixed field in the record and only one allowed per cow per season. Again no drying off code Is required (figure

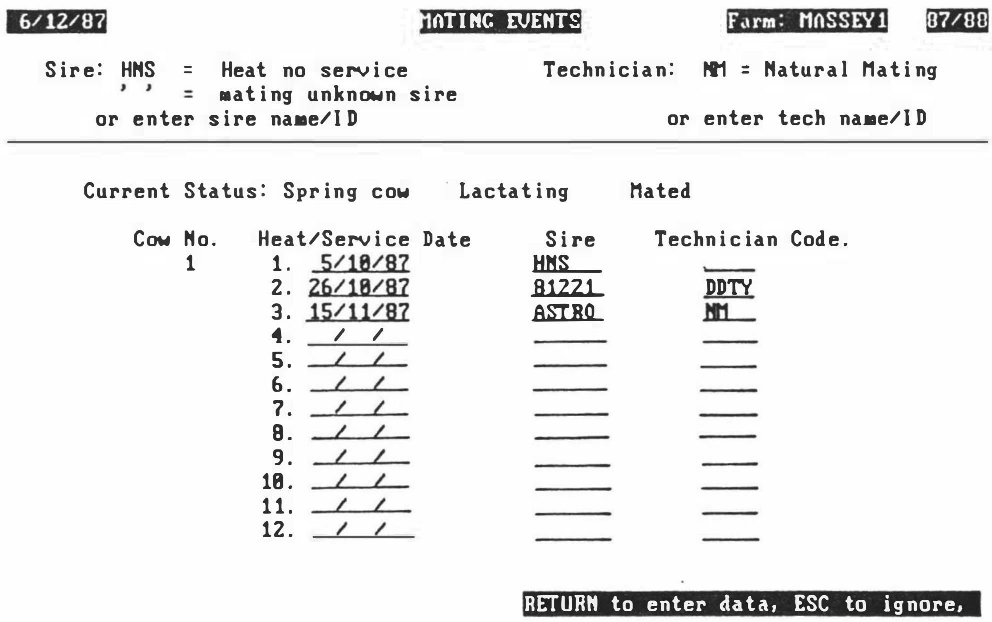
4.25).

Primary information	Secondary information
Drying off date	Dry cow therapy date
	Dry cow therapy drug used

2. Cow removal data has a fixed field for the date and accompanying data (figure 4.26).

Primary information	Secondary information
Removal date	Cow fate
	Reason for removal

The reason for removal code is chosen from the health code list, any three of 150 possible codes may be chosen (Appendices III and VI).


6/12/87 MATING EVENTS Farm: MASSEY1 87/88

Sire: HNS = Heat no service
' ' = mating unknown sire
or enter sire name/ID

Technician: NM = Natural Mating
or enter tech name/ID

Current Status: Spring cow Lactating Mated

Cow No.	Heat/Service Date	Sire	Technician Code.
1	1. 5/10/87	HNS	
	2. 26/10/87	81221	DDTY
	3. 15/11/87	ASTRO	NM
	4. / /		
	5. / /		
	6. / /		
	7. / /		
	8. / /		
	9. / /		
	10. / /		
	11. / /		
	12. / /		

RETURN to enter data, ESC to ignore,

Figure 4.24 Mating events - input screen.

6/12/87 Farm: MASSEY1 87/88

DRY COW RECORDS

[A] = Biopen DC
[B] = Orbenin DC
Blank = no treatment

Current Status: Spring cow Lactating Mated

DRY COW THERAPY

Cow No.	Date dried off	Date given	Drug used
1	__/__/__	__/__/__	__

RETURN to enter data, ESC to ignore.

Figure 4.25 Drying off events - input screen.

6/12/87 Farm: MASSEY1 87/88

COW REMOVAL

Fate C: Culled
D: Died
S: Sold for dairying

Reasons : Refer to the code book
Code Types R,D.

Current Status: Spring cow Lactating Mated

Cow No.	Date	Fate	Reason(s)
1	__/__/__	__	1 ______ 2 ______ 3 ______

RETURN to enter data, ESC to ignore.

Figure 4.26 Cow removal - input screen.

The production events are listed as follows:

1. Milk recording data has a separate dynamic record and no restriction on the number of records entered per season (figure 4.27).

Primary information	Secondary information
Date of record	Milk fat percent
Volume in litres	Protein percent
OR	Lactose percent
Individual somatic cell count	

2. Results of rapid mastitis test examinations. This has a dynamic record with no limit on the number entered per season (figure 4.28).

Primary information

Date of the test

Results of the test

The **Body weight** and condition score events are listed below. They also have their own dynamic record and there is no limit on the number of records added per season (figure 4.29).

Primary information

Date of the event

Body weight

OR

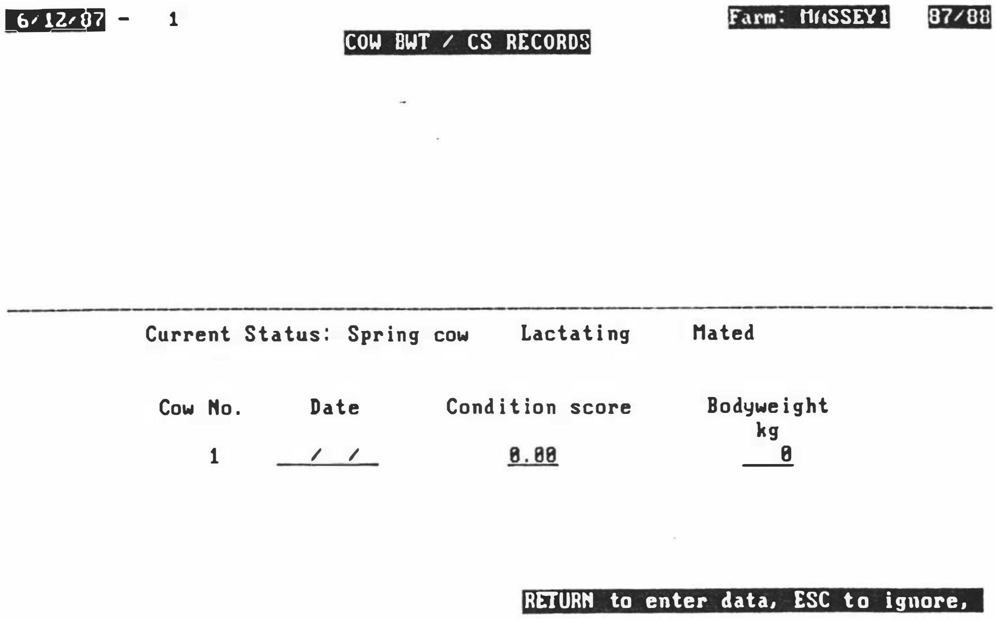
Condition score

```
 6/12/87  -   1                                        Farm: MASSEY1    87/88
                            COW MILK PRODUCTION

------------------------------------------------------------------------------
      Current Status: Spring cow    Lactating     Mated

 Cow no.     Date      Total litres    Milkfat     Protein   Total Solids    ISCC
                                          %           %           %          (000)
    1       __/__/__        0.0          0.00        0.00        ____           0

                                    RETURN to enter data, ESC to ignore,
```

Figure 4.27 Cow milk production - input screen.

```
 6/12/87  -   1                  PRODUCTION RECORDS            Farm: MASSEY1    87/88
                                RAPID MASTITIS TESTS

                                   Quarter codes

                                    - :Negative
                                    + :Positive
                                    C :Clinical Mastitis
                                    B :Blind Quarter
                                    X :Dry Cow Therapy
------------------------------------------------------------------------------
      Current Status: Spring cow    Lactating     Mated

                  Cow No.        Date           Quarters

                     1         __/__/__           _ | _
                                                  _ | _

                                    RETURN to enter data, ESC to ignore,
```

Figure 4.28 Rapid mastitis tests - Input screen.



6/12/87 - 1 Farm: MASSEY1 87/88

COW BWT / CS RECORDS

Current Status: Spring cow Lactating Mated

Cow No.	Date	Condition score	Bodyweight kg
1	/ /	0.00	0

RETURN to enter data, ESC to ignore,

Figure 4.29 Cow body weight and condition score - input screen.

The health events are the final dynamic record, this record has developed into a "potpourri" of event types, as new events are added they are done so in this section, if events do not fit into any other record they are added here. The health record has a number of lactational and reproductive events as well as health events. Each entry in the health record is a collection of a number fields (figure 4.30).

Primary information	Secondary information
Date of the event	Farmer or vet treated
Health code entered	Revisit required
	Up to four extra health codes
	Comments on each health code

The health records are grouped into six types which are a function of the record descriptor and health code used in each record.

1. **Management events.**

   These are informational codes and can be grouped into types, critical codes and noncritical codes. This Is explained in detail in the following section (Appendix I).

2. **Visit reason events.**

   These are reasons the veterinarian visited the cow to perform a reproductive examination. They are not essential codes but are used in analysis of the results of a veterinarian's visits (Appendix II).

3. **Reproductive examination results.**

   These codes contain information on the result of a reproductive examinations performed by a veterinarian, Detail of ovarian findings may be entered in the comments section (Appendix III).

```
6/12/87 -   1 (last)            HEALTH EVENTS              Farm: MASSEY1   87/88

V/F                              Event                          Code
----                             ------                         ----
V: Vet                           V: Visit reason                See Code Book
F: Farmer                        D: Disease diagnosis
Revisit                          R: Reproductive examination    Comments
-------                          M: Management event            --------
 : Does not apply                T: Treatment                   Text Field
N: Exclude from next action list S: Sample
Y: Include in next action list
--------------------------------------------------------------------------------
     Current Status: Spring cow     Lactating     Mated

Cow No.     Date       V/F     Revisit  Event  Code       Comments

   1      6/12/87      V         _        V    MVO       ____________________
                                          R    CYCLED      C2,UN,L-F10,R-CL15
                                          T    PG        ____________________
                                          _    ______    ____________________
                                          _    ______    ____________________

                 RETURN to enter data, ESC to ignore, ←→ for prev or next record
```

Figure 4.30 Health events - Input screen.

4. Disease or disorder events.

   The code is chosen from a list of possible entries. Currently the list is not a large one, and has only 130 codes to choose from. The codes are general in nature, with few aetiological diagnoses. This was done because a significant number of problems are dealt with by the farmer and his ability to make a specific diagnosis is limited, so the codes are kept simple and descriptive to avoid an inappropriate diagnosis of the problem (Appendix VI).

5. Treatment codes.

   Codes are again chosen from a list of possible medical, surgical or procedural treatments. Details of the dose rates and length of treatment may be entered in the comments section of the record (Appendix V).

6. Samples taken.

   Recording samples taken, a choice is made from a list of ten possible codes (Appendix IV).

<u>Cow Status</u>

Each cow has a lactational and reproductive status from the following list:

Lactational status	Reproductive status
Dry	Calved
Lactating	Aborted
Nurse cow	Heat
Sold	Mated
Culled	Non return to service
Died	Pregnant
Unknown	Empty
	Unknown

Critical event codes change the status of the cow record. Each cow's status aids error checking, code writing and cow management. The status of a cow is based on the most recent of the critical events entered, which may be specific events or critical codes in the health record. The critical events are used in data validation, when new data is added to the record it is compared with previous and subsequent events in the record for biological consistency and if a discrepancy is found then the input operator is notified of the inconsistency. This way data may be added at any point in the record file of the cow and checked for biological sense. Codes in the health records that change a cow's status are said to be critical codes.

Critical events and health codes are listed below:

Lactational events include the following:

- Specific events
  - Calving events
  - Abortions starting a lactation
  - Drying off
  - Cow removals
- Health records with the following codes:
  - Bought lactating
  - Bought dry
  - Nurse cow
  - Return to milk
  - Induced lactation

Reproductive events include the following:

Specific events

Calving

Abortion

Heat

Mating

Health records with the following codes:

Pregnant

Empty

Unknown

Abortion

Other critical codes which may be entered include

Withheld

To be culled

These codes come under the critical code classification but as yet do not alter the cow's status.

Yearly File Management

When the herd moves into its second year of program use, on the first of June the program automatically creates a new year-directory and transfers the herd into it using an update program. The removed cows are left behind, ages are incremented by a year and data deemed critical is transferred with the cow signature into the new directory. This necessitates the creation of more fixed fields in the cow file for this data. The data includes such information as predicted calving date, sire of the expected calf if known, and a health summary of the previous season (figure 4.31).

```
6/12/87                                            Farm: MASSEY1   87/88
                        DATA FROM PREVIOUS SEASON

     Current Status: Spring cow    Dry          Test Prgnt

  Cow No.    1   Age  _2 yr

                        REPRODUCTIVE EVENTS

   Previous calving date      Descriptor          Health problems
        11/ 8/87                  N               MFEVER ______

     Due calving date         Due Sire            Lameness cases
         2/ 8/88                81221                   1

                          MASTITIS EVENTS

       Clinical cases    ISCC geometric mean    Dry cow therapy given
             1                  254                     A

                                      RETURN to enter data, ESC to ignore,
```

Figure 4.31 Data from previous season - input screen.

CHAPTER FIVE

DairyMAN: PERFORMANCE REPORTS

INTRODUCTION

In the past diseases which were able to be controlled have been greatly reduced in importance. Such diseases generally had recognizable clinical signs and a clear aetiology, so they responded to traditional methods of disease control. Farming is now faced with a number of complex diseases which cannot be dealt with in this way. These production limiting diseases are generally multi-factorial in nature and do not necessarily express themselves by clear signs of disease (Blackmore, 1985; Morris, 1976).

In many cases disease problems are due to inadequate management rather than to specific aetiological agents. Williamson (1982) for example suggested that the major factor limiting reproduction in United States dairy herds is the inability of dairymen to adequately detect oestrus.

Because of this change in emphasis in disease control a more epidemiological approach to animal health issues, as discussed in Chapter two, is now necessary. The essence of this approach is to collect a large amount of relevant data, and process it to produce information, upon which decisions can be made and a plan of action implemented.

Reliance is increasingly being placed on performance-related diagnosis in which normality and abnormality can be measured in relation to selected performance indicators and their deviation from target values. These target values are set to take account of the management situation, the economic implications of deviations from the targets, the goals and capabilities of the farmer.

It is important not to view a single performance indicator in isolation, as this may give misleading information on the economic health of the enterprise. The evidence from any single indicator may be equivocal, but in combination a set of marginal and/or clearly abnormal values may suggest a particular syndrome, whether it be infertility as a result of poor nutrition, a problem of poor growth rate, or a specific infectious disease (Morris, 1982).

Various authors have described the steps to follow when approaching a managerial or production-oriented problem using epidemiological techniques. All have a similar theme, although each may vary slightly in the detail of each of the steps (Blackmore, 1985; Morris, 1987; Stein, 1986a,1986b,1986c).
The steps are described in the following headings:

Planning

An important first step is to set realistic attainable objectives for the enterprise. These should be recorded in approximate order of priority. To measure progress they should be constantly referred to by the users. They should also be used to remind the user of the objectives for the enterprise. As set objectives are reached new ones should be decided upon depending on knowledge and experience gained.

The key to planning is to start with what you want to achieve then work backwards. Working backwards tells you what must be achieved at each critical point, to realize your goal.

The single most important planning decision made on New Zealand dairy farms is the matching of feed supply and feed demand of the enterprise. The demand is dictated by the stocking rate, the calving date, and the calving pattern for the herd; the supply is determined by the available feed and the expected pasture growth. Future events may be predicted based on known, current or past occurrences and future predictions; this allows the farmer to anticipate and identify problems and solve them at an early stage. By this means potential difficulties are avoided.

Monitoring

In any investigation the first step is to establish if a problem does exist, and if so the size of the problem. This requires a thorough analysis of all relevant records, and is considered by Eddy (1980) as a prerequisite to the investigation of a problem. Unless this is known recommendations may not take into account all aspects of the enterprise and its function.

Morris (1987) suggested there are few businesses as large as a dairy enterprise which do not have an accurate monitoring system in place to access how actual performance is measuring up against expectations in a number of key areas.

The farmer needs short-term measurements of performance which correlate highly with the long term economy of the enterprise. The figures, against which performance indicators are compared, are called target values. Although the targets will be similar within a region, they must be adjusted for each farm, keeping in mind the management, financial, and physical constraints of the farm as well as the goals for performance of the farmer.

Analysis

The purpose of analysis is to define problems in as much detail as possible. The method of analysis is carried out systematically, within a structured format. The problems once defined lead to hypothesis formation and testing, and hence to epidemiological problem-solving. The diagnostic process is analogous to that used for individual animals, but is applied to the population or herd.

By using computers for the analysis of records the drudgery is removed and many of the potential pitfalls of manual analysis are avoided. Results can easily become misleading unless various precautions are built into the analysis procedure. For example it is necessary to write in the correct inclusion and exclusion rules for cows when calculating specific measures of performance, and to group animals correctly for comparisons. If the computer program is well designed the user is protected against making common errors which could lead to erroneous conclusions.

Evaluation

In this phase of the management process the information produced in the analysis is assessed and interpreted. Problems are assessed in light of their economic effect on the enterprise, or more correctly, is the instigation of control procedures, to deal with the existing problem, going to produce a return on money invested. Evaluation identifies problems, assesses trends, determines the efficiency of production and checks the response to management changes. Disease in this context becomes redefined as "deviations from the expected or target levels of performance".

Decision Making

Once the problem has been identified a decision needs to be made; whether it is economically sound to initiate control procedures, and if so the control procedures to be used.

Support For Action

The results of action taken must be monitored continually. The performance parameters need to be reassessed to support the action taken or re-evaluate the problem. Information systems such as DairyMAN also produce management aids which help with day-to-day decisions on the management of individual animals in the herd.

Veterinarians should focus on two objectives of management, these are the maintenance currently satisfactory levels of production and the improvement of performance if the levels attained fall short of expectations. The management cycle described is continuous. Each time the cycle is repeated there exists a slightly altered objective or data base from which to work. This defines the level of achievement in a herd and provides motivation for change. The process is biased towards action (Stein, 1986b).

THE ECONOMIC DICTATION OF PERFORMANCE INDICATORS

Introduction

The goal of a health management program is optimum production with a minimum of disease and related problems (MacKay, 1984). The production cycle of dairy cows is intimately linked with the annual production of a calf, and the cow's subsequent lactation. Because of this relationship, breeding efficiency has a major effect on overall farm efficiency. The economic dependence on reproductive efficiency establishes the need for reproductive programs, shapes them, and causes them to be adapted to meet new or resistant problems (Weaver and Goodger, 1987b).

The economic impact of reduced breeding efficiency is shown in the following ways:

1. Reduced numbers of offspring.
2. Lowered efficiency of milk production and less life time production, because of prolonged lactations.
3. Decreased efficiency of feed conversion and increased management costs of carrying cows with extended lactation and dry periods.

4. Increased replacement costs, added to the loss of increased numbers of cows being culled because of reproduction failures.
5. Reduced genetic gain and capacity for selection.
6. Increased breeding and veterinary costs.

MacKay (1984) estimated that the annual loss in the United States because of reduced breeding efficiency was 800 million dollars per year. This was equated to a cost of $4.68 per day for each day a cow's calving to conception interval was greater than 85 days.

Much has been written on the economic advantage of the 365 day calving interval. Although there is some variation in advantage there is general agreement that the 365 day interval is the most economically efficient (Bailie, 1982; Eddy, 1980; Esslemont et al, 1985; MacKay, 1984; MAFF/ADAS, 1984; Morris, 1971; Warren, 1984; Williamson, 1982). The cost of lost production for each day the calving interval is greater than 365 days will vary if there is a different price for milk products for each month of the year, and if replacement costs were included in the calculation or not.

Reproductive indices may be influenced by the culling of cows that have performed inadequately. The culling rate due to involuntary losses, and the total culling rate should be considered when evaluating reproductive performance. These should be considered is in addition to the calving interval and the proportion of cows conceiving within a restricted breeding season.

The aim in reproductive management is to have the herd on an annual cycle which approximates as closely as possible to the following (Blood et al, 1978; MacKay, 1984; Williamson, 1982):

1. All heifers should calve by 24 to 28 months of age.

2. The mean calving interval should be at or below 375 days.
3. The average calving to conception interval should be less than 90 days, with a standard deviation of under 40 days.
4. The average lactation length for a herd should exceed 300 days and the average dry period should be less than 65 days.
5. No more than 20% of a dairy herd should be dry at any one time.
6. Less than 10% of the adult herd should be culled each year for infertility or failure to conceive within an acceptable period. The total culling rate should not exceed 25% (Macmillan and Murray, 1974).

It is important to appreciate that the above targets are for the herd, not individual cows. There will be a variation in performance between cows. In economic terms the extent of this variation between cows is almost as important as the average, and measures of this variation are just as important in herd analysis as are measures of the average (Morris, 1976).

New Zealand Dairy Herds

Where the herd calves on a seasonal basis the gains in productive efficiency are made by linking calving patterns closely to the seasonal feed supply.

As yet few attempts have been made to identify important measures by which to compare different seasonally concentrated calving patterns. As a consequence the possible effects of calving patterns on herd management and production have not been investigated fully (Macmillan, 1985c).

A summary of Macmillan, (1985c, 1985e) is presented as these papers cover the points which are important when designing performance indicators for New Zealand dairy herds.

In New Zealand the prices received for milk, or milk solids, usually preclude the continued use of a feed ration which is based on energy-rich concentrates. Fresh pasture, supplemented with pasture conserved as hay or silage, provides over 90% of a cow's diet in most New Zealand dairy herds. The availability of fresh pasture varies throughout the year because of climatic conditions and the normal growth patterns of the grass and clover species which make up these pastures.

In New Zealand dairy herds, it is possible to spread the calving evenly throughout the year, but in order to do this either the stocking rate must be reduced to allow the feeding of cows during periods of lowered feed supply, or feed must be purchased. Conserving feed, during periods of surplus to feed out when feed is short, involves considerable loss of dry matter and reduction in nutritive value. The price of purchased feed is often such that it is an uneconomic practice to buy in feed.

The primary objective of a breeding program in a seasonal dairy herd is to produce a calving pattern which relates to pasture growth. Hence calving is concentrated into a period which precedes a period of rapid pasture growth. Because no cows in a seasonal herd will be milked for a 4 to 8 week period preceding the planned start calving, and most cows in the herd will have stopped milking on the same date, a cow's lactation length is mainly affected by its calving date relative to the Planned Start Calving (PSC) date (Macmillan, 1985e).

Although a seasonally concentrated calving pattern may be the main objective of a breeding program, other objectives must be achieved simultaneously. Heifer calves, which have potentially superior average performance to their dams, must be produced from within the herd. There should be sufficient numbers of these calves to replace all adult animals which either die or must be culled (involuntary losses), as well as displacing poorer producers (voluntary losses). A major factor influencing the number of involuntary losses in a herd is the proportion of cows which fail to conceive during the breeding period. Reducing this number is one of the objectives of a breeding program.

The primary objectives of a breeding program in a seasonal herd can be summarised as:

1. Producing a calving pattern which allows seasonal differences in pasture growth to be closely related to herd requirements.
2 Producing sufficient heifer calves of superior genetic merit to maintain herd numbers and to achieve consistent genetic progress by displacing poorer producing animals.
3. Minimising the proportion of cows in the herd which fail to conceive.

Secondary objectives also exist and may include:

4. Production of surplus calves for sale.
5. Improvement of labour efficiency by batch calving of the cows and rearing of calves of the same age.

These objectives must take into account other factors known to influence the productive efficiency of the herd, namely herd nutrition, pasture production patterns, stocking rate, and the herd's genetic merit.

Macmillan (1985c) suggested a cow's lactation length is largely dictated by its calving date relative to the PSC date. This is because most cows will be dried off within a week of each other, and from two to three months before planned start calving. The immediate availability of fresh pasture (average pasture cover) during late lactation, and the amount of supplementary feed on hand are the major factors which influence the time when milking is stopped for the season. Lesser factors include cow condition, current level of production, expected pasture growth rates and personal matters of the farmer.

Initial studies on the effect of calving date relative to PSC in herds of identical twins indicated that each one day reduction in the interval from PSC to the median calving date (MCD) increased production by around 0.9 kg milk fat per cow. This was more than the 0.7 kg milk fat per cow per extra day found in commercial herds (Macmillan, 1985e).

PERFORMANCE INDICATORS

The calculation of performance indicators allows herds to be monitored and compared against standard or target values. A failure to achieve targets can be then used as a cue to undertake investigations to define problems and to encourage changes in management. Since the objectives of most herd health programs is to optimize production efficiency in economic terms, biological targets must be carefully chosen to relate closely to the economic efficiency of the herds.

For example the calving interval of 365 days mentioned above is desirable for adult milking cows since it is related to efficient milk production and a high financial return. This applies whether calving is continuous throughout the year, seasonal or synchronised with periods of increased payment for milk. In seasonal calving herds an additional objective is to adjust the proportion of cows that calve in a concentrated period, in order to make the most efficient use of available feed. This need for concentration of calving may, at least in the short term, override the objective of having each cow calve at intervals of 365 days.

To be effective, monitoring requires a set of performance indicators to which immediate attention can be directed (Stein, 1985). In addition performance measures cannot be interpreted in isolation, and must give a true indication of the economy of the enterprise (Morris, 1976).

Recording systems are capable of producing massive amounts of information leading to information overload and confusion for the user.

Stein (1985) decided that a functional approach to the performance reports would reduce the information overload and simplify the procedure, this is the philosophy adopted in the development of reports from the DairyMAN program.

Reproductive Performance Indicators

The ideal performance index should have a direct correlation with the economy of the enterprise, be easily understood, highlight precisely the problem area and be able to be calculated immediately (that is as events that determine the final outcome occur). This would allow quick remedial action to take place, thus reducing the effect of a problem. Unfortunately this is not yet possible, so that measures which approach the ideal have been produced.

Before the calving index may be estimated for the herd all cows must have calved twice. This means that some events included in the calculation will be one and a half to two years old. This makes the calving index too historical to be of real value.

The components of the calving interval are the gestation period and the interval from calving to conception (Eddy, 1980). The gestation interval is generally constant at about 282 days so the calving to conception interval (C-C) may also be used as a measure of performance that relates directly with the economic efficiency of the herd. The advantage of this value is that it may be calculated at an earlier stage, often at the end of the breeding season, thus making the value more current and therefore of more value. Assuming a 282 day gestation length the target for C-C interval is 83 days, for an individual cow. Because the herd is composed of individual cows, with variations in performance, the target C-C interval for the herd is a mean value of less than 90 days and a standard deviation of less than 40 days.

In assessing herd fertility the C-C interval must not be considered in isolation as, artificially low figures may be obtained by heavy culling for infertility. Some farmers routinely cull for infertility after three or four services so producing a low C-C interval whereas another may persist with these cows and have a high C-C interval but a lower culling rate.

The C-C interval may also be divided up into two further components based on what occurs between calving and conception. The first period is the calving to first service interval and the second is the first service to conception interval. The first of the two intervals is again a more current measure of performance, as the calving to first service interval may be calculated as soon as the cows are served. This interval is thought to have a high association with the calving interval, second only to the "oestrus index", used by Jensen (1987) as a measure of efficiency of detection of oestrus. The components of the calving interval are shown in Figure 5.1, with factors known to influence each parameter listed.

Calving intervals in seasonal calving herds do not correlate well with objectives of the breeding program, that is the sychronisation of the calving pattern with the increase in feed supply. The measures used in seasonal herds are an attempt to describe the skewed nature of the calving pattern, beginning at the Planned Start Calving (PSC) date (Macmillan, 1985e).

Two measures of spread have evolved to describe the calving pattern. Each has its advantages and disadvantages. The first is the percentage of eligible cows calving by a set time in relation to the PSC date (the calving rate). The periods generally chosen in which to analyze the calving rate are weekly as they fit into the three weekly heat cycle of the cow from the previous mating season. The **calving rate** for a herd is defined as the percentage of cows eligible to calve which have calved by a defined day, relative to PSC.

- Calving interval
  - Gestation period
  - Calving to conception period
    - Calving to first service interval
      - Farm policy
      - Postpartum involution
      - Detection of oestrus
    - First service to conception interval
      - Oestrus detection
      - Conception rate

Figure 5.1 The components of the calving interval.

The second measure of the calving spread is based on the number of days it takes a predetermined percentage of the eligible herd to calve. This is usually broken into three periods; the first is number of days it takes 50% of the herd to calve from the PSC date; the second is the number of days it takes the next 25% of the herd to calve; and the final period is the number of days it takes the final 25% of the herd to calve.

Initially the first set of measures has been adopted for use in the program because they are the ones veterinarians and advisors are more used to dealing with and interpreting. On the "reproductive performance summary" page of DairyMAN, only the four and eight week calving rates are presented, to keep information saturation to a minimum yet still present an accurate picture of events (figure 5.2).

The practice of induction of calving has gained favour in recent years. It now common for up to 10% of the herd to be induced to calve early in one season. The percentage induced is included on the summary page, as this practice can distort the calving pattern.

The actual adult calving spread of one season, without inductions to reduce the gestation length, is a reflection of the conception pattern for the herd of the preceding season (Macmillan, 1985e). A period of one year has to elapse before the calving analysis may be worked out, by this time the information is going to be too old and of limited use to solve infertility problems for that season. More up-to-date information can be obtained by looking at the conception pattern of the season in question, that is the rate at which cows in the herd become pregnant. This information is very similar to the calving pattern, the major difference is that the predicted calving dates of the cows culled before the calving period are included in the conception pattern and are not included in the actual calving pattern. A policy of culling of late calving cows may influence the calving pattern obtained. Similarly the influences of induction are not accounted for in the conception pattern.

The conception pattern is measured by the **herd-in-calf rate**. This is defined as the percentage of eligible cows in calf by defined times in relation to the Planned Start Mating (PSM) date. The time periods are generally weekly as this coincides well with the cow's natural heat cycle. The four week and eight herd-in-calf rates are displayed on the reproductive performance summary page (figure 5.2).

The mating process commences at the PSM date. The cows are detected in heat and mated after this date irrespective of their previous calving date. Because of this policy cows with varying calving to first service lengths will be mated within the same heat cycle, consequently the traditional calving to conception interval is of reduced value in seasonal herds as there will by nature be a large deviation about the mean value.

Before the conception pattern can be calculated the cows have to be diagnosed pregnant, this currently involves a minimum delay of 42 days from service. The delay may be partially overcome by determining the two components that produce the conception pattern; the submission rate and the conception rate.

The **submission rate** is defined as the percentage of eligible cows mated for the first time by a defined time from the PSM date. Therefore the submission rate is qualified by a set number of days from PSM at which the calculation was carried out. The most common periods used are either 21 days or 28 days, the former because of the 21 day oestrous cycle of the cow, and the latter because of its relationship with the first month of calving and it also includes cows with longer heat cycle lengths. This is a useful measure as it is not difficult to calculate and may be calculated immediately after the event, thus providing an immediate measure of performance. The 21 day and 28 day submission rates are displayed on the reproductive performance summary page (figure 5.2).

The **conception rate** is defined as the proportion of services that lead to a successful conception. The direct determination of whether a cow conceives is not easy, because of the possibility of embryonic loss before the pregnancy may be confirmed, the variation in post service heat detection, and overt display of oestrous activity in pregnant cows. Progesterone assays on milk, now available routinely in some parts of the world, do improve this situation because the assays may be carried out as soon as 19-23 days after the service date. Because of the problem of pregnancy determination, best approximations of the conception rate are often used and can lead to confusion when comparing conception rates between farms, and reports from experimental work; this is because the method used to calculate conception rate in each case may not be adequately defined. The two methods used to estimate conception rate are pregnancy rate and the non-return rate.

The pregnancy rate is defined as the proportion of services that are subsequently confirmed successful by a positive pregnancy diagnosis. The confirmation of pregnancy is usually made by rectal palpation 35 to 42 days after service, although on other countries it is increasingly made by progesterone assay 18 to 24 days after service.

The non-return rate has been defined as the proportion of services which have not had a return to service recorded within a defined number of days after the date of the service. This figure relies on excellent post-service heat detection efficiency so is subject to error. It is, however, the figure most commonly used in New Zealand to describe conception rates. This is because the number of cows subjected to pregnancy examination is in the region of 10 to 20 percent of the mated cows, thus reducing the usefulness of pregnancy rates to provide conception estimates on a sample of the population. Non-return rates may be calculated at a relatively early stage after mating, depending on the time period chosen for the calculation.

There have also been considerable problems with consistency in methods of calculating non-return rates. A technique described by Wilcockson (1981), used by many in the manual analysis of herd reproductive performance, was the initial method used for the DairyMAN program.

The procedure was easy to calculate and to understand (refer to figure

5.3 to illustrate points made in the text). The calculation is based on scanning back 21 days from the most recently recorded observation date for the herd (point "C"), then determining whether or not services occurring before the selected date (point "B") had a return to service entered before point "C". The non-return rate was calculated as the number of cows not returning to service by point "C", divided by the total number of services occurring before point "B". This figure proved useful, but the measured values could not be used for comparisons between farms, between time periods in the breeding program, or between different cohorts of cows on the same farm. This is because the inclusion/exclusion rules were not consistent in their operation in different situations. For a service to be included in the calculation it had to occur at least 21 days before the last recorded day of observation (before point "B"). All services occurring before this date were included in the calculation, producing a range of periods from the service date until the last recording date (point "C") from 21 to 63 days (A-C and B-C respectively). There is no control over the distribution of services within the period (A-B), so we could be comparing a group of services with predominantly 21 days in which to return to service and a group of services with predominately 63 days in which to return to service. It would be expected that there was a difference between the two results.

Two examples from figure 5.3 will be shown to explain this point. A service that occurred at point "B" is included in the calculation as it occurred 21 days before point "C". This service has 21 days within which a return to service may be recorded, a non-return result would be expected as few returns to service are recorded within 21 days. On the other hand, a service occurring at point "A" is also included in the same calculation, but this mating has 63 days within which a return to service may be recorded. It is expected that the chance of a return to service recorded for a mating at point "A" would be higher than for a mating occurring at point "B", but both matings are included in the same calculation.

It was decided to adopt a more consistent approach to the calculation of the non-return rates. The inclusion rule adopted is as follows: for each service date recorded the addition of the non-return rate time period (in days) to that date must still produce a date less than that of the last recorded observation day (point "C"), in addition the cow in question, must still be eligible to return to service on that date (that is the service date plus non-return rate time period).

Referring to figure 5.3, the method of calculation of a 21 day non-return rate can be demonstrated. The services that with the addition of 21 days are still within points "A-C" are included in the denominator. Only the returns to service occurring within 21 days of the service date in question are used to calculate the numerator (by subtracting from the total number of qualifying services). For the purpose of the calculation returns to service occurring after 21 days are ignored. Thus each service included has an equal opportunity to have a return to service recorded. Hence valid comparisons between farms and between cohorts within a farm can be made. This makes the measurement technique much more defensible than the earlier one used.

One further inconsistency is the handling of consecutive day matings, occurring on a number of occasions, and often as a result of professional advice. Previous non-return rate algorithms considered the second of the two matings to be a return to service. It was decided that this was not the case and consecutive day matings are now considered as one service. So a cow may have more than one mating for each service, the non-return rate algorithm considers the final of the matings when calculating returns to service. We are adopting a similar policy to that used by Stein (1985) for the PigCHAMP sow breeding program. The first service and total service non-return rates are displayed in the reproductive performance summary page (figure 5.2). The first service non-return rate is less subject to post-service variability in heat detection. It is also not influenced by a few cows repeatedly returning to service and hence lowering the non-return rate for the total services (Williamson, 1982).

The length of the breeding period has a marked influence on the final number of empty cows. Macmillan (1985b) reported that for each week the mating period was extended beyond nine weeks the final empty percentage was reduced by half a percent.

The final performance parameter on the summary page is the empty rate. This is the proportion of cows present at PSM that are found to be empty at any point in time. This figure will change as the breeding season progresses and more information comes to hand. A schematic of the factors influencing the calving pattern in New Zealand dairy herds is shown in Figure 5.4.

Health Performance Indicators

Because productivity will be directly influenced by the health status of the herd, it becomes necessary to establish optimal health in the herd. For every given disease situation there is an economically optimal level of control. In financial terms alone, disease control is justifiable when a dollar spent on the control of the disease returns more than a dollar's worth of the product (MacKay, 1984).

```
BURNETT              REPRODUCTIVE PERFORMANCE MONITOR      12/04/88
                                  Spring Herd
                              Days since PSM = 906
Planned start calving          Adults  31/ 7/85        Targets
     Cows to calve                        215
     Cows calved                          213
     4 week Calving Rate                   68 %           66 %
     8 week Calving Rate                   91 %           90 %
     Percent Induced                        2 %
     Percent Aborted                        2 %

Planned start mating (PSM)              22/10/85
     Mating end                          4/ 2/86  =  15.0 wks
     Cows to be mated at PSM              209
     Cows yet to be mated
     21 day Submission Rate                59 %           90 %
     28 day Submission Rate                63 %           92 %

     First Service 42 day NRR              65 %           62 %
     Total Service 42 day NRR              64 %           62 %

     4 week Herd-in-calf Rate              46 %           57 %
     8 week Herd-in-calf Rate              78 %           86 %
     Percent Empty                          7 %            7 %
```

Figure 5.2 The Reproductive Performance Summary showing the performance indicators used for seasonal New Zealand dairy farms.

Figure 5.3 A time graph during the breeding period.

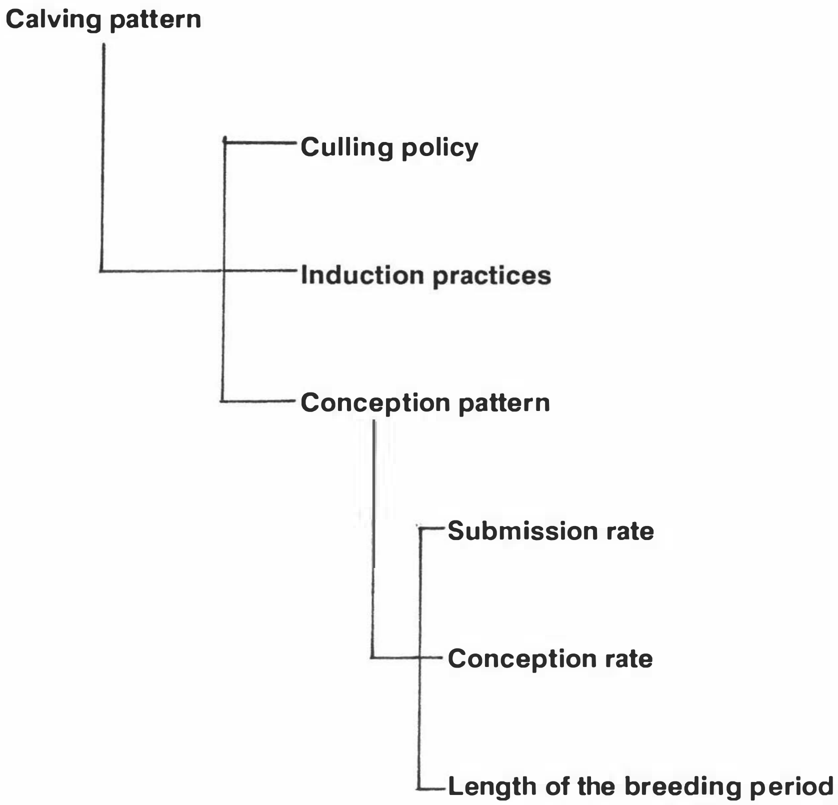


Figure 5.4 The factors influencing the calving pattern.

Disease contributes to the decreased efficiency of production in the following ways:

1. Reduced production during the illness, and for a varied period after the recovery or partial recovery from the illness.
2. Interference with the animal's ability to peak in production.
3. Loss of body condition that should be available for mobilization during peak production.
4. Cost of replacing the lost body condition.
5. Stress produced by the primary disease reduces the animals resistance to other diseases.
6. Cost of treatment.

7. Increased labour costs and reduced efficiency of personnel involved in treating the disease.
8. Increased deaths and premature culling.
9. Increased feed costs per unit of production.

There are 200 health codes that may be entered into the health records for an individual cow. To avoid being confused with listings of the numbers of cows with each of these codes, they have been grouped for the performance monitor page. Only the disease codes are dealt with, and they are displayed as the total number of entries of the code made, the number of cows involved and the percentage of the total herd affected. The total herd was chosen as the denominator because the seasonal calving pattern means that the difference between the number of cows and the number of parturitions for a given period is not sufficient to change the result in the performance monitor (figure 5.5).

The frequency of the conditions may be shown over variable time periods. The default is monthly, but this may be changed to weekly or to a user-defined period. This allows for versatility in analysis.

The general headings for the health problems occurring are listed as follows:

Calving difficulties

Postpartum infections

Metabolic problems

Mastitis

Lame cows

Other conditions

Demographics

This section of the performance monitor gives the number of cows in the milking herd, the number dry, and the number sold or died in each of the time periods displayed. The totals to date for the season, on the date of the report are also displayed. It is important to be aware of the loss rate from the herd and the effect this may have on other measurements for the herd. If for example a high number of cows were culled for infertility the calving to conception interval may be shorter than if the farmer were to keep the cows longer and continue to mate them. This emphasises the importance of not viewing performance measures in isolation (figure 5.6).

With an average number of involuntary culls (14%) and an average replacement rate (21%) up to 7% of the herd may be culled because of low production, unsuitable temperament, milking characteristics or old age (voluntary culling). If however the number of empty cows is high (10%), or very high, then voluntary culling is restricted to about 4%. An important point is that if replacement rate is high (27%), because of high numbers of empty cows and high disease losses, then some of the benefits of a high replacement rate are reduced and a high replacement rate becomes an expensive practice (Macmillan and Murray, 1974).

Production Summary

From the herd production data and the knowledge of the number cows in milk for each of the time periods, the production characteristics for the herd can be calculated. A summary of the production details is displayed on the performance monitor. Each of the components of production (milk volume in litres, milk fat and protein) are shown as total daily herd production, total per cow per day, and total per hectare per day. This allows the productivity of the herd to be monitored and compared with neighbouring herds (figure 5.7).

Summary

The performance monitor aims to produce a single page report covering the critical areas of reproduction, health and production. This allows the user to assess how the enterprise is performing in each of these areas. It is important that the targets chosen are at an optimum level economically for the enterprise in question. The performance monitor should have enough information to convey accurately what is happening in the herd, but it is not intended that it be used as a diagnostic report.

BURNETT COW HEALTH SUMMARY 12/04/88
Spring herd
monthly periods for last six periods

	Oct		Nov	Dec	Jan	Feb	Mar	Total	
Calving difficulties								6	3%
Postpartum infections	9	5%	1					15	7%
Metabolic problems	1							4	2%
Mastitis	1							4	2%
Lame cows	1		1					10	5%
Other conditions	3	2%					1	6	3%

Figure 5.5 Health performance indicators.

BURNETT — COW DEMOGRAPHIC SUMMARY — 12/04/88

Spring herd

monthly periods for last six periods

	Oct	Nov	Dec	Jan	Feb	Mar	Total	
Total herd	198	198	198	182	173	173		
Cows in milk	198	198	198	182	173	173		
Cows dry								
Cows sold				20	5		28	14%
Cows died	1						3	1%
Purchases							13	

Figure 5.6 Demographic performance indicators.

BURNETT — COW PRODUCTION SUMMARY — 12/04/88

Spring herd

for the last six periods entered

	9 Feb	20 Feb	28 Feb	9 Mar	20 Mar	31 Mar	Total
Cows in milk	173	173	173	173	173	173	190
litres/day	1917	1561	1664	1603	1337	1741	580873
litres/cow/day	11.1	9.0	9.6	9.3	7.7	10.1	2934
litres/ha/day	22.3	18.2	19.4	18.6	15.5	20.2	6754
Kg mf/day	88	75	81	77	68	86	26527
Kg mf/cow/day	0.51	0.43	0.47	0.45	0.39	0.50	134
Kg mf/ha/day	1.02	0.87	0.94	0.90	0.79	1.00	308
Kg prot/day	65	52	57	56	46	60	232
Kg prot/cow/day	0.37	0.30	0.33	0.33	0.28	0.38	101
Kg prot/ha/day	0.75	0.60	0.67	0.65	0.57	0.76	232
BMSCC				291			212

Figure 5.7 Production performance indicators.

CHAPTER SIX

DairyMAN: DIAGNOSTIC REPORTS

INTRODUCTION

Herd productivity can be monitored using averages for indicators which have a high correlation with the optimum productivity for the herd. These indicators, discussed in Chapter five, have been termed "performance indicators" by Morris (1982). They are essential for routine monitoring, but alone not adequate for a complete analysis of either a health problem or reproductive performance. To fully identify a problem a detailed analysis of herd records needs to be done. Morris (1982) called the measures produced from such analyses "diagnostic indicators". They are based on the isolation of factors known to contribute to the herd performance, and the use of epidemiological techniques to investigate each of these factors (Morris, 1982; Stein, 1985; Weaver and Goodger, 1987a).

The timing of the onset of the problem as well as its extent and pattern of spread are important considerations when investigating a fertility problem. Relating the occurrence to location, age groups, families, sires, nutritional groups, and other cohort groups is critical to the solving of the problem. In order for this type of analysis to be carried out the data has to be in its original form, and not summarised into indices. Unless the full records are available, the detail of the analysis possible is very restricted.

ISSUES KNOWN TO INFLUENCE REPRODUCTIVE PERFORMANCE

Introduction

As already discussed it is vital for a calving interval of 12 months to be maintained, which means that a cow has only 83 days within which to recover from calving and become pregnant again. During this time the uterus must involute, normal cyclical ovarian activity must recommence, and an insemination must lead to pregnancy. The events that occur during this postpartum period are critical to the success of the breeding program. In seasonal dairy herds, cows are required to get in calf during the first 3 to 4 weeks of the mating period, irrespective of their postpartum interval. Under these circumstances postpartum events are even more critical to the success of the program (Macmillan, 1985a).

Conception Pattern

The herd conception pattern has previously been shown (Chapter two) to be closely related to the profitability of the herd. The conception pattern is in turn a reflection of when cows were inseminated in relation to the Planned Start Mating (PSM) date, what proportion of cows conceived to first or subsequent matings, and what was the interval between the matings. The pattern is a consequence of the interaction between the submission rate and the conception rate (Macmillan, 1985a).

Submission rates

Assuming that the herd uses artificial insemination, and/or supervised service by a bull, the percentage of cows submitted for service during the first 3 to 4 weeks of the breeding program is governed jointly by the percentage of cows in the herd which have returned to cyclical ovarian activity and the herdsman's ability to detect cows in oestrus and present them for service (Moller, 1978b; Williamson, 1987).

The percentage of cows cycling in the herd is going to be influenced by when the cows calved in relation to the PSM date, and the length of their postpartum anoestrus.

The previous calving pattern has an effect on the submission rate in the seasonal calving herd because the commencement of breeding is a decision made by the farmer and has little relationship to when each cow calves. The PSM date is usually 83 days after the planned start calving date. Once the herd commences breeding, all cows which exhibit oestrus (regardless of their previous calving date) are mated. The average interval to first recorded oestrus in New Zealand dairy cows is 47 to 50 days, so cows which calve later in the season are less likely to be cycling during the early part of the breeding season (Macmillan, 1985a).

Morris (1976) concluded that the major factors influencing the length of **postpartum anoestrus** after an uncomplicated calving are age, condition at calving, feeding level after calving, and suckling intensity.

Nutritional deficiencies are a common cause of prolonged postpartum anoestrus (Morris, 1976). McGowan (1981) reported that each additional unit of condition at calving will reduce the interval to first recorded oestrus by 6 days, irrespective of post calving feeding level. He also found that if daily **feed intakes after calving** were increased by 3 kilograms of pasture dry matter per day (up to a maximum of 15 kilograms of dry matter per cow per day) for the first five weeks of lactation postpartum anoestrus was reduced by 3 days irrespective of the cow's calving condition score.

Specific nutritional deficiencies of phosphorus, manganese, and copper have been reported by various authors to cause a lengthening of postpartum anoestrus (Morris, 1976; Weaver, 1987).

Age effects are generally limited to younger cows. First calf heifers have a postpartum interval 9 to 16 days longer than mature cows. The effects of prepartum and postpartum feeding are even more pronounced in the younger cows (two and three years old), than in older cows (de Kruif and Akabwai, 1978; Moller, 1978b).

Over a nine year period at the animal research station at Ruakura a breed effect was found. Adult Jersey cows had an average postpartum interval of 47 days, the average for the Friesian-cross adults was 50 days (Macmillan, 1985a). Other authors have reported no demonstrable breed effects on the interval from calving to first oestrus (Morant, 1984).

In the same trial as above (Macmillan, 1985a) the range of postpartum intervals over the nine year monitoring period varied from 37 days to 55 days. This was thought to reflect the different feeding levels for each season over the nine years. Erb and Smith (1987) in a brief review found that the time of year when calving takes place in year round herds "usually does not influence breeding performance". de Kruif and Brand (1978) suggest that in temperate regions fertility is higher in the spring than in the autumn and winter months, and in tropical regions fertility is higher in the rainy season when compared with the dry season.

McGowan (1981) in Victoria (Australia) showed that an increase in daily production of 0.2 kilograms of milk fat reduced the postpartum interval by 6 days.

Individual cows affected with periparturient diseases will often show a delayed return to oestrus after calving. This can be a problem in herds where there is a significant number of cows affected with this complaint (Morris, 1976; Erb and Smith, 1987). Dystocia, retained afterbirth and metritis will cause delays in the interval to first oestrus (Eddy, 1980; Morant, 1984).

In breeding programs using artificial insemination, the thoroughness of heat detection has a major role in influencing submission rates. The detection of oestrus has been identified repeatedly as the major factor reducing reproductive efficiency in many dairy herds (de Kruif and Brand, 1978; Esslemont and Ellis, 1974; Jensen, 1987; Macmillan, 1985e; Morris, 1976; Weaver and Goodger, 1987a; Williamson et al, 1972a; 1972b). Jensen (1987) found that the loss due to sub-optimal calving interval was best estimated by the "oestrus index". He found a correlation between the oestrus index and the calving interval of 0.63 and concluded that detection of oestrus was the major factor affecting reproductive performance.

Conception rates

Williamson (1987) divided the factors influencing conception rate into three functional areas; female factors, male factors and management practices.

Female factors that influence conception rates may also have an effect on submission rates, so one factor may influence the reproductive performance in two ways.

Various authors have reported that cows inseminated within 60 days of calving have a lower conception rate than cows inseminated more than 60 days from calving (Macmillan, 1985a; Weaver and Goodger, 1987a; Williamson, 1987). This is the result of two integrated factors; one is the time required for uterine involution and the second is the interval from calving to first oestrus, which in practical terms is recognised by the occurrence or absence of pre-mating heats. Macmillan (1985a) found that conception rates were lower at the first postpartum heat irrespective of the postpartum interval, and also that the interval from calving to first service reduced the conception rate if it was less than 40 days irrespective of whether there had been a pre-mating heat. The same work showed an improvement of seven percentage points in conception rate of cows which had experienced at least one pre-mating heat before being served.

A large New Zealand trial (Macmillan, 1985a) showed that the conception rates were not affected by condition at calving within the normal range of condition score of 4 to 6.5, in a range of 1 to 10. Below and above this range there was a decline in the conception rate at first service.

In general most nutritional factors which can cause anoestrus may also cause low conception rates (Erb and Smith, 1987; Radostits and Blood, 1985; Williamson, 1987). Morris (1976) hypothesised that there is a range of effects of nutritional deprivation, from anoestrus through suboestrus, weak oestrus, delayed ovulation, to normal cycling. At the less extreme end of the scale there will be no evidence of abnormality other than failure to conceive. The expression of the nutritional problem will also depend on when it occurs, either late or early after calving. If the feed deficit occurs 70 to 80 days after calving, only a low conception rate may result, if it occurs soon after calving it will also reduce the cycling rate (Morris, 1976). Specific nutritional deficiencies may also have an effect on conception rate.

de Kruif and Brand (1978) found that young cows and cows over seven years of age have lower conception rates than the other age groups. In the young cows this is thought to be due to the postpartum effect while in older cows it is due to the higher incidence of repeat breeding and embryonic loss.

Jersey cows were found to have a lower conception rate than Friesian or cross-bred cows (Macmillan, 1985a).

Bar-Anan et al (1985) showed in a study involving over 67,000 inseminations that on a within-herd basis, the change in daily milk yield during the month of insemination had a significant effect on conception rate. The genetic correlation coefficient between annual yield and conception rate was only 10% but it was 42% between lactational persistence (a measure of rate of decline in yield) and conception rate. Macmillan (1985f) suggested that these relationships between annual yield, lactational persistence and conception rate imply that lactational persistence could be regarded as a marker for the adaptability of an animal to lactational stress. The effects of milk yield on fertility are confusing and it is difficult to draw conclusive results (de Kruif and Brand, 1978; Erb and Smith, 1987).

The effect of parturient diseases on herd performance will depend upon the incidence of the problem. Their consequence on herd reproductive performance is significant, but may not be as important as the effect on herd wastage due to infertility (de Kruif and Brand, 1978; Erb and Smith, 1987; Radostits and Blood, 1985; Weaver and Goodger, 1987a; Williamson, 1987). Substantial increases in body condition in late pregnancy provide tissue reserves which can be mobilised to increase production in early lactation. Reid (1984) estimated that 30% of high yielding cows developed fatty infiltration of the liver as a consequence of rapid tissue mobilization and energy imbalance. In many herds in this study this resulted in a delay in the onset of postpartum ovarian activity, and hence caused reduced fertility. However, this is not a consistent finding (Morant, 1984). Pelisser (1976) reported that the incidence of retained placentae was 24% in cows with milk fever compared with 12% in herd mates. He also reported a reduction in conception rate of 12% in cows with retained placentae, similar findings were reported by Erb and Smith (1987). de Kruif and Brand (1978) suggested a similar effect on conception rate and also a higher percentage of cows culled for poor fertility.

Vibriosis and trichomoniasis will also produce a low conception rate problem, frequently with long interoestral intervals (Morris, 1976; Radostits and Blood, 1985; Williamson, 1987).

Male factors also play an important role in conception rates (de Kruif and Brand, 1978; Macmillan, 1985f; Williamson, 1982). Sire variation may be significant enough to cause a problem. Davidson and Farver (1980) classified 18 sires, whose semen was used in a large 2550 cow herd, into three categories; low (38.2%), medium (55.7%), and high (66.1%) conception rates. Cows inseminated with semen from the high conception rate sires had an average calving to conception interval of 85 days compared with 109 days for the low group sires. Semen costs were similar for each group yet the increase in number of days to conception associated with using semen from the low group sires was estimated to cost $75 per cow. The workers calculated that accurate information was only needed from 30 services to predict a sire's conception rate group. de kruif and Brand (1978) suggested there may be as high as 15 percentage points variation in conception rate between bulls used in artificial insemination. They found that natural service provided higher conception rates at both the first and subsequent services. However, Williamson et al (1978b) found little difference between natural service and artificial insemination.

Inseminator's ability is also a "male" factor that may affect conception rates (de Kruif and Brand, 1978; Macmillan, 1985f; Weaver and Goodger, 1987a; Williamson, 1987). The skill of the operator in placement of the semen, the training of the technician, the loss of concentration due to personal problems or poor facilities may lead to a variation of up to 5 to 10% in non-return rates between technicians (de Kruif and Brand, 1978). In a recent analysis of New Zealand Dairy Board data Visser et al (1988) found variation in technician performance to be second to herd factors in a list of variables affecting subsequent calving rates to first service using liquid semen.

Management factors may also affect the conception rate. The stage during oestrus at which insemination takes place was thought in early studies to affect conception rates enough to advise herdsmen not to submit cows for insemination until 8 hours after the cow was seen in heat (de

Kruif and Brand, 1978). This has subsequently been shown to be unnecessary when dealing with semen of average or good quality which is processed by modern techniques (Macmillan, 1985a). Even with semen of poor quality it may be better to inseminate a second time, if the cow is still on heat 8 hours after the first insemination. The herdsman rarely knows when the cow first came on heat so is not in position to judge what stage of oestrus the cow is in.

Cows which are not in oestrus when they are submitted for insemination will not conceive, so causing a reduction in the computed conception rate. These situations usually involve errors in identification or in diagnosis of oestrus, so that cows are inseminated at incorrect stages of their heat cycle (Macmillan, 1985f; Morris, 1976; Radostits and Blood, 1985; Weaver and Goodger, 1987a). The insemination of cows already in calf may have detrimental affects on the conception if this occurs within 21 days of the successful insemination, and the insemination procedure involves deep uterine penetration. Heat detection thoroughness and accuracy interact with conception rate. Low accuracy will yield low conception rates at any level of thoroughness, but low conception rates do not always indicate poor heat detection accuracy. High conception rates always indicate accurate heat detection. However they do not measure heat detection thoroughness. Excellent conception rates and heat detection thoroughness eliminate heat detection as a source of herd infertility (Weaver and Goodger, 1987a).

DIAGNOSTIC INDICATORS

The reproductive performance of herds can be broken down into a number of areas, and various performance indices relate to each of these areas. The calving interval, the proportion of cows calving in a defined period, and the proportion of cows culled for infertility are closely related to productivity but give no indication of the cause of infertility problems. Diagnostic information is provided by other indices, which can easily be derived from computer data (Williamson, 1982).

The structure of the diagnostic profiles developed within DairyMAN is based on factors known to influence reproductive performance. The epidemiological technique of cohort comparison is used to analyze the performance of epidemiologically valid cohorts within the herd. The performance of a cohort, selected because of a common "risk factor" of interest, is compared with those individuals not in the cohort (ie. the cohort of those animals which do not have the risk factor) to test the hypothesis that the group in question has a value for the index of interest which is sufficiently different from the remainder of the herd to be a cause for concern.

The Cohort Groups For The Diagnostic Reports

Age

This section is broken down into four age groupings; the two year old cows, the three year old cows, the four to eight year old cows and the nine or more years old cows. This grouping allows those cows most commonly affected as a group by reproductive problems (the two and three years old cows) to be compared with the older cows, without excessively complicating the analysis.

Calving date

The cows are divided into two groups, those that calved more than a chosen number of days before planned start of mating and those that calved less than or equal to the chosen number of days before planned start of mating. Age stratification of this cohort is possible in some of the functional areas of the diagnostic reports.

Health problem group

Presence of one of a defined group of health codes in the health record of a cow qualifies the cow for inclusion in this cohort. The codes are those involving parturient health problems. The group is then broken into four subgroups;

Calving problems

Parturient infections

Metabolic disorders

Inductions and abortions

Each group is a collection of health codes that are considered to qualify for the above subgroups. The facility exist to further choose or group cows on any of the individual health codes entered in the health records.

Sires used for service

Each of the sires used is compared against the rest of the herd in the non-return rate analysis. There is no limit on the number of possible sires.

Technicians used for artificial inseminations

Results for each of the technicians who carries out inseminations is compared against the remainder of the technicians used in the herd in the non-return rate analysis. There is no limit on the number of possible technicians.

Time of the mating in the breeding program relative to PSM

The non-return rate during user-defined time periods of the breeding season may be analyzed separately.

Diagnostic Profiles

The structure of the diagnostic profiles Is given below. Each of the functional areas Is listed and the cohort groups considered within each of the functional areas are given.

Performance Monitor

Summary

Cohorts Age groups

Calving date

Health problem groups

The report produces similar measures of performance to the reproductive section of the performance monitor. The difference is that the cohort groups are analyzed separately. This produces a structured diagnostic report summarising the performance of the cohort groups within the herd (figure 6.1).

BURNETT REPRODUCTIVE PERFORMANCE MONITOR 12/04/88

Age Stratification - Spring Herd

Days since PSM = 175

Planned start calving: Heifers 21/ 7/87 Adults 31/ 7/87

Age cohorts	2yr	3yr	4-8yr	9+yr	total	targets
Cows to calve	51	46	90	15	202	
Cows calved	47	47	90	14	198	
4 week Calving Rate	82%	60%	69%	79%	74%	66%
8 week Calving Rate	100%	91%	91%	100%	94%	90%
Percent Induced	28%	28%	7%	20%		
Percent Aborted						
Cows to be mated	45	45	86	13	189	
Cows yet to be mated						
21 day Submission Rate	93%	89%	90%	100%	91%	90%
28 day Submission Rate	98%	91%	93%	100%	94%	92%
First Service 42 day NRR	67%	60%	66%	77%	68%	62%
Total Service 42 day NRR	69%	69%	68%	65%	68%	62%
4 week Herd-in-calf Rate	73%	60%	70%	77%	69%	57%
8 week Herd-in-calf Rate	93%	82%	90%	85%	89%	86%
Percent Empty	2%	4%			2%	7%

Planned start mating 22/10/87 Mating end 21/ 1/88 = 13.0 wks

Figure 6.1 Age cohorts in the reproductive performance monitor.

Previous Calving Analysis

Summary of births

Cohorts Calving rates

Total herd

Age groups

The summary of births gives the number of cows and heifers calved to date, and if the sex and fate of calves have been entered a summary of the numbers of males, females and unknown sex calves is given with their fates tabulated in a cross-sectional table. This table highlights calf losses within 48 hours of birth.

The calving rates are analyzed using the definition previously given in Chapter five. The reports give the calving rate at the end of each week of the calving season, the total number of cows that calved during each of the weeks, and the total cows calved to date for the cohort group being considered. Also displayed is the number and percentage of abortions and inductions for each of the weeks. Space allows for only eleven weeks to be displayed in the report. Any calvings after this are added to the eleventh week column.

The age cohort groups are chosen to highlight the previous season's performance. The total herd is displayed in the summary and then broken into first calf heifers and adults for separate reports. The calving pattern of heifers is a reflection of their mating performance as yearlings and, unless artificial insemination was used in the yearlings, is a reflection of bodyweight in the heifers and bull soundness, and not subject to the same variables the adult herd was during the mating period of the previous season (Moller, 1978b). The adult herd may be analyzed in further depth by a breakdown into the standard age cohort groups.

BURNETT CALVING SUMMARY 17/ 4/88
Spring Herd

Planned start of calving: Adults = 31/ 7/87
Heifers = 24/ 7/87

Total number of adults calved = 151
Total number of heifers calved = 47

Total cows calved = 198

2

Calves born:

	Died	Bobbied	Sold	Reared	
Heifers	11	19	17	45	92
Bulls	15	3	77	1	96
Unknown	11				11
	37	22	94	46	199

Figure 6.2 Calving summary report.

BURNETT CALVING RATE 15/ 4/88
Spring Herd

Planned start of calving: Adults = 31/ 7/87 Heifers = 24/ 7/87

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total	7	28	34	46	28	11	8	8	16	10	2		
Cum total	7	35	69	115	143	154	162	170	186	196	198	198	
Cum %	3	17	34	57	71	78	82	86	94	99	100	100	
Targets			36 %		66 %		83 %		90 %		100 %		
Induced			2	10	13	1				3	2		20 %
Aborted													%

Figure 6.3 Calving rate report.

BURNETT — CALVING RATE : Adults — 15/ 4/88

Spring Herd

Planned start of calving: Adults = 31/ 7/87

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total	7	20	17	36	21	7	7	8	16	10	2		
Cum total	7	27	44	80	101	108	115	123	139	149	151	151	
Cum %	5	18	29	53	67	72	76	81	92	99	100	100	
Targets			36 %		66 %		83 %		90 %		100 %		
Induced			2	18	13	1				3	2		26 %
Aborted													%

Figure 6.4 Adult calving rate report.

BURNETT — CALVING RATE : Heifers — 15/ 4/88

Spring Herd

Planned start of calving: Heifers = 24/ 7/87

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total		8	17	10	7	4	1						
Cum total		8	25	35	42	46	47	47	47	47	47	47	
Cum %		16	49	69	82	98	100	100	100	100	100	100	
Targets			40 %		68 %		84 %		90 %		100 %		
Induced													%
Aborted													%

Figure 6.5 First calf heifer calving rate report.

Pre-mating Heat Rates

Summary

Cohorts   Age groups

Calving dates

Health problem groups

The "pre-mating heat rate" is defined here as the percentage of animals in the herd which are to be mated and have been detected in oestrus before the planned start mating (PSM) date. The group of cows that had a pre-mating heat also have their first service non-return rate compared with the cows without a pre-mating heat entered. The report gives an early indication of the cycling activity of the herd, or efficiency of the herdsman in the detection of oestrus. Reproductive examinations of cows which have not exhibited oestrus are needed to differentiate between the two possibilities.

Unfortunately herdsman do not yet regularly record pre-mating heats, and if they do they often record the fact that a cow has cycled but do not record the date on which the heat was observed. This limits the usefulness of the data collected. The various cohorts may be investigated if it is found that the performance on the summary page is not up to target levels.

Submission Rates

Summary

Cohorts   Age groups

Calving date

Health problem groups

The summary page gives the submission rates at the end of each week of mating, the numbers of cows mated to date, and the number of first services occurring during each week. The number of cows in the current herd and the number of those mated is also displayed in the report. The cohort groups are as shown above.

Return Interval Analysis

Summary

Cohorts Service groups

In the summary the intervals between the first and second, and the second and third services are combined and displayed in a histogram. The shape of the histogram is used to determine the accuracy of the heat detection and the thoroughness of heat detection after service. The latter is quantified by calculating the ratio of single (18-24 day) returns to double (38-45 day) returns. A target of above 6:1 is considered satisfactory, a value below 4:1 is indicative of a problem. The accuracy of detection is determined by the percentage of returns to service which occur outside the normal range of 18 to 24 days. One-day returns are excluded from the calculation of percentage of returns in each of the categories shown.

The service report displays separately the intervals between each of the following heats recorded; the interval between the last pre-mating heat and the first service, the interval between the first and second and the second and third services. The first group mentioned gives an early indication of the heat detection efficiency in the herd while the final two service intervals portray the actual heat detection efficiency during the mating period.

BURNETT PREMATING HEAT ANALYSIS 17/ 4/88
Spring Herd

Planned start mating 22/10/87 | Days since PSM 178 | Cows to be mated at PSM 189

	Prevalence				First Service 42 day NRR			
	+PMH		-PMH		+PMH		-PMH	
	no.	%	no.	%	matings	NRR	matings	NRR
Total	150	79	39	21	149	70 %	38	55 %
Targets		85 %		15 %		62 %		62 %

Figure 6.6 Pre-mating heat rate report.

BURNETT SUBMISSION RATES 17/ 4/88
Spring Herd

Planned start mating 22/10/87 | Days since PSM 178 | Cows to be mated at PSM 189

No. in current herd 173
No. mated 173 = 100 %

Cows submitted for their first service during each week

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Weekly tot	50	67	37	6	4	1
Cum. tot	67	134	171	177	181	181
Cum %	35 %	71 %	91 %	94 %	96 %	97 %
Targets	30 %	60 %	90 %	92 %	96 %	100 %

Figure 6.7 Submission rate report.

```
BURNETT                RETURN INTERVAL ANALYSIS              15/ 4/88
                              Spring Herd
Days   Total     % |  5%  10%  15%  20%  25%  30%  35%  40%  45%  50%  Normal
-------------------|----+----+----+----+----+----+----+----+----+----+----+---
 1       5         |                                                  | 2
 2-7               |                                                  | 2
 8-10    4       4 |====                                              | 8
11-17    2       2 |==                                                | 3

18-19   30      32 |================================                  |14
20-21   35      37 |=====================================             |37
22-24    9      10 |==========                                        |18

25-31    2       2 |==                                                | 8
32-38    2       2 |==                                                | 7

39-45    2       2 |==                                                | 2

46-59    5       5 |=====                                             |
60-66              |                                                  |
67+      3       3 |===                                               |
-------------------+----+----+----+----+----+----+----+----+----+----+----+---
       Ratio 18-24 to 39-45 intervals = 37.0 :1  (target: > 6:1)
------------------------------------------------------------------------------
                                           Press any key to continue
```

Figure 6.8 Return interval analysis - summary.

BURNETT — RETURN INTERVAL ANALYSIS — 15/ 4/88

Spring Herd

Days	PMH-S1	%	S1-S2	%	S2-S3	%	Total	%	Normal	
1	1	1	4	100	1	100	5	100	2	1
2-7	1	1							2	2-7
8-10	2	1	3	4	1	4	4	4	8	8-10
11-17	6	4	2	3			2	2	3	11-17
18-19	26	17	20	29	10	40	30	32	14	18-19
20-21	60	40	25	36	10	40	35	37	37	20-21
22-24	36	24	8	12	1	4	9	10	18	22-24
25-31	5	3	1	1	1	4	2	2	8	25-31
32-38	1	1	2	3			2	2	7	32-38
39-45	7	5	2	3			2	2	2	39-45
46-59	2	1	3	4	2	8	5	5		46-59
60-66	3	2								60-66
67+	2	1	3	4			3	3		67+
Ratios	17.4		26.5		0.0		37.0		> 6.0	

Press any key to continue

Figure 6.9 Return interval analysis - service cohorts.

Non-return Rates

Cohorts Service

Age groups

Sire

Technician

Time of mating relative to PSM

Calving date

Pre-mating heat occurrence

Health problem group

The non-return rates are calculated using the formula described in Chapter five. In each of the cohort groups the first service non-return rate and the total service non-return rate is reported. The first service non-return rate is useful as it is not subject to alteration by a few infertile cows repeatedly returning to service. The number of pregnancies per cow bred is shown for the service analysis.

One analysis not found in any other system is the 18-24 day non-return rate. This analysis is based on the usual non-return rate calculation procedure used elsewhere in the program, but considers only cows which either do not return (pregnancies) within the non-return rate period, or return 18 to 24 days after the insemination (returns). The 18-24 day non return rate effectively eliminates the short and long returns to service from the calculation so reducing the effect which heat detection accuracy has on the non-return rate. Because of the method of calculation the target must accordingly be higher than for other non-return rate estimates. The figure has proved useful in comparing cohorts selected on male factors, and determining the size of the effect which heat detection accuracy is having on the conception rate.

The extra cohort group termed "time frame analysis" allows the user to analyze the non-return rate for variable time periods over the mating season. This report has the first service, the total service and the 18-24 day non-return rate included in it.

BURNETT NON RETURN RATE ANALYSIS 17/ 4/88

Spring Herd

Days since PSM 178

Non Return Rate 42 days

2YR OLD COWS

	1st Service matings	NRR	2nd Service matings	NRR	3rd+ Service matings	NRR	Total matings	NRR	Services/ cows bred
2 year	45	67 %	16	69 %	6	83 %	67	69 %	1.49
Rest	143	68 %	54	69 %	21	71 %	218	68 %	1.52
Targets		62 %		62 %		62 %		62 %	1.60

Figure 6.10 Non-return rate analysis - 2 year old cows.

BURNETT NON RETURN RATE ANALYSIS 17/ 4/88
Spring Herd
Days since PSM 178 SIRES Non Return Rate 42 days

Sire	1st Service matings	NRR	2nd Service matings	NRR	Total matings	NRR	18-24 d matings	NRR
Targets		62 %		62 %		62 %		72 %
83209	15	87 %	7	57 %	22	77 %	22	77 %
Rest	171	66 %	62	69 %	263	68 %	242	69 %
83283	15	60 %	6	83 %	23	65 %	22	68 %
Rest	171	68 %	63	67 %	262	69 %	242	70 %
83253	18	61 %	8	63 %	28	61 %	24	58 %
Rest	168	68 %	61	69 %	257	69 %	240	71 %
81221	31	58 %	16	69 %	48	60 %	43	60 %
Rest	155	70 %	53	68 %	237	70 %	221	71 %
83282	9	78 %		%	9	78 %	9	78 %
Rest	177	67 %	69	68 %	276	68 %	255	69 %

Press any key to continue

Figure 6.11 Non-return rate analysis - sires.

BURNETT NON RETURN RATE ANALYSIS 17/ 4/88
Spring Herd
Days since PSM 178 Non Return Rate 42 days

TIME FRAME ANALYSIS : BY 7 DAY PERIODS

First day of each period	1st Service matings	NRR	18-24 day matings	NRR	Total matings	NRR
Targets		62 %		72 %		62 %
22/10/87	50	68 %	47	70 %	50	68 %
29/10/87	67	63 %	63	62 %	69	64 %
5/11/87	37	70 %	40	72 %	44	70 %
12/11/87	6	67 %	24	67 %	24	67 %
19/11/87	4	100 %	22	68 %	25	68 %
26/11/87	1	100 %	11	55 %	11	55 %
3/12/87	2	50 %	12	67 %	13	69 %
10/12/87	1	100 %	10	80 %	10	80 %
17/12/87	1	100 %	5	100 %	5	100 %
24/12/87	1	100 %	3	67 %	5	40 %

Figure 6.12 Non-return rate analysis - time frame.

Herd-in-calf rate

Summary

Cohorts Age groups

Calving date

Health problem group

The rate at which (in farmer parlance) the herd "gets in calf" in relation to the planned start of mating is measured in this report. It demonstrates clearly the interaction between the submission rate and the conception rate. Because of the nature of the calculations, this report cannot be calculated until the breeding season is so far advanced that little can be done to rectify any problems. The report shows the percentage of the eligible herd that is known to be in calf at the end of each week, the number in calf to date and the number that became pregnant during each week. Also displayed is the number of cows in the current herd and the number of these cows in calf. The cohort group reports show a comparison between cows in the group and the cows not in the group. This report is strictly a retrospective monitor report as it measures the outcome of the breeding period.

Predicted calving spread

Summary

Cohort Age groups

This report is very similar to the herd-in-calf rate report, the only difference is that the empty cows and those removed from the herd have been removed from the report. The denominator used to predict the calving rates in the report is the total cows predicted to calve rather than the total cows eligible to be in calf as is the case in the herd-in-calf report.

BURNETT HERD IN CALF RATE 17/ 4/88
Spring Herd

Planned start mating 22/10/87 Days since PSM 178 Cows to be mated at PSM 189

Current herd = 173 In calf = 172 : 99 %

Cows in calf by the end of week

	1	2	3	4	5	6	7	8	9	10
Wkly Total	33	39	29	16	15	6	8	8	4	2
Cum. Total	45	84	113	129	144	150	158	166	170	172
% of Herd	24 %	45 %	60 %	69 %	77 %	80 %	84 %	89 %	91 %	92 %
Targets		33 %		57 %		80 %		86 %		93 %

Figure 6.13 Herd-in-calf rate report.

BURNETT HERD IN CALF RATE : 3 year olds 17/ 4/88
Spring Herd

Planned start mating 22/10/87 Days since PSM 178 Cows to be mated at PSM 3yr: 45 Rest: 144

3 yr olds in current herd = 40 In calf = 39 : 97 %
Others in current herd = 133 In calf = 133 : 100 %

Cows in calf by the end of week

	1	2	3	4	5	6	7	8	9	10
3 yr	8	17	25	27	32	36	36	36	37	37
Rest	37	67	88	102	112	114	122	130	133	135
% 3 yr	18 %	38 %	56 %	60 %	71 %	82 %	82 %	82 %	84 %	84 %
% Rest	26 %	47 %	62 %	71 %	78 %	80 %	85 %	91 %	93 %	94 %
Targets		33 %		57 %		80 %		86 %		93 %

Figure 6.14 Herd-calf-rate - three year old cows.

```
BURNETT          PREDICTED CALVING SPREAD NEXT SEASON       17/ 4/88
                              Spring Herd
 Planned start of calving  adults : 30/ 7/88
                          heifers : 17/ 7/88

          Number of adults to calve          172
          Number of yearlings mated  52
                                             ====
          Total cows to calve
                                             ----
```

	Cows to calve during weeks												
	before PSCA	1	2	3	4	5	6	7	8	9	10	11+	date unkwn
Weekly no.	11	32	34	27	15	14	6	8	8	4	2	11	
Cum. tot	11	43	77	104	119	133	139	147	155	159	161	172	172
Yearlings													
Cum %	6	25	45	60	69	77	81	85	90	92	94	100	100
Targets			36 %		66 %		83 %		90 %		100 %		

Figure 6.15 Predicted calving rate report.

Cow fate analysis

Summary

Cohorts **Age groups**

Calving date

Health problem groups

With fixed breeding periods one of the major effects of poor performance in seasonal calving herds is an increase in the number of cows lost because of the involuntary culling of empty cows. The cow fate analysis is a chronological record of the herd, and its cohort groups, from calving until the end of lactation. The number of cows to calve is the initial starting figure, the percentage calved is a proportion of this figure. The number lost before start of mating gives an indication of loss rate due to parturient problems. Any purchases are added here to produce the number of cows to mate. Cows not to be mated are excluded from this group. The current reproductive status of the herd is listed next - giving the numbers of cows mated, the number assumed in calf, the number empty, and the number with unknown status (because they have either recently been mated, or left the herd before pregnancy could be assumed). The percentage figures use the "total to mate" as the denominator in the equations. The final section gives the number in the current herd and the number in calf. This is also able to be run for each of the cohort groups to determine the loss rate in each of the cohort groups.

```
BURNETT                    FATE SUMMARY                    17/ 4/88
                            Spring Herd
                        Days since PSM = 178

         COWS TO CALVE AT PSC :31/ 7/87        202
         Cows calved                           198   98 %
         Cows removed before PSM                 7
         Cows witheld from mating               10
         Purchases, new cows & carryovers        4
                                             ===========
         COWS TO MATE AT PSM  :22/10/87        189  100 %
                                             -----------
         Total cows mated                      188   99 %
         Cows in calf (asmd, cnfrm, rmvd)      183   97 %
         Cows empty (asmd, cnfrm, rmvd)          3    2 %
         Cows mated or rmvd within  42 days      3    2 %
         Cows unknown                                   %
                                             -----------
         Cows rmvd since PSM                    26
         Purchases & new cows
                                             ===========
         Cows in current herd                  173
         Cows in calf                          172   99 %

                                               Press any key to continue
```

Figure 6.16 Cow fate summary report.

BURNETT FATE SUMMARY 17/ 4/88
Spring Herd
Days since PSM = 178

	2 YR OLDS		REST	
COWS TO CALVE AT PSC :31/ 7/87	51		151	
Cows calved	47	92 %	151	100 %
Cows removed before PSM	5		9	
Cows witheld from mating	1		9	
Purchases, new cows & carryovers			4	
COWS TO MATE AT PSM :22/10/87	45	100 %	144	100 %
Total cows mated	44	98 %	144	100 %
Cows in calf (asmd, cnfrm, rmvd)	44	98 %	139	97 %
Cows empty (asmd, cnfrm, rmvd)	1	2 %	2	1 %
Cows mated or rmvd within 42days		%	3	2 %
Cows unknown		%		%
Cows removed since PSM	2		24	
Purchases & new cows				
Cows in current herd	44		129	
Cows in calf	44	100 %	128	99 %

Press any key to continue

Figure 6.17 Cow fate - two year old cows.

CHAPTER SEVEN

DairyMAN: HEALTH, PRODUCTION AND DEMOGRAPHIC REPORTS

HEALTH

Introduction

The successful control and prevention of diseases and causes of sub-optimal performance is dependent on an understanding of their aetiology and epidemiology. Although sporadic diseases such as salmonellosis may cause crippling losses on a single farm the overall impact of traditional diseases on the dairy industry is quite small (Radostits and Blood, 1985). Radostits and Blood (1985) reported that Australian national estimates of the average shortfall in production due to specific disease in dairy herds are for mastitis a loss of 6%, and diseases other than mastitis a loss of less than 1%, although individual farms may suffer higher losses.

The effects of disease on animal productivity are listed below;

1. Mortality -lost production
   -cost of replacements
2. Morbidity -lowered throughput for the same fixed costs
   -poorer feed conversion
   -longer time to reach market weight
   -failure to market at the most advantageous price
   -milk production at less favorable time of year
   -increased culling rate
   -slaughterhouse condemnations
   -increased accommodation required

Rowlands (1982) showed a negative effect of retained fetal membranes and ketosis on 305 day production figures for cows when their production for the affected lactation was compared with that in the previous season.

One of the benefits of a herd health program is that valuable information is continuously accumulated on all diseases which are recognised by either the farmer or his veterinarian. While the primary purpose is to facilitate prompt action to control emerging disease problems, it also provides valuable information on the incidence of clinical disease. It is generally accepted that farmers treat a large number of clinical diseases themselves. Morris et al (1978), at Melbourne, found that only 28% of diseases affecting the reproductive tract and udder, and 23% of other disease were treated by the farmer's veterinarian. Smith (1982), in England, reported an annual incidence of 25% of lameness in cows using the Dairy Herd Health and Production Service recording scheme compared with a 5.5% annual incidence of lameness reported by Russell (1982) using the number of cases treated by a veterinarian as the recording procedure.

The health analysis reports produced by DairyMAN are divided into two areas, cow health and herd health. This division is a result of the format in which information is stored in the data files.

Cow health

The cow health analysis is divided into six sections, similarly designed, each dealing with a section of the possible 200 codes entered from the DairyMAN code book (Appendices I - VI).

The divisions are as follows:

Disease codes

Treatment codes

Reproductive examination result codes

Management codes

Sample taken codes

Veterinary visit codes

In the seasonal calving herd the majority of cows in the herd are at the same stage of lactation. Because of this the information is recorded as rates per 100 cows present in the cow file for the season and herd in question. The population used for the denominator in these analyses is therefore the same for all diseases. This is in contrast to other workers (Williamson, 1987) who use denominators such as the "herd average" (the number of cow days in the period divided by the number of days in the period under consideration) for diseases occurring throughout lactation, and the number of new lactations initiated during the year as the denominator for diseases related to parturition. Williamson is strictly correct but because of the seasonal nature of dairy farming in New Zealand the figures used are appropriate.

The number of each of the disease codes recorded for the season to date, the number of cows affected with the condition, and the percentage of cows recorded with the entry are all reported on the cow health summary report (figure 7.1). The user may stratify the report by age to determine age-associated trends (figure 7.2).

Each of the remaining sections of the code book may be used for analysis in an similar manner to the disease codes.

The section on veterinary visit analysis is designed to evaluate the results of reproductive findings from farm visits. The user may select for analysis one of the visits or the total visits for the season to date. The reason each cow is visited is reported, and each visit reason has the results of the reproductive examinations tabulated and expressed as a percentage of the cows visited for each of the listed reasons (figure 7.3). This analysis is designed to aid the problem-solving aspect of the program, for example in determining the role which thoroughness of heat detection has in a low 21 day submission rate. The analysis will give the percentage of cows which were examined for "no visible oestrus" that were found to be cycling, and the percentage found to be in true anoestrus.

If, from the health code summary reports, a problem is seen to require further investigation, the code in question may be selected and investigated in isolation (figure 7.4).

The health code evaluation may be stratified by age (figure 7.5), analyzed by time (figure 7.6), or analyzed by days since calving that the event occurred (figure 7.7). A list of affected cows may be produced and sorted by number, by date of occurrence or by days since calving when the event occurred (figure 7.8).

The analysis by time is in monthly periods. It reports the number of cases for the month, the percentage of cows affected and the proportion of the cases that occurred during the month in question.

The analysis by days since calving is presented in 30 day intervals from the calving date for the affected cows.

Lists of affected animals contain the date of occurrence, days since calving, whether the diagnosis was made by the farmer or veterinarian, and comments entered with the health code.

The analyses are designed to highlight the emergence of clinical problems and enable them to be controlled promptly. The influence of meteorological changes, management changes or any other external influences may then be determined, and in combination with soundly based clinical reasoning a diagnosis may be reached.

Herd health

The information presented in this section of the program is used to advise on the control of herd diseases in the milking herd and in replacement stock on the property (figure 7.9).

Current vaccination programs are displayed, and from this they may be evaluated for correctness. This will also prompt the herdsman to administer booster vaccinations at the correct time (figure 7.10).

The results of tissue analysis and blood analyses for trace elements is also reported. The report first sorts the results into stock classes. The tissues and elements being analyzed are then sorted into like groups. This allows changes in levels of elements in different tissues to be monitored over time (figure 7.11). The results may then be interpreted in the light of the information presented in the report on trace element supplementation of the herds (figure 7.12).

Parasite control programs for young stock are reported and may be scrutinized in conjunction with knowledge of the weight gain performance of these animals. The data used is derived from the body weight and condition score reports, and also from the results of parasite monitoring procedures (figure 7.13).

Disease prevention procedures not covered elsewhere, such as bloat prevention and ectoparasite control programs, are reported in the section on disease prevention. Herd problems of the replacement stock are reported in the section covering herd disease (figure 7.14).

Drug sensitivities on bacteria isolated from milk samples are sorted and reported in chronological order, giving indications of possible drug resistance problems and changing trends over time (figure 7.15).

The information given in the various herd health reports are of little value in isolation, but if used collectively, in conjunction with a health program, they complete the information on management practices. Hence they enable the veterinarian to give more precise advice to the herdsman.

BURNETT	COW HEALTH SUMMARY Spring Herd		17/ 4/88	
Health code	Occurrence	Cows	% Herd	Percent of codes
Ret afterbirth	2	2	1 %	4 %
Vaginal disch	9	8	4 %	18 %
Vaginal injury	2	2	1 %	4 %
Cervix large	1	1	%	2 %
Metritis	3	2	1 %	6 %
Cystic ov	1	1	%	2 %
Assisted calv	6	6	3 %	12 %
Milk fever	3	3	1 %	6 %
Ketosis	1	1	%	2 %
No milk	1	1	%	2 %
Mastitis	4	4	2 %	8 %
Teat disease	1	1	%	2 %
Teat injury	2	2	1 %	4 %
Lame	10	9	4 %	20 %
Upper limb dis	1	1	%	2 %
Pneumonia	1	1	%	2 %
Scouring	1	1	%	2 %

Figure 7.1 Cow health summary report.

BURNETT	COW HEALTH SUMMARY Spring Herd					17/ 4/88
	2 YR OLD COWS			REMAINING HERD		
Health code	Occurrence	Cows	% Herd	Occurrence	Cows	% herd
Vaginal disch	2	2	4 %	7	6	4 %
Vaginal injury	1	1	2 %	1	1	1 %
Metritis	2	1	2 %	1	1	1 %
Assisted calv	5	5	10 %	1	1	1 %
Lame	3	3	6 %	7	6	4 %
Upper limb dis	1	1	2 %			%

Figure 7.2 Cow health report - 2 year old cows.

BURNETT — VET VISIT REPORT — 17/ 4/88

Spring Herd

Summary of all visits this season
111 total cows were visited

Visit Reason	Results	Total cows	
Pregnancy test		39	35 %
	Pregnant	38	97 %
	Empty	1	3 %
Prebreeding ex		17	15 %
	Vaginal injury	1	6 %
	Cervix large	1	6 %
	Speculum +ve	4	24 %
	Speculum -ve	11	65 %
Anoestrus		55	50 %
	Inactive ov	8	15 %
	Active ov	22	40 %
	Cycled ov	24	44 %
	Cystic ov	1	2 %

Figure 7.3 Veterinary visit report - summary.

17/ 4/88 — HEALTH CODE ANALYSIS — Farm: OCONNOR — 87/88

Current Herd Spring

Investigated Health Code Lame

[A] Age
[B] Occurrence by Time
[C] Occurrence by Days Since Calving
[D] Cow List

[X] Return to Health Analysis Menu

[Enter] Your Choice

Figure 7.4 Health code analysis menu.

BURNETT	COW HEALTH ANALYSIS Spring Herd	17/ 4/88

AGE

Health Code
Anoestrus

	Occurrence	Cows	% Herd
Total Herd	55	42	20 %
2 yr olds	8	7	14 %
Rest of Herd	47	35	23 %
3 yr olds	15	9	18 %
Rest of Herd	40	33	21 %
4-8 yr olds	32	26	29 %
Rest of Herd	23	16	14 %
9+ yr olds			%
Rest of Herd	55	42	22 %

Figure 7.5 Health code analysis - age stratification.

OCONNOR	COW HEALTH ANALYSIS Spring Herd	17/ 4/88

Health Code
Lame

Date

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
Occurence			25	21	19	15	2	3		2	3		90
% Total			28	23	21	17	2	3		2	3		
% Herd			8	7	6	5	1	1		1	1		305

Figure 7.6 Health code analysis - time.

OCONNOR COW HEALTH ANALYSIS 17/ 4/88

Spring Herd

Health Code

Lame

	Days since calving								
	-30 calve	calve -30	30 -60	60 -90	90 -120	120 -150	150 -180	others	total
Occurence	1	28	25	20	6	5		5	90
% Total	1	31	28	22	7	6		6	
% Herd		9	8	7	2	2		2	305

Figure 7.7 Health code analysis - days since calving.

OCONNOR HEALTH CODE ANALYSIS 17/ 4/88

Spring Herd Health code is Lame

Sorted by Cow number

Cow	Age	Date	DSC	Vet/Fmr	Comments
6		21/ 8/86	24	F	BL,STONE
6		27/ 9/86	61	F	LB LF BRUISING
6		18/10/86	82	F	
7		30/ 8/86	9	F	RF, SWOLLEN JOINT
12		23/10/86	90	F	FL, white line sep
12		23/10/86	90	F	FL, white line sep
20		22/10/86	74	F	BL, footrot
24		3/ 8/86	-20	F	LF ,FOOTROT
46		22/10/86	58	F	FL, stones
52		20/11/86	98	F	BR crack, abscess
54		22/10/86	12	F	BL, white line sep
55		3/ 8/86	13	F	FR,BR,STONE
55		12/ 9/86	53	F	ALL FEET,CRACKS
71		24/ 8/86	6	F	STONE
93		7/11/86	60	F	BL footrot
93		25/ 4/87	229	F	BL, white line sep
100		27/10/86	74	F	FR, footrot

Figure 7.8 Health code analysis - cow list.

17/ 4/88 **** HERD HEALTH **** Farm: OCONNOR 87/88

[A] LWt/CS
[B] Tissue Analysis
[C] Vaccinations
[D] Disease Prevention
[E] Drenching Dates
[F] Trace Element Supplementation
[G] Drug Sensitivities
[H] Herd Disease Problems

[X] Return to Main Menu

[Enter] Your Choice

Figure 7.9 Herd health reports menu.

OCONNOR HERD HEALTH - VACCINATIONS 17/ 4/88

Date	Class of Stock	V/F	Vaccine	Doses	S/B	Booster due
23-Apr	85hfrs	F	Lepto	62	B	29/ 6/88
17-Apr	86hfrs	F	Lepto	72	S	1/ 6/87
20-Apr	Cows	F	Lepto	250	B	29/ 6/88

Figure 7.10 Herd health - vaccinations.

MEYER TISSUE ANALYSIS- SUMMARY 17/ 4/88

Class of stock	Tissue	Element	Date	Mean	Units	V/F
Cows	Blood	GSH Px	16/10/86	4.60	katal	V
			21/11/86	3.60	katal	V
			12/12/86	3.27	katal	V
			17/ 2/87	1.60	katal	V
			16/ 3/87	2.10	katal	V
			24/ 4/87	1.73	katal	V
			19/ 5/87	4.57	katal	V
			26/ 6/87	10.60	ppm	V
			16/ 1/87	2.80	katal	V
	Liver	Copper	16/10/86	213.00	ppm	V
			21/11/86	198.80	ppm	V
			16/ 1/87	157.80	ppm	V
			16/ 3/87	158.80	ppm	V
			19/ 5/87	149.60	ppm	V
			26/ 6/87	266.80	ppm	V
	Serum	Copper	16/10/86	9.29	ppm	V
			22/ 5/86	10.63	ppm	V

Figure 7.11 Herd health - tissue analysis.

BURNETT TRACE ELEMENTS - SUPPLEMENTATION 17/ 4/88

Date	Class of Stock	V/F	Number	Product	Dose
29-Sep	86hfrs	F	52	Coprin	2 mls
21-Oct	86hfrs	F	52	Sehypo	5 mls
26-Jun	86hfrs	F	52	Sehypo	2 mls
21-Dec	86hfrs	F	52	Sehypo	4mls
21-Dec	87hfrs	F	50	Selenium	in drench
11-Apr	87hfrs	F	43	Se hypo	2.5 mls
2-Oct	Cows	F	200	Coprin	2 mls
2-Aug	Cows	F	200	Sehypo	5 mls
21-Dec	Cows	F	199	Sehypo	5mls

Figure 7.12 Herd health - trace element supplementation.

BURNETT INTERNAL PARASITES - DRENCHING RECORD 17/ 4/88

Date	Class of Stock	No.	Drench	Management	Days between drenches
25-Jun	86hfrs	50	Ivomec 5mls		
19-Sep	86hfrs	52	Ivomec		86
11-Jan	86hfrs	50	Ivomec 4mls		114
24-Nov	87hfrs	50	Ivomec	2-3 day shifts	
21-Dec	87hfrs	50	Nilverm		27
7-Feb	87hfrs	50	lvomec 3mls		48
20-Mar	87hfrs	43	4 mls lvomec		42
11-Apr	87hfrs	43	4 mls lvomec		22

Figure 7.13 Herd health - drenching report.

BURNETT HERD HEALTH - DISEASE DIAGNOSIS 17/ 4/88

Date	Class of Stock	V/F	Disease	Affected	Deaths	Confirmation
23-Feb	86hfrs	V	preg test empty	2		22,11
23-Feb	86hfrs	V	50,24,5, aborted	3		clinical
3-Apr	86hfrs	F	abortion	1		8643 - fmr
21-Sep	87hfrs	F	scour (31,33)		2	farmer
27-Sep	87hfrs	F	calf 29		1	farmer
19-Oct	bull	V	lame	1		vet

Figure 7.14 Herd health - herd disease report.

BENNEVIS DRUG SENSITIVITY RESULTS FOR MILK 17/ 4/88
S = sensitive, MS = moderately sensitive, R = resistant

Date	Bacteria	Antibiotic - Result						
27-Mar	S.aureus	pen	neo	str	novo	ceph	meth	
		R	S	S	S	S	S	
27-Mar	S.aureus	pen	neo	str	novo	ceph	meth	
		S	S	S	S	S	S	
27-Mar	S.aureus	pen	neo	str	novo	ceph	meth	
		S	S	S	S	S	S	
27-Mar	S.aureus	pen	neo	str	novo	ceph	meth	
		S	S	S	S	S	S	
27-Mar	S.aureus	pen	neo	str	novo	ceph	meth	
		S	S	S	S	S	S	
27-Mar	S.aureus	pen	neo	str	novo	ceph	meth	
		R	S	S	S	S	S	
27-Mar	S.dysgal	pen	neo	str	novo	ceph	meth	
		S	S	S	S	S	S	
27-Mar	S.uberis	pen	neo	str	novo	ceph	meth	
		S	S	S	S	S	S	
29-Sep	Strep sp	PEN	STR	TET	NEO	SUL	TRIM	NOV
		S	M	S	S	S	S	S

Herd health 7.15 Herd health - drug sensitivity report.

PRODUCTION

Production information is available from the factory production sheets. This, combined with the knowledge of the numbers of cows in milk on each day of the season, allows the production per cow per day, per hectare per day and total output per day to be calculated. The production reports give the total production to date for each of the measured milk components (volume, milk fat and protein) produced (figure 7.16). The components are also separated into three different reports giving the production per cow, per hectare and total output per day (figures 7.17, 7.18 and 7.19). This allows comparisons to be made between years and between farms. It is also useful in giving an indirect measure of the feeding levels of the herd at various stages of lactation and assessing the suitability of the calving pattern to the feed available. If the performance is seen to be increasing, between year comparisons of production (or between farm comparisons) can be a very powerful incentive for the herdsman to continue with a health program. If the performance is not increasing investigation into the possible causes for failure to increase may be prompted.

Bulk milk somatic cell count information is presented, showing changes over time (figure 7.20). The value of this figure is limited because if a rise is detected it gives no indication of the cause of the rise - whether it is due to a few cows with high cell count or a large number of cows with moderate rises in cell count. Single counts are of little value, but when used as a monitor over time the bulk milk cell count does serve as a crude monitor of the level of mastitis in the herd.

BURNETT — HERD MILK PRODUCTION — Total to Date — 17/ 4/88

First collection date 1/ 8/87 Last collection date 10/ 4/88 253 days

Number of cows in milk = 198

	Total	per cow	per mha
Litres	595363	3007	6923
Butterfat	27273 kg	138	317
Av. Fat %	4.6		
Protein	20546 kg	104	239
Av. Protein %	3.5		

Figure 7.16 Herd production summary.

BURNETT HERD MILK PRODUCTION 17/ 4/88
Litres

Date	Total litres/day	Cows	litres/cow/d	litres/mha/d
10/ 8/87	248	65	3.81	2.88
20/ 8/87	1076	120	8.97	12.51
31/ 8/87	2171	153	14.19	25.24
10/ 9/87	2692	163	16.52	31.30
20/ 9/87	2851	179	15.93	33.15
30/ 9/87	3186	196	16.26	37.05
10/10/87	3323	199	16.70	38.64
20/10/87	3423	199	17.20	39.80
31/10/87	3486	198	17.61	40.54
10/11/87	3366	198	17.00	39.14
20/11/87	3176	198	16.04	36.93
30/11/87	3068	198	15.49	35.67
10/12/87	2857	198	14.43	33.22
20/12/87	2685	198	13.56	31.22
31/12/87	2690	198	13.59	31.28
10/ 1/88	2661	198	13.44	30.94
20/ 1/88	2241	188	11.92	26.06
31/ 1/88	2105	178	11.83	24.48

Figure 7.17 Herd production - volume.

BURNETT HERD MILK PRODUCTION 17/ 4/88
Butterfat

Date	Total fat/day	Cows	kg fat/cow/d	kg fat/mha/d
10/ 8/87	12	65	0.18	0.13
20/ 8/87	49	120	0.41	0.58
31/ 8/87	96	153	0.63	1.12
10/ 9/87	118	163	0.73	1.38
20/ 9/87	124	179	0.69	1.44
30/ 9/87	138	196	0.71	1.61
10/10/87	146	199	0.73	1.70
20/10/87	154	199	0.78	1.80
31/10/87	157	198	0.79	1.82
10/11/87	154	198	0.78	1.79
20/11/87	148	198	0.75	1.72
30/11/87	143	198	0.72	1.66
10/12/87	129	198	0.65	1.50
20/12/87	122	198	0.62	1.42
31/12/87	123	198	0.62	1.43
10/ 1/88	120	198	0.61	1.40
20/ 1/88	103	188	0.55	1.20
31/ 1/88	96	178	0.54	1.12

Figure 7.18 Herd production - milk fat.

BURNETT HERD MILK PRODUCTION 17/ 4/88
Protein

Date	Total protein/day	Cows	kg protein/cow/d	kg protein/mha/d
10/ 8/87	10	65	0.15	0.12
20/ 8/87	40	120	0.34	0.47
31/ 8/87	78	153	0.51	0.91
10/ 9/87	94	163	0.58	1.10
20/ 9/87	99	179	0.55	1.15
30/ 9/87	110	196	0.56	1.27
10/10/87	111	199	0.56	1.29
20/10/87	116	199	0.58	1.35
31/10/87	120	198	0.61	1.40
10/11/87	118	198	0.60	1.37
20/11/87	110	198	0.55	1.28
30/11/87	106	198	0.53	1.23
10/12/87	96	198	0.48	1.12
20/12/87	90	198	0.45	1.04
31/12/87	91	198	0.46	1.06
10/ 1/88	89	198	0.45	1.04
20/ 1/88	74	188	0.39	0.86
31/ 1/88	70	178	0.39	0.82

Figure 7.19 Herd production - protein.

BURNETT HERD MILK PRODUCTION 17/ 4/88
Factory Sheets

Date	Cows	Litres	Butterfat	Av %	Protein	Av %	BMSCC
10/ 8/87	65	2230	104	4.6	90	4.0	0.0
20/ 8/87	120	10760	495	4.6	405	3.8	0.0
31/ 8/87	153	23880	1060	4.4	857	3.6	189.0
10/ 9/87	163	26920	1184	4.4	942	3.5	0.0
20/ 9/87	179	28510	1240	4.3	986	3.5	196.0
30/ 9/87	196	31860	1383	4.3	1096	3.4	0.0
10/10/87	199	33230	1459	4.4	1107	3.3	168.0
20/10/87	199	34230	1544	4.5	1160	3.4	0.0
31/10/87	198	38350	1726	4.5	1323	3.4	0.0
10/11/87	198	33660	1538	4.6	1181	3.5	209.0
20/11/87	198	31760	1483	4.7	1099	3.5	0.0
30/11/87	198	30680	1430	4.7	1055	3.4	0.0
10/12/87	198	28570	1291	4.5	960	3.4	181.0
20/12/87	198	26850	1222	4.5	897	3.3	0.0
31/12/87	198	29590	1355	4.6	1000	3.4	0.0
10/ 1/88	198	26610	1200	4.5	894	3.4	0.0
20/ 1/88	188	22410	1031	4.6	742	3.3	247.0
31/ 1/88	178	23160	1058	4.6	771	3.3	0.0

Figure 7.20 Herd production - factory sheets.

DEMOGRAPHICS

Demography is the science of vital and social statistics of populations. It is important to be aware of the wastage rate in the milking herd as this can disguise the effect of poor reproductive performance, curtail genetic progress and decrease the herd's potential for production.

Stock on hand

The stocking rate for the farm (including all classes of stock which are grazed on available land) is calculated to indicate the current carrying level of the farm (figure 7.21). The effective grazing area excludes any area used by buildings, raceways and hedges. Each of the stock classes is assigned a stock unit value (1 stock unit is equivalent to one ewe) and the values are totaled to give the total stock units carried on the property. The total stock units is divided by 7.5 to give the equivalent number of adult cows per hectare if all stock carried were in this category (1 cross-bred cow equals 7.5 stock units). Also reported is the total adult cows in the herd divided by the milking area.

The change in stock numbers since the beginning of the season which has occurred as a result of births, purchases, deaths, and sales is shown. It is used to calculate the current stock on hand at the report date, and the change over time since the start of the season (figure 7.22).

Herd profile

This report gives the current status of the milking herd, the number on hand, the number lost since the start of the season, and the lactational and reproductive status of animals in the herd. Numbers are given in each group in a cross-sectional array. This allows the state of the herd to be viewed at a glance (figure 7.23).

An age profile gives the age structure of the herd and the breeding and production indices for each age group. The age groups have been broken into "age in years" categories (figure 7.24). This is a useful report as it gives an indication of past wastage rates in each age group; when combined with knowledge of the replacement rates for each year. Poor reproductive performance may lead to a high level of culling in the first calf heifers for that season. This shows up as an under-representation of the age group (those cows that were first calf heifers during the problem year) in the age structure of the herd. The breeding indices gradual increase as age decreases indicates consistent recording of births and good genetic progress. If the breeding indices suddenly increase as the age decreases it may mean that recording has only recently been undertaken with any conviction, this is often apparent in herds recently purchased by a new owner.

```
BURNETT                      INITIAL STOCK CARRIED                 17/ 4/88
                                   1987
      Class of Stock        No.    Stock Units   % of Milking Herd

      Dairy
      87 Calves              0          0.0
      86 Heifers            52        234.0            37 %
      85 Heifers            52        260.0            37 %
      Cows                 141       1198.5

      Adult Bulls            0          0.0

      Beef
      87 Calves              0          0.0
      86 born                0          0.0
      85 born                0          0.0
      Beef Cows              0          0.0
      Adult Steers           0          0.0

      Sheep/Goats            0          0.0
      Other Stock            0          0.0

      STOCKING RATE         1.9  DCE  / effective ha
                            1.6  Cows / milking ha
                                             Press any key to continue
```

Figure 7.21 Initial stocking rate.

BURNETT CURRENT STOCK 17/ 4/88

Class of Stock	Init Stk87	Purchases (Births)	Sales	Deaths	17-Apr
Dairy					
87 Calves	0	199	116	40	43
86 Heifers	52	0	0	0	52
85 Heifers	52	0	6	2	44
Cows	141	13	25	1	128
Bulls	0	0	0	0	0
Beef					
87 Calves	0	0	0	0	0
86 born	0	0	0	0	0
85 born	0	0	0	0	0
Beef Cows	0	0	0	0	0
Adult Steers	0	0	0	0	0
Sheep/Goats	0	0	0	0	0
Other Stock	0	8	0	0	0

Press any key to continue

Figure 7.22 Stock reconciliation.

BURNETT HERD PROFILE 26/ 4/88
Spring Herd

Current Spring Herd = 153

	Total	Lact	Nurse	Dry	Unkwn	Died	Sold	Culls
		Current Status						
Total	206	153				3	5	45
Fertility Event								
Calved	2					2		
Aborted								
Heat	3					1		2
Mated	10							10
Non Return	146	120						26
Tested Pregnant	38	33						5
Tested Empty	1							1
Tested Unknown								
Unknown	6						5	1

Press any key to continue

Figure 7.23 Herd status report.

BURNETT HERD PROFILE Spring Herd 17/ 4/88

	Age (years) 2	3	4	5	6	7	8	9+	Total
Number	44	40	22	26	12	10	7	12	173
% of Herd	25 %	23 %	13 %	15 %	7 %	6 %	4 %	7 %	
Breeding Index : Production Index									
Average BI	117	117	112	108	103	104	103	104	112
Average PI	110	116	111	111	114	120	116	122	114

Figure 7.24 Herd profile.

Cow removals

Cows may be removed from the herd by one of three possible methods; death, sale for dairying or culling of unwanted animals. A summary of cow removals lists the three methods for removal and the numbers of cows removed by each method since the start of the season. The percentage value uses the total herd entered into the records file as the denominator in the equation (figure 7.25).

The "reason for removal" report lists the reasons cows were removed from the herd. The reasons are taken from the health code book and each cow listed may have up to three reasons for removal (figure 7.26) The total number of cows removed for each reason is given, together with the percentage of the herd and the number removed by each of the three methods (figure 7.27).

With the knowledge that the average removal rate in New Zealand dairy herds is 21%, and the percentage of involuntary losses is 14% of the herd, variations from these values can be investigated. Macmillan and Murray (1974) suggested the major influence on involuntary culling was the number of empty cows at the end of the breeding season, the culling of these and late calving cows may mask the effect of poor reproductive performance.

BURNETT COW REMOVAL 15/ 4/88

Spring Herd

Summary

Total Herd Entered	230	100 %
Deaths	10	4 %
Culls	79	34 %
Sold for dairying		%
Total Removed	89	39 %

Figure 7.25 Cow removal summary.

BURNETT COW REMOVAL 17/ 4/88
Spring Herd

Chronological Sort

Cow	Age	Date	Fate	Reason(s) for Removal
30	10	5/ 8/87	Died	Milk fever
147	2	6/ 8/87	Died	Assisted calv
250		25/ 8/87	Sold	Dairy
24	2	26/ 8/87	Sold	Dairy
68	2	26/ 8/87	Sold	Dairy
207	2	26/ 8/87	Sold	Dairy
221	2	26/ 8/87	Sold	Dairy
176	2	29/10/87	Died	Bloat
20	3	11/ 1/88	Culled	Pr temperament
45	3	11/ 1/88	Culled	Udder disease
125	3	11/ 1/88	Culled	Pneumonia
126	6	11/ 1/88	Culled	Udder disease
133	4	11/ 1/88	Culled	Mastitis
180	3	11/ 1/88	Culled	Slow milker
189	3	11/ 1/88	Culled	Udder disease
196	7	11/ 1/88	Culled	Slow milker

Figure 7.26 Cow removal list.

BURNETT COW REMOVAL 15/ 4/88
Spring Herd

A cow may be removed for more than one reason.
This summary totals all the entries made for each reason for removal.

Reason Removed	Culls	Deaths	Sold	Total	% of herd
Empty	29			29	13 %
Test unknown	2	1		3	1 %
Uterus abnorm	2			2	1 %
Abortion	1			1	%
Assisted calv		4		4	2 %
Downer cow		1		1	%
Mastitis	11	1		12	5 %
Udder disease	1			1	%
Lame	1			1	%
Upper limb dis	1			1	%
Injury		1		1	%
Facial eczema		5		5	2 %
Old age	2			2	1 %
Slow milker	4			4	2 %
Low Production	26			26	11 %

Figure 7.27 Cow removal reasons report.

CHAPTER EIGHT

DairyMAN: MANAGEMENT AIDS

Introduction

The phases of herd management as discussed in Chapter five are;

1. Planning
2. Monitoring
3. Analysis
4. Evaluation
5. Decision-making
6. Support for action.

The production of management aids from the program helps to fulfil the final two steps of herd management, namely decision-making and support for action. The management aids help in the day-to-day running of the enterprise, releasing personnel from the manual chore of records analysis and cow selection to perform more productive tasks.

Regardless of whether they participate in herd health programs or not, most farmers periodically evaluate the performance of each cow by reviewing the cow's record or history card. They may then call their veterinarian to examine a cow if they believe that there is an abnormality in performance or that the cow requires an examination such as pregnancy diagnosis. The farmer may wish to make a decision about the future of the cow in the herd with respect to culling her, he may wish to determine when she is due to calve, when she is due to cycle, or when she is to be dried off. If there is a sale of cows for dairying purposes the history lists can serve as a source of information in the sales brochure.

As the average herd increases in size, the problem of record keeping also increases, and the cow history card system used successfully in a 20 cow herd may become difficult to operate in a herd of 200 to 400 cows.

There are three types of management aids produced from the program; cow histories, management guides, and veterinary visit lists.

COW HISTORIES

The cow histories may be produced at any stage during the lactation cycle. Depending on the list produced they may be an up-to-date list of the members of the herd showing current reproductive status and full event histories, or simply a one line per cow list of current members of the herd.

Report generation

The user can produce a report for the whole herd, or select the group of cows to be listed in the report by using a preprogrammed selection facility. Once the cows have been selected he may then chose the report format required from a list of possible reports or he may chose his own variables to include in the report (figure 8.1).

Once the report type is chosen there are various possible priorities by which the cows in the report are sorted (figure 8.2). There are up to two sorting priorities operating at one time. The report is then either viewed on the screen, written to a file or printed directly to a printer.

Report format

The range of report types is large, varying from simple one-line lists of herd members showing the cow herd number, age, and current status (figure 8.3), to full page histories of the cow, showing individual reproductive intervals and calculated figures for lactational performance (figure 8.4). There is also a range of report types between the two extremes.

```
17/ 4/88                 COW HISTORIES              Farm: BURNETT   87/88
                    **** LIST FORMAT MENU ****

[A]  Simple cow list                   [K]  Health event history
[B]  Cow details list                  [L]  Full event history
[C]  Cow sorted list
                                       [M]  Mastitis history-Clinical summary
[D]  Calving list                      [N]  Mastitis history-ISCC
[E]  Mating history                    [O]  Mastitis history-RMT
[F]  Reproductive intervals (S)
[G]  Reproductive intervals (Y)        [P]  Milk production summary
[H]  Reproductive history              [Q]  Herd test results

[I]  Cow summary                       [R]  Cow condition score
[J]  Full cow history                  [S]  Cow body weight

                                       [X]  Return to Herd Selection Menu

                  [Enter] Your Choice
```

Figure 8.1 Cow histories - format selection.

```
17/ 4/88                 COW HISTORIES              Farm: BURNETT   87/88
                   **** SORT PRIORITY MENU ****
                       (defaults to numeric)

                          [A]  Numeric

     [B]  Age                              [L]  First heat date
     [C]  Breed                            [M]  First service date
     [D]  Breeding index                   [N]  Predicted calving date
     [E]  Production index
                                           [O]  Last test litres
     [F]  Days in milk                     [P]  Last test milkfat
     [G]  Lactational status               [Q]  Last test protein
     [H]  Fertility status                 [R]  Last test ISCC

     [I]  Calf sire this calving           [S]  Geometric mean ISCC
     [J]  Due calving date this season     [T]  Last body weight
     [K]  Calving date this season         [U]  Last condition score

                       [Enter] Your Choice
```

Figure 8.2 Cow histories - sort priorities.

BURNETT SIMPLE COW LIST 17/ 4/88

Sorted by Age then Number

Cow no.	Age	Current Status		
120	2	Spring cow	Lactating	Non Return
121	2	Spring cow	Lactating	Non Return
131	2	Spring cow	Lactating	Non Return
132	2	Spring cow	Lactating	Test Prgnt
136	2	Spring cow	Lactating	Non Return
141	2	Spring cow	Lactating	Non Return
142	2	Spring cow	Lactating	Non Return
147	2	Spring cow	Died	Calved
150	2	Spring cow	Lactating	Non Return
154	2	Spring cow	Lactating	Non Return
156	2	Spring cow	Lactating	Non Return
157	2	Spring cow	Lactating	Non Return
163	2	Spring cow	Lactating	Non Return
164	2	Spring cow	Lactating	Test Prgnt
171	2	Spring cow	Lactating	Non Return
172	2	Spring cow	Lactating	Test Prgnt
173	2	Spring cow	Lactating	Non Return
176	2	Spring cow	Died	Heat
183	2	Spring cow	Lactating	Non Return
185	2	Spring cow	Lactating	Non Return

Figure 8.3 Cow histories - herd member list.


```
  BURNETT                              FULL COW HISTORY                     17/ 4/88

  33          8240    5yr   F    BI 104   PI   92 Spring cow  Lactating   Test Prgnt
PRODUCTION
Total litres to date....         ltrs       Days in milk............ 206
Total milk fat to date..         kg         Days dry................ 144
Total Protein to date...         kg         Days to calving......... 176

HEALTH                        curr   prev                             curr     prev
Lameness problems.......        0      0    Mastitis cases.........    0        0
Reproductive problems...        0           ISCC geometric mean....   86
Metabolic disorders.....        0           Dry cow therapy........             no
Miscellaneous disorders.        0           RMT positive qtrs......


REPRODUCTION
Calving interval........   375              Predicted calving interval..  382
Calving date............ 24/ 9/87           Predicted calving date...... 10/10/88
Previous calving date... 14/ 9/86           Predicted sire..............  NM
Calving to PSM..........   28               Calving to first heat.......  36
PSM to first service....    8               Calving to first service....  36
PSM to conception.......   72               Service 1 to conception.....  64
Total matings...........    4               Calving to conception....... 100

                                    Event History
     24/ 9/87    Calved          Heifer    Reared   calf id:        8749
     20/10/87    Health Vet      Visit     Anoestrus
                                 Repexam   Active ov           C3,RH2XLH,LI,RF10
                                 Treated   CIDR in
     27/10/87    Health Vet      Treated   CIDR out
                                 Treated   PMSG                400 iu Folligon
     30/10/87    Mated           Sire      83258               Technician   DWBL
     31/10/87    I.S.C.C.        47,000 cells/ml
     22/11/87    Mated           Sire      83283               Technician   DWBL
     13/12/87    Mated           Sire      NM
      2/ 1/88    Mated           Sire      NM
      9/ 1/88    I.S.C.C.        69,000 cells/ml
      5/ 3/88    I.S.C.C.        195,000 cells/ml
     12/ 4/88    Health Vet      Visit     Pregnancy test
                                 Repexam   Pregnant
```

Figure 8.4 Cow histories - full history.

MANAGEMENT GUIDES

The management guides are designed to aid in the day-to-day management of the cows in the herd. They alleviate the need to manually sift through records to obtain the desired information. The guides are of four types, each dealing with different areas of the cow's lactation cycle; calving guides, mating guides, drying off guides, and culling guides (figure 8.5).

```
17/ 4/88                                              Farm: BURNETT    87/88
                   **** COW MANAGEMENT GUIDES MENU ****

    CALVING GUIDES                            MATING GUIDES
    --------------                            -------------
[A] Cows to calve next season             [J] Cows due to cycle
[B] Cows due to calve (detailed list)     [K] Cows not cycled
[C] Cows due to calve (daily summary)     [L] Cows not mated

[D] Calving guide selector                [M] Mating guide selector

    DRYING OFF GUIDES                         CULLING GUIDES
    -----------------                         --------------
[E] All remaining lactating cows          [N] All current cows
[F] Program selected cows                 [O] Program selected cows
[G] User selected cows                    [P] User selected cows

[H] Dry off guide selector                [Q] Culling guide selector
[I] Dry cow therapy selector              [R] Unused cow numbers

                                          [X]  Return to Main Menu

                         [Enter] Your Choice
```

Figure 8.5 Management guides.

Calving guides

Lists cows due to calve between two dates set by the user. Relevant information accompanies each cow in the list. The list may be sorted for convenience from the sort screen. The list types produced vary in format from simple daily listings of the herd numbers of the cows due to calve on each day (figure 8.6) to one line summaries containing information on parentage, due date, and past treatments at drying off, or calving problems the cow may have had at previous calvings (figure 8.7).

```
    SHOW1          SPRING COWS DUE TO CALVE 12/ 8/87 - 12/ 9/87       12/11/87
                                  DUE DATE ORDER

DATE                           COWS LISTED TO CALVE = 48

UKN HFRS
UKN COWS
OVER DUE
12/ 8/87
13/ 8/87   45  153
14/ 8/87   17  107  110  128  179  192
15/ 8/87   44   81  119  184  188  213
16/ 8/87
17/ 8/87   77  129  137
18/ 8/87   47  100  162  196
19/ 8/87  104  130
20/ 8/87  155  166  234
21/ 8/87  135
22/ 8/87
23/ 8/87
24/ 8/87    4
25/ 8/87    8   87  101
26/ 8/87
```

Figure 8.6 Daily calving guide.

BURNETT — SPRING COWS PREDICTED TO CALVE — 17/ 4/88
Planned Start 8/ 5/88 — Cows to Calve 172

Cow	Age	BI	PI	DCT	Health History	Sire	Due Date	Days
41	5	104	125	In Milk		83256	28/ 7/88	102
55	3	100	118	In Milk		83256	28/ 7/88	102
83	3	117	97	In Milk		83256	28/ 7/88	102
157	2	98	113	In Milk		83256	28/ 7/88	102
190	3	118	97	In Milk	I	83256	28/ 7/88	102
210	2	124	103	In Milk		83256	28/ 7/88	102
228	2	114	97	In Milk	Difclv	83256	28/ 7/88	102
11	4	102	109	In Milk	I	83253	29/ 7/88	103
78	3	119	95	In Milk		83253	29/ 7/88	103
107	5	116	115	In Milk		83253	29/ 7/88	103
132	2	100	107	In Milk		83253	29/ 7/88	103
2	5	118	0	In Milk		82279	30/ 7/88	104
113	2	120	103	In Milk		82279	30/ 7/88	104
141	2	118	119	In Milk		82279	30/ 7/88	104
148	12	97	117	In Milk		82279	30/ 7/88	104
158	4	119	120	In Milk	I	82279	30/ 7/88	104
188	7	106	117	In Milk		82279	30/ 7/88	104
65	5	118	112	In Milk	I	83283	31/ 7/88	105
162	3	121	134	In Milk		83283	31/ 7/88	105
1	3	0	103	In Milk		82252	1/ 8/88	106

Figure 8.7 Cows to calve list.

Mating guides

Mating guide lists are of three types; cows due to cycle, cows calved x days and not yet cycled, and cows calved x days and not yet mated.

The "cows due to cycle" list is based on heat date entries over the previous 21 days. The report produces a list of cows due to cycle for up to the next 21 days (figure 8.8).

The "cows not cycled or mated" list is based on the cows which have calved x days but have not yet cycled or been mated. The list is a modification of one of the veterinary visit lists, but is designed to bring to the herdsman's attention to the anoestrous cows. The lists contains information on the previous calving date and results of any reproductive examination performed to date (figure 8.9).

BENNEVIS SPRING COWS DUE TO CYCLE 23/11/87 - 3/12/87 12/11/87

DATE	COWS DUE TO CYCLE						
23/11/87							
24/11/87	172	179					
25/11/87	27	102	181				
26/11/87	136	144	180	194			
27/11/87	1	127	138				
28/11/87	3	57	64	84	131		
29/11/87	10	20	103	118	176	177	189
30/11/87	145						
1/12/87	101	122	166				
2/12/87	109	173	196				
3/12/87	55	83	107				

Figure 8.8 Cows due to cycle.

SHOW3 AUTUMN COWS NOT YET MATED AND CALVED ge 0 DAYS 28/ 4/88

Cow	Age	PI	Calved	d	Heats	Last heat	d	Examined	Result
32	2	0	9/ 4/87	385	0			10-Jun	INACTI
54	5	99	9/ 4/87	385	0			1-Jul	INACTI
61	2	0	6/ 4/87	388	0			1-Jul	INACTI
74	2	0	28/ 3/87	397	0			1-Jul	ACTIVE
76	7	100	14/ 5/87	350 I	0			10-Jun	INACTI
139	4	113	6/ 4/87	388	0			1-Jul	INACTI
213	7	115	3/ 5/87	361	0			1-Jul	ACTIVE
296	5	111	16/ 6/87	317	0			1-Jul	NSF
299	2	0	4/ 4/87	390	0			8-Jul	METRIT

Figure 8.9 Cows not mated.

Drying off guides

In seasonal calving herds cows are generally dried off in batches. The factors that determine when cows are dried off are the amount of feed on hand and expected feed supply in the short term, cow condition, and the level of milk production. Once a decision has been made to dry cows off the drying off guide is will aid in the selection of these cows. The whole lactating herd may be listed or a selection program can list only those cows that comply with a set of inclusion rules set by the user (figures 8.10 and 8.11).

An option also exists to aid in the selecting cows for drying off therapy with intramammary antibiotics, as part of a mastitis control program. The selection program can be set at different selection intensities based on cases of clinical mastitis, records of individual somatic cell counts, or results from rapid mastitis tests carried out during lactation (figure 8.12).

```
17/ 4/88            DRYING OFF GUIDE SELECTOR          Farm: BURNETT    87/88
 Selection criteria for cows to be dried off   ge  17/ 4/88   le  17/ 5/88
  Y/N
  Y   To meet the required dry spell before calving of......  60  days
  N   Cows with a current lactation lenth.................ge 320  days
  N   Cows with a current Production index................le  95
  N   On Production index the lowest........................  10  %
  Y   Cows at their last herd test producing..............le   5  litres
  N   Cows at their last herd test producing..............le 0.40 kg milkfat
  Y   Cows with their last condition score................le 3.00
  Y   Cows on the Cull Guide.................................
  N   Cows due for Dry Cow Therapy at drying off............
                                            RETURN to enter data, ESC to ignore,
```

Figure 8.10 Drying off guide - selection criteria.

BURNETT DRYING OFF GUIDE FOR LACTATING SPRING COWS 17/ 4/88

				LAST HERD TEST		CALVING		MASTITIS		For	On Cull
Cow	Age	PI	DIM	litres	mfat	Due date	Days	ISCC	cases	DCT	Guide
1	3	103	234	0.0	0.00	1/ 8/88	106	237		No	No
2	5	0	258	0.0	0.00	30/ 7/88	104	48		No	No
3	3	129	244	0.0	0.00	10/ 8/88	115	122		No	No
4	6	102	242	0.0	0.00	18/ 8/88	123	198		No	No
5	7	118	226	0.0	0.00	7/ 8/88	112	236		No	No
6	5	121	258	0.0	0.00	4/ 8/88	109	1012		Yes	Yes
7	4	129	234	0.0	0.00	7/ 8/88	112	147		No	No
8	4	105	239	0.0	0.00	4/ 8/88	109	180		No	No
9	5	126	212	0.0	0.00	25/ 8/88	130	262		Yes	No
10	3	122	211	0.0	0.00	6/ 8/88	111	78		No	No
11	4	109	247	0.0	0.00	29/ 7/88	103	175		No	No
12	3	127	220	0.0	0.00	31/ 8/88	136	109		No	No
14	5	112	260	0.0	0.00	3/ 8/88	108	156		No	No
15	3	115	262	0.0	0.00	5/ 8/88	110	102		No	No
16	7	112	210	0.0	0.00	16/ 8/88	121	143		No	No
17	3	129	246	0.0	0.00	14/ 8/88	119	212		No	No
18	5	101	218	0.0	0.00	26/ 8/88	131	291		Yes	Yes
21	7	122	238	0.0	0.00	27/ 8/88	132	461		Yes	No

Figure 8.11 Drying off guide - cow list.

17/ 4/88 DRY COW THERAPY SELECTOR Farm: BURNETT 87/88

Clinical Mastitis

Y/N
Y Cows that had Clinical Mastitis cases........................ge 1

Individual Somatic Cell Counting

Threshold level 000 cells/ml

2 yr	3yr	4-8yr	9+ yr
250	250	250	250

[A] Cows with an ISCC Geometric mean above the Threshold level.
[B] Number of raw ISCC values above Threshold level.............ge 0

Rapid Mastitis Test

[C] Number of positive quarter results during the season........ge 2

Dry Cow Therapy selection method [A - C]: A

RETURN to enter data, ESC to ignore.

Figure 8.12 Drying off guide - dry cow therapy selector.

Culling guides

Information listed in the culling guide covers a production history, reproductive status and health history for the cows in the list (figure 8.13). This information may then be used to make culling decisions on the cows. The cows listed in the guide may comprise the whole herd or only cows that meet the preprogrammed selection criteria set by the user (figure 8.14).

BURNETT CULL GUIDE PROGRAM SELECTED SPRING COWS 17/ 4/88

				CALVING		MASTITIS		HEALTH HISTORY		
Cow	Age	BI	PI	Due date	day	ISCC	cases	INDUC1	CIDROU	LAME
83	3	117	97	28/ 7/88	102	195				
85	3	121	98	10/ 8/88	115	56		1		
89	6	108	116	1/ 9/88	137	520				
90	9	100	124	17/ 8/88	122	575				
93	2	118	98	22/ 8/88	127	81				
94	5	117	97	18/ 8/88	123	45			1	
98	0	121	110	29/ 9/88	165	118				
114	3	120	126	Tested empty		100				
115	4	105	97	21/ 9/88	157	236		1		
116	6	102	113	5/ 8/88	110	1085	1			
117	4	114	121	23/10/88	189	168		1		
129	10	108	121	12/ 8/88	117	649				
139	6	103	117	25/ 8/88	130	501				
148	12	97	117	30/ 7/88	104	768				1
150	2	116	109	1/10/88	167	38				
152	3	119	95	29/ 8/88	134	259				1
155	5	114	95	15/ 9/88	151	73		1	1	
156	2	121	101	1/ 9/88	137	94				

Figure 8.13 Culling guide - cow list.

```
17/ 4/88                 CULL GUIDE SELECTOR                Farm: BURNETT   87/88

 Y/N
  N    Cows with age.......................................ge 10 years

  Y    Cows with a current Production index................le 101
  N    Cows on Production index in the lowest...............  10  %

  Y    Cows empty and calved..(0 = all cows not in calf)...ge 100  days
  N    Cows due to calve after PSC by......................ge   0  days
  Y    Cows due to calve..................ge 25/ 9/88 ....le 31/10/88

  N    Cows that had Clinical Mastitis cases..............ge   3  cases
  Y    Cows with an ISCC Geometric mean....................ge  500 000 cells
  N    Cows with    2  or more raw ISCC values.............ge  750 000 cells

  N    Cows with occurrences of the Health code............INDUC1  ge  2 times
  N    Cows with occurrences of the Health code............CIDROU  ge  1 times
  N    Cows with occurrences of the Health code............LAME    ge  2 times
  N    Cows with occurrences of the Health code............        ge  0 times


                                          RETURN to enter data, ESC to ignore,
```

Figure 8.14 Culling guide - cow selection criteria.

VETERINARY VISIT LISTS

In order for the herd to achieve reproductive objectives consistent with optimal economic efficiency, each member of the herd must also achieve defined goals. The reproductive aims for individual cows are that they should:

1. Calve for the first time at approximately 24 to 28 months of age.
2. Continue to calve subsequently at annual intervals (ie. every 365 days).
3. Milk at an economical level for at least 305 days in each lactation.
4. Be sold for low milk production after completing five to seven lactations.

If the herd owner waited until the above targets were not being met by individuals in the herd, before he presented cows for examination, he would loose much of the possible gain to be made from early correction of problems. In order for a cow to meet the above targets she must commence cycling soon after calving, be detected in heat and conceive in the first four to six weeks of the breeding program. The factors known to affect this performance have been discussed in Chapter six.

To enable the above targets to be met requires monitoring of the performance of individual members of the herd. When a cow fails to achieve a target she is examined to determine a reason, and is treated in the light of the examination findings. This type of program requires regular veterinary visits to the farm, the frequency depending on the herd size. These visits keep the herdsman's attention on the objectives to be met.

Cows are selected for veterinary examination for a number of reasons (Williamson, 1982):

1. they are at risk of not meeting performance objectives,
2. they fail to met performance targets,
3. they require routine examination, as for pregnancy diagnosis,
4. they show excessive variation from normal function.

As part of the reproductive program the veterinarian can formalise the monitoring of individual cow performance. The selection criteria for performance may be adjusted to best suit the management situation and the goals of the individual farmer. In the operation of the program a number of examination categories are defined based on the cow's reproductive cycle.

Late Calving Cows

Cows due to calve between two dates, cows overdue to calve by a define number of days may be selected to be examined. The former group may be selected for possible induction of calving procedures (figure 8.15).

Pre-breeding Examinations

Cows selected here may be all cows calved more than a defined number of days or cows that have experienced some abnormality near the time of calving. Cows showing discharge may also be included in this list of cows to be examined (figure 8.16).

No Visible Oestrus

Cows that have either not cycled or have not been detected in oestrus by a defined number of days since they cow calved are selected for the visit list. This examination is a useful one for confirming or refuting suggestions that heat detection inefficiency is playing a role in limiting reproductive performance (figure 8.17).

Nymphomania

Cows that have had a stated number of heats within a defined number of days are examined for evidence of ovarian follicular cysts (figure 8.18).

Failure To Conceive

Cows that fail to conceive after a defined number of services are selected for examination, although to date there is no appropriate means of treating the majority of cows in this category (figure 8.19).

Pregnancy Diagnosis

The number of days since service at which the veterinarian is confident of detecting pregnancy is first set, then a number of possible inclusion rules are activated depending on the management system of the enterprise.

Cows with no recorded service date but which have calved more than a defined number of days are listed. Cows with a return to service interval of greater than a defined number of days may be checked to determine which was the successful service. Cows with a heat recorded since their last service date may be listed. In fixed-length breeding seasons those cows mated after a certain date may be listed to check, as these cows may be selected for inductions next season. The final group that may be listed are those cows that were clinically abnormal during the breeding season but have not previously been tagged and listed (figure 8.20).

Revisit Cows

Cows that have been tagged with a "revisit flag" in the health records file are examined at the following veterinary visit. If the cow still has not met requirements she may be examined again at the next visit. It is possible to exclude cows if they have already been examined and it is found that further treatment will not be of benefit to the cow (figure 8.21).

New Cows

Cows recently purchased may be examined to check for current reproductive status (figure 8.22).

No Activity Cows

This selection procedure lists cows that have had no entries for a defined number of days. The purpose of this is to keep the records up to date rather than to check the cows for abnormalities. A common occurrence is that cows removed from the herd are not recorded as having left, and this tends to confound interpretation of reports (figure 8.23).

Visit Lists

Each of the above selection programs may be active or non-active at the user's discretion (figure 8.24). In year-round calving herds it is likely that all the programs will be operational, but in seasonal calving herds where all the cows are at a similar stage of lactation only a selected group of the programs need be operational at any particular time. The selection procedure begins with the first program and if a cow is selected it immediately moves on to the next cow, consequently the order in which the selection takes place is important, as this may dictate why a cow with multiple problems is chosen.

The lists of the selected cows may take one of three possible forms. The first is a simple list giving the cow's herd number and which of the selection programs triggered the selection. This list is called the farmer's summary (figure 8.25). It is generally sent out to the farm a few days before the intended visit so that the herdsman can get the appropriate cows ready for examination. The second and third list types are designed for the veterinarian as cow-side histories, with spaces to record findings at the examination (figure 8.26). These have proven to be very useful when examining cows.

Using this technique of cow selection for examination keeps the herdsman aware of current developments in his herd. Treatments and management practices are carried out at time when they are more likely to be of value, rather than waiting until the cow has not calved or is still empty six months after calving.

Discussion

The setting of the selection values in each of the management guides has been left to be set by the user. This allows the inclusion programs to be tailored to each enterprise. Default values have been set for each value for use by those unfamiliar with the programs. The level of involvement which the veterinarian has with his client varies, and the aim was to be able to accommodate all levels of involvement the veterinarian is likely to have with his clients.

```
12/11/87                                              Farm: SHOW3      87/88
                         ACTION LIST PARAMETERS


            Select the parameters that define  LATE CALVING COWS
                   Only the 'Y' choices are active

                          LATE CALVING COWS
      Choice?
        Y/N
         N    Cows past due date........ ge    0 days

         N    Cows due to calve..........ge    / /    le   / /    .

         N    Cows due to calve..........ge    0  days after PSC.



                                       RETURN to enter data, ESC to ignore,
```

Figure 8.15 Veterinary visit reason definition - late calving cows.

```
12/11/87              ACTION LIST PARAMETERS          Farm: SHOW3      87/88

            Select the parameters that define PREBREEDING EXAMINATION
                      Only the 'Y' choices are active

                            PREBREEDING EXAMINATION

            Choice?
              Y/N
               N    All cows calved............ge  21 days

               --------------------OR--------------------------------------

               Y    Cows calved................ge  21 days

                                 --and--

                    Y    Had a reproductive problem
                    Y    Were induced/aborted
                    Y    Cows with health code  RFM    or  METRIT  or  DIFCLV
                                                DISCHA or  MFEVER  or  CDOWN

                                          RETURN to enter data, ESC to ignore,
```

Figure 8.16 Veterinary visit reason definition - pre-breeding examination.

```
12/11/87              ACTION LIST PARAMETERS          Farm: SHOW3      87/88

               Select the parameters that define ANOESTOUS COWS
                        Only 'Y' choices are active

                               ANOESTROUS COWS
            Choice?
              Y/N
               N    Cows that have not yet cycled

               Y    Cows...ge  50   days after calving and not yet cycled


               Y    Cows that have not been mated

               N    Cows...ge  50   days after calving and not been mated



                                          RETURN to enter data, ESC to ignore,
```

Figure 8.17 Veterinary visit reason definition - no visible oestrus.

```
12/11/87              ACTION LIST PARAMETERS        Farm: SHOW3     87/88

              Select the parameters that define NYMPHOMANIAC COWS


                            NYMPHOMANIAC COWS

                         (excludes 1 day returns)

                      Cows with........ge     3
                      heats in.........le    15    days




                                        RETURN to enter data, ESC to ignore,
```

Figure 8.18 Veterinary visit reason definition - frequent cyclers.

```
12/11/87              ACTION LIST PARAMETERS        Farm: SHOW3     87/88

              Select the parameters that define REPEAT BREEDERS
                        Only the 'Y' choices are active

                             REPEAT BREEDERS

                         (excludes 1 day returns)
    Choice?
     Y/N
      N     Cows with..........ge     3  services


      N     Cows with exactly....     3  services

                           or

            ...................ge     6  services

                                        RETURN to enter data, ESC to ignore,
```

Figure 8.19 Veterinary visit reason definition - repeat breeders.

```
12/11/87                ACTION LIST PARAMETERS          Farm: SHOW3     87/88

             Choose the parameters that select PREGNANCY TEST COWS
                       Only the 'Y' choices are active

   Minimum days since last service before Preg test.......  42 days

                           PREGNANCY TEST COWS
    Choice?
      Y/N
       Y    Cows without mating records and calved..ge    150   days
       Y    Cows returning to service...............ge     42   days

       Y    Cows mated after mating start by........ge     56   days
       Y    Cows with a heat recorded after last mating entry
       N    Cows that had a reproductive problem
       Y    Cows that were induced/aborted
       N    Cows with health code  cidrin  or  inducl  or  rfm
                                   treatl  or  cntrll  or

            All cows mated greater than pregnancy test days

                  RETURN to enter data, ESC to finish, ↔ to change fields
```

Figure 8.20 Veterinary visit reason definition - pregnancy diagnosis.

```
12/11/87                ACTION LIST PARAMETERS          Farm: SHOW3     87/88

             Select the parameters that define RECHECK COWS
                      Only the 'Y' choices are active

                             RECHECK COWS

         This allows the user to modify the revisit flag options.

          Y/N
           Y    Include in next visit if revisit flag = Y
           Y    Exclude from next visit if revisit flag = N

                                     RETURN to enter data, ESC to ignore,
```

Figure 8.21 Veterinary visit reason definition - revisit cows.

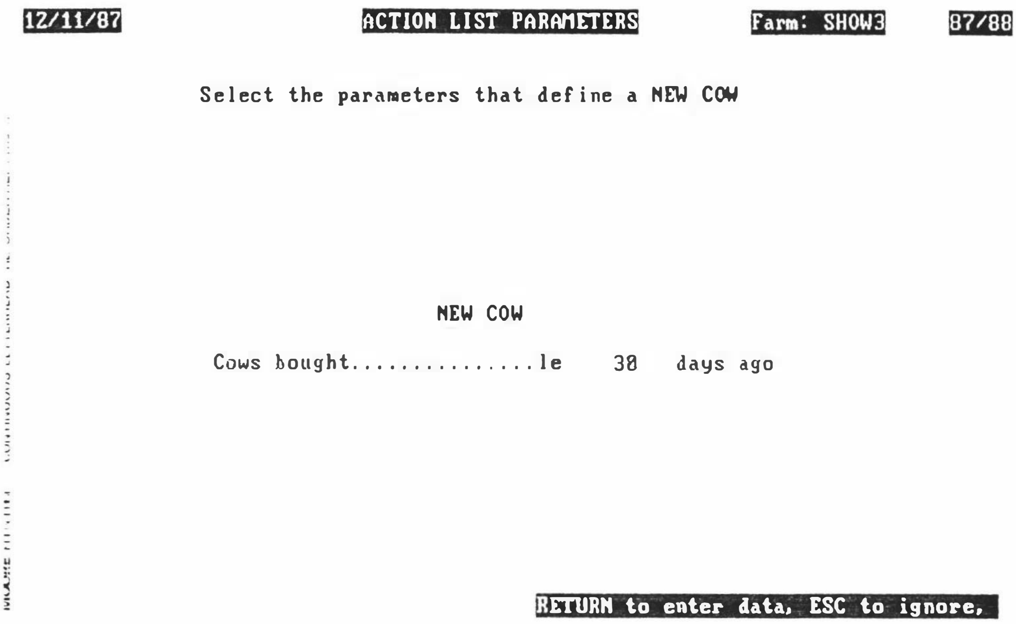


Figure 8.22 Veterinary visit reason definition - new cows.

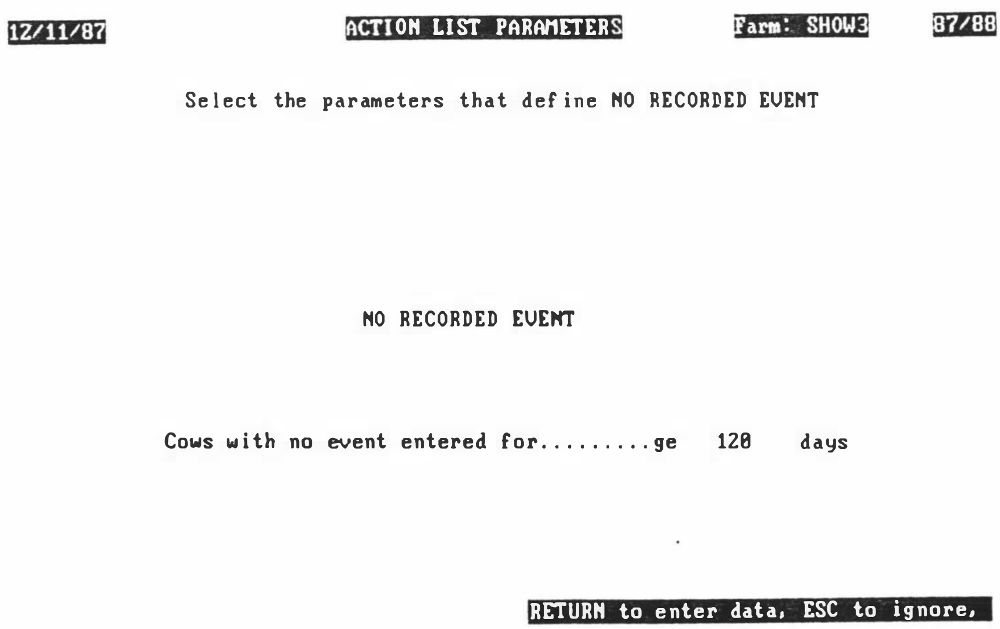


Figure 8.23 Veterinary visit reason definition - cows with no events recorded.

```
12/11/87          **** ACTION LIST SELECTION MENU ****   Farm: SHOW3      87/88

          Visit Reasons                                 Include Visit
                                                        Reason [Y/N]?
     [A]  Late calving cows............................ N
     [B]  Postpartum examination....................... N
          Prebreeding examination AND anoestrous cows.... N
     [C]  Prebreeding examination...................... N
     [D]  Anoestrous cows.............................. Y
     [E]  Nymphomaniac cows............................ Y
     [F]  Repeat breeders.............................. N
     [G]  Pregnancy test cows.......................... N
     [H]  Recheck cows................................. N
     [I]  New cows..................................... N
     [J]  Cows with no recorded events................. N
     [K]  Vet/farmer request........................... N

     [L]  GENERATE LIST            [X]  Return to Main Menu

                     [Enter] Your Choice

    Press [<- ->] then 'Y' to include Visit Reason on action lists
    Press [A..K]  to define cows selected for visit reason
```

Figure 8.24 Veterinary visit reason selection.

```
SHOW3                    COWS TO BE EXAMINED                    12/11/87

     Cow no.  Reason for examination    Modifier

        32    Anoestrous                calved & not cycled
        54    Revisit                   anoestrous
        61    Revisit                   anoestrous
        74    Revisit                   anoestrous
        76    Anoestrous                calved & not cycled
       139    Revisit                   anoestrous
       213    Revisit                   anoestrous
       296    Revisit                   anoestrous
       299    Revisit                   anoestrous
```

Figure 8.25 Veterinary visit list - farmer's summary.

```
SHOW3                          COWS TO BE EXAMINED                      12/11/87

      --------------------------------------------------------------------------
299  |   2  | CD  4-Apr  222 |                 | H  0      | S  0       |  CV |
      --------------------------------------------------------------------------
          Revisit? ___  Visit  Revisit             anoestrous

                                 Event History
    1/ 4/87     Health          Event      Autumn cow
    4/ 4/87     Calved
    6/ 4/87     Health Vet      Disease    Assisted calv       CALVED
                                Treated    Pessary             Terramycin,oxytocin
   16/ 4/87     Health Fmr      Treated    Pessary             FUREA
                                Treated    Procedure           DEHORNED
                                Treated    Antibiotics         TERRYAMYCIN
    1/ 7/87     Health Vet      Visit      Anoestrus
                                Rectal     Inactive ov         C3,UN,I,I
                                Disease    Vaginal disch       puss
                                Treated    Prostaglandins
    8/ 7/87     Health Vet      Disease    Metritis
                                Treated    Streptopen
```

Figure 8.26 Veterinary visit list - cow history.

CHAPTER NINE

AN EXAMPLE OF THE FIELD USE OF DAIRYMAN AND HERD HEALTH TECHNIQUES

INTRODUCTION

This chapter will cover the use of the computer program DairyMAN on one of a number of farms that were used to test the field application of the program. The farm was chosen for this discussion because it typified the problems veterinarians were commonly confronted with in practice, but were unable to resolve satisfactorily using traditional clinical techniques.

The health supervision was taken over on this farm from a colleague in the University practice when the program (DairyMAN) was in the early stages of its development. The client is a fifty percent share-milker, and was in his third season on the property.

During my first visit to the property (in mid July 1986) I made a point of establishing the objectives of my client. We wrote these down and ranked them in order of priority:

1. To develop the capital value of his herd through genetic improvement using progeny tested bulls from the New Zealand Dairy Board's artificial insemination service.
2. To maintain sufficient cash flow through efficient production from the enterprise to meet overheads and service existing debts on the herd.
3. Personal satisfaction gained from the knowledge that the farm is being managed efficiently.
4. To be able to compare favourably with other dairy farmers in the local discussion group.

METHODS

Good records were available from the previous season's performance. These had already been collected by my predecessor and entered into the DairyMAN program. Therefore, I was able to use DairyMAN to analyze the previous season's performance. During the first two visits a farm walk was carried out to establish the average pasture cover on the farm and the condition of the cows. The initial period of the study was primarily concerned with gathering information.

The farm is situated 35 kilometers west of Palmerston North at Himatangi. The soil types are light sandy loams; one third Himatangi light sands and two thirds Puki Puki and Himatangi heavy sands. The farm is divided into two blocks; the home block is 88 hectares, while the runoff block across the road is 28 hectares of the lighter soil types. Generally the replacement stock were run on this adjoining block. Pasture development was poor with the youngest pasture estimated to be at least seven years old.

Because of farm locality and soil type, moisture retention is low. By mid November soil moisture has fallen to the point where the effective grazing area is reduced on average by one third. Therefore, the aim is to have 70% of the season's milk produced by Christmas (the season begins in July and finishes in late April). The planned start of calving is July 21 for the heifers and July 31 for the adult cows.

Problems Found From Initial Records Analysis

From the previous seasons's records the calving pattern for the 85/86 season is shown in figures 9.1 and 9.2.

The subsequent reproductive performance, which is similar to previous years, is shown in figure 9.3.

Problems found:

1. A moderate spread in calving pattern.
2. A high level of involuntary culling for infertility. This was especially high in the two and three year old cows, thus slowing the genetic gain of the herd considerably, (these age groups were genetically the best in the herd).

The probable causes were:

1. A nutritional problem both before and after calving. This caused a high level of lactational stress leading to a low submission rate in the two year old cows. It also produced a low peak in milk production.
2. The high level of facial eczema which was experienced in the previous autumn (March 1986). Since 25 cows showed clinical signs of the condition during the autumn, a larger number of animals would have been affected by the condition. They would not show signs until the stress of parturition and early lactation, due to occur in the following spring.
3. The herd was in a known selenium deficient area, this was confirmed by blood tests and was being rectified by parenteral supplementation of selenium.

17/ 4/88 CALVING RATE farm code 202 85/86

Adult cows

PSCA = 31/ 7/85

Weeks

	Before PSCA	1	2	3	4	5	6	7	8	9	10	11+	Total
3yr olds	4	4	3	6	8	4	7	5	3	5	1	1	51
cum %	8	16	22	33	49	57	71	80	86	96	98	100	
Induced		1	2	1					1				10 %
Adults	9	18	19	18	12	6	4	2	4	3	4	3	102
cum %	9	26	45	63	75	80	84	86	90	93	97	100	
Induced													%
10+yr olds	1	1	2	2		4	1	2					13
cum %	8	15	31	46	46	77	85	100	100	100	100	100	
Induced													%
Tot Number	14	23	24	26	20	14	12	9	7	8	5	4	
Cum No.	14	37	61	87	107	121	133	142	149	157	162	166	
Cum %	8	22	37	52	64	73	80	86	90	95	98	100	
Targets					66 %		83 %		90 %				
Induced		1	2	1					1				3 %
Aborted	4												2 %

Figure 9.1 The calving pattern for adult cows spring 1985.

17/ 4/88 CALVING RATE farm code 202 85/86

Heifers

PSC2 = 21/ 7/85

Weeks

	Before PSC2	1	2	3	4	5	6	7	8	9	10	11+	
Number	6	9	10	7	4	2	2	1	3	1	1	1	
Total No.	6	15	25	32	36	38	40	41	44	45	46	47	
Total %	13	32	53	68	77	81	85	87	94	96	98	100	
Targets					66 %		83 %		90 %				
Induced													%
Aborted													%

Figure 9.2 The calving pattern for first calf heifers spring 1985.

BURNETT	REPRODUCTIVE PERFORMANCE MONITOR	12/04/88
	Spring Herd	
	Days since PSM = 906	
Planned start calving	Adults 31/ 7/85	Targets
Cows to calve	215	
Cows calved	213	
4 week Calving Rate	68 %	66 %
8 week Calving Rate	91 %	90 %
Percent Induced	2 %	
Percent Aborted	2 %	
Planned start mating (PSM)	22/10/85	
Mating end	4/ 2/86 =	15.0 wks
Cows to be mated at PSM	209	
Cows yet to be mated		
21 day Submission Rate	59 %	90 %
28 day Submission Rate	63 %	92 %
First Service 42 day NRR	65 %	62 %
Total Service 42 day NRR	64 %	62 %
4 week Herd-in-calf Rate	46 %	57 %
8 week Herd-in-calf Rate	78 %	86 %
Percent Empty	11 %	7 %

Figure 9.3 Summary of the 1985/86 reproductive performance.

July 1986

From the initial farm walk pasture cover was determined to be 1200 kilograms of dry matter per hectare. Average cow condition score was 4.0 on a scale of 1 to 10 (each change in one condition score unit equals about 25 kilograms of live-weight). This was unsatisfactory; the ideal situation would have been a pasture cover of about 1600 kilograms per hectare and cows in condition score 5.

Finances did not permit the purchase of supplementary feed at the time, and because the majority of the herd was so close to calving little weight gain could be expected before calving began.

The herd was divided into two mobs. Those older cows in better condition were sent to the runoff block, and fed maintenance rations. The remainder were grazed at home and fed 8 to 10 kilograms of dry matter per day, in an effort to improve body condition before calving. Cows suitable for induction of parturition were identified. To ensure that all of this group were in reasonable condition, the ones in poorer condition were put with the thin cow mob. It was intended to induce these cows early in the season in order to allow them enough time to recover from calving and recommence cycling before the breeding period began. This was to avoid the problem of induced cows conceiving late in the breeding program and possibly being induced again the following season or culled for infertility. Care had to be taken with this technique because the feed availability was low and it was pointless to induce more cows to calve when little feed was available.

As cows calved they were allowed to graze to requirements (12 to 13 kilograms of dry matter per cow per day). This was achieved by restricting intake by the use of an electric fence. This was a significant management change on the property as the cows were previously fed ad libitum immediately after calving.

Calving 1986

The calving pattern produced for the 86/87 season (with inductions shown) is seen in figures 9.4 and 9.5.

Cow losses were high over the calving period, the majority of losses being attributed to problems associated with facial eczema from the previous autumn. Cow losses can be seen in table 9.1.

Of the cow deaths, one was due to mastitis, four were associated with calving difficulties, and five were associated with metabolic problems complicated by residual liver damage due to facial eczema.

Table 9.1 A summary of cow numbers for the 1986/87 season.

Cows wintered 1986	220
Cows calved spring 1986	212
Empty cows carried over the winter	8
Cow deaths in spring 1986	10
Cows milked 1986/87 season	202

Inductions were carried out on 11% of the herd. Eighteen percent of the three year old cows were induced. This was higher than the other age groups, and a result of their poor conception pattern in the previous season when they were first calf heifers (figure 9.6).

By the 8th of October the average pasture cover had risen to 1328 kilograms of dry matter per hectare. It was explained to the farmer that reproductive performance was anticipated to be similar to the previous season, because of the poor cow condition at calving and inadequate feeding after calving. Attention was given to the most efficient use of available feed and improvement of mating management for the current season.

Mating 1986

Cows selected by DairyMAN to be examined for a pre-breeding check were visited on the 22nd of October. Fifteen cows were examined and 11 of these were found to be abnormal. Each affected cow was treated in light of the examination findings. Mating commenced on the 22nd of October. Pre-mating heats were detected with the aid of tail-paint, and because the number of "no visible oestrus" cows was so high (123), only 10 were examined for signs of ovarian activity. Of the ten, three had evidence of previous ovulations, four were in shallow anoestrus, having some activity on their ovaries, and two had inactive ovaries. These cows were not treated.

BURNETT CALVING RATE : Adults 12/11/87
Spring Herd

Planned start of calving: Adults = 25/ 7/86

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total	2	8	20	18	19	11	9	15	14	16	9	13	
Cum total	2	10	30	48	67	78	87	102	116	132	141	154	
Cum %	1	6	19	30	42	50	55	65	74	85	90	99	
Targets			36 %		66 %		83 %		90 %		100 %		
Induced								2	8	2		5	11 %
Aborted													%

Figure 9.4 Calving pattern for adult cows spring 1986.

BURNETT CALVING RATE : Heifers 12/11/87
Spring Herd

Planned start of calving: Heifers = 21/ 7/86

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total	5	9	11	15	1	2	7	3	2	1	2		
Cum total	5	14	25	40	41	43	50	53	55	56	58	58	
Cum %	8	23	41	66	67	74	86	91	95	97	100	100	
Targets			40 %		68 %		84 %		90 %		100 %		
Induced													%
Aborted													%

Figure 9.5 Calving pattern for first calf heifers spring 1986.

BURNETT PREDICTED CALVING SPREAD THIS SEASON 12/11/87
Planned start calving Spring Herd Cows to calve
25/ 7/86 3yr: 37 Rest: 120

3 YR OLD COWS TO CALVE THIS SEASON

Cows to calve during weeks

	before PSCA	1	2	3	4	5	6	7	8	9	10	11+	date unkwn
Wkly tot Age		1	3	4	2	1	3	4	3	5	2	9	
Wkly tot Rest	1	1	15	19	19	8	6	5	9	14	8	15	
Total Age		1	4	8	10	11	14	18	21	26	28	37	37
Total Rest	1	2	17	36	55	63	69	74	83	97	105	120	120
Cum % Age		3	11	22	27	30	38	49	57	70	76	100	100
Cum % Rest	1	2	14	30	46	52	57	62	69	81	88	100	100
Targets			36 %		66 %		83 %		90 %		100 %		

Figure 9.6 Predicted calving spread for the 3 year old cows, spring 1986.

Four weeks after mating had begun 64 anoestrous cows were examined. Of these, 25 (39%) were found to have luteal tissue present and were treated with prostaglandins, 27 (42%) were showing signs of commencement of cycling activity and 12 (19%) were in deep anoestrus. The anoestrous groups were not treated at the time. The cow condition at this examination was poor (average 3.8). In mid December we were able to try the use of CIDRs[1] (Controlled Internal Drug Release) in the non-cycling cows, in an attempt to stimulate cycling. By this stage the cows still not cycling were paired for age and calving date and randomly allocated into treatment and control groups. DairyMAN produced lists of these cows sorted by age and calving date, which allowed the cows to be paired more

[1]New Zealand Dairy Board/Alex Harvey Industries.

easily. The treatment cows had CIDRs inserted for seven days, and all cows were inseminated on observed oestrus. The results are shown in Table 9.2. No improvement was achieved with the CIDRs, when used under these circumstances.

Table 9.2 Results of a within herd comparison of anoestrus cows treated with a CIDR for 7 days and those left as controls.

	Treatment	Control
Number	17	17
Cycled within 7 days of CIDR withdrawal.	6	7
Empty at end of breeding season.	9	8

On the 29th of December the remaining non-cycling cows (20) were treated by the insertion of CIDRs, and of these 11 cycled within 7 days of withdrawal of the CIDR. There were no controls for this group.

The final reproductive performance for the herd is given in Figure 9.7. The results are similar to the previous season's performance. This was to be expected because cow condition and feeding levels had not altered. Heat detection efficiency was determined to be adequate, thus not significantly limiting performance. This is shown by the return interval analysis in Figure 9.8.

The return interval analysis, combined with the finding that 39% of the anoestrous cows had luteal tissue present, led to a diagnosis of suboestrus and anoestrus in the herd. This was in turn responsible for a poor submission rate and a high involuntary cull rate, due to infertility.

```
BURNETT            REPRODUCTIVE PERFORMANCE MONITOR          15/ 4/88
                              Spring Herd
                          Days since PSM = 541
Planned start calving      Adults 25/ 7/86          Targets
  Cows to calve at PSC             222
  Cows calved                      212
  4 week Calving Rate               50 %                66 %
  8 week Calving Rate               80 %                90 %
  Percent Induced                    8 %
  Percent Aborted

Planned start mating (PSM)       22/10/86
  Mating end                      3/ 2/87          14.9  week mating
  Cows to be mated at PSM          203
  Cows yet to be mated
  21 day Submission Rate            54 %                90 %
  28 day Submission Rate            58 %                92 %

  First service  42  day NRR        59 %                62 %
  Total service  42  day NRR        61 %                62 %

  4 week Herd-in-calf Rate          36 %                57 %
  8 week Herd-in-calf Rate          58 %                86 %    preg  empty unkwn
  Percent Empty                     15 %                 7 %    168    31     4
                                                   Press any key to continue
```

Figure 9.7 Summary of the 1986/87 reproductive performance.

```
BURNETT                    RETURN INTERVAL ANALYSIS              12/11/87
                                   Spring Herd
Days   Total     % |    5%  10%  15%  20%  25%  30%  35%  40%  45%  50%  Normal
-------------------|----+----+----+----+----+----+----+----+----+----+----+---
 1       1         |                                                       | 2
 2-7     4       4 |====                                                   | 2
 8-10   10       9 |=========                                              | 8
11-17    7       6 |======                                                 | 3

18-19   25      23 |=======================                                |14
20-21   25      23 |=======================                                |37
22-24   15      14 |==============                                         |18

25-31    9       8 |========                                               | 8
32-38    2       2 |==                                                     | 7

39-45    2       2 |==                                                     | 2

46-59    6       6 |======                                                 |
60-66    4       4 |====                                                   |
67+                |                                                       |
--------------------+----+----+----+----+----+----+----+----+----+----+----+---
         Ratio 18-24 to 39-45 intervals = 32.5 :1  (target: > 6:1)
-------------------------------------------------------------------------------
```

Figure 9.8 The return interval analysis for 1986/87.

The culling summary for the season is shown in Figure 9.9. From this it was determined that the involuntary culling rate was 24% of the herd. Eight of these cows were carried over empty from the previous season and culled prior to the commencement of calving. They have been included in the 1985/86 analysis, adjustment for this carryover reduces the computed 1986/87 involuntary loss rate to 22%. The target involuntary culling rate was reported by Macmillan and Murray (1974) to be 10%, if maximum genetic progress is to be made.

A comparison was made with the results achieved by other farmers from the local discussion group. It was found that, on average, they had a submission rate 10% below the previous season's performance. This suggested that the farmer in the study, although in a similar position to the previous year, had made more efficient use of available feed and had improved the mating management of his herd. However this could be no more than a subjective assessment.

BURNETT COW REMOVAL 18/ 4/88

Spring Herd

A cow may be removed for more than one reason.
This summary totals all the entries made for each reason for removal.

Reason Removed	Culls	Deaths	Sold	Total	% of herd
Empty	29			29	13 %
Test unknown	2	1		3	1 %
Uterus abnorm	2			2	1 %
Abortion	1			1	%
Assisted calv		4		4	2 %
Downer cow		1		1	%
Mastitis	11	1		12	5 %
Udder disease	1			1	%
Lame	1			1	%
Upper limb dis	1			1	%
Injury		1		1	%
Facial eczema		5		5	2 %
Old age	2			2	1 %
Slow milker	4			4	2 %
Low Production	26			26	11 %

Figure 9.9 Cow removal summary 1986/87.

February 1987

Cows were condition scored in late February, in order to dry off the thinner cows early to improve their condition. Pregnancy testing was carried out on 75 cows thought to be at risk of being empty. The final empty percentage value was determined to be 15% of those cows intended to be mated at PSM (figure 9.10). The 50 rising two year old heifers were also pregnancy tested. As a result of the pregnancy test there were found to be two empty rising two year old heifers, this was considered satisfactory because the bull had been left with them for only 7 weeks. We were not intending to carry any empty cows through the winter period. The autumn climate was such that facial eczema was not considered a risk that season. This was supported by the fact that no clinical cases were seen.

BURNETT FATE SUMMARY 12/11/87

Spring Herd

Days since PSM = 386

COWS TO CALVE AT PSC :25/ 7/86	222	
Cows calved	212	95 %
Cows removed before PSM	27	
Cows witheld from mating		
Purchases, new cows & carryovers	5	
COWS TO MATE AT PSM :22/10/86	203	100 %
Total cows mated	182	90 %
Cows in calf (asmd, cnfrm, rmvd)	168	83 %
Cows empty (asmd, cnfrm, rmvd)	31	15 %
Cows mated or rmvd within 42 days	4	2 %
Cows unknown		%
Cows rmvd since PSM	62	
Purchases & new cows		
Cows in current herd	141	
Cows in calf	141	100 %

Press any key to continue

Figure 9.10 Cow fate summary 1986/87.

May 1987

The herd was dried off on the 5th of May. The objective for the winter period was to improve cow condition in order to calve at a condition score of five, and to have on hand an average pasture cover of 1700 kilograms of dry matter per hectare at calving. The farmer was able to secure grazing rights away from the farm for six weeks during June for 100 head of cattle. The number of cows wintered was reduced from 221 the previous season to 202 for the 1987 winter period. The herd was split into two mobs, the older better conditioned cows going to the grazing-out and the thinner cows and heifers remaining at home. Due to a favourable Autumn the pasture growth rates were above normal, and this made the task of improving average pasture cover and cow condition easier. By July the average cow condition was 4.8 and average pasture cover on the farm was 1600 kilograms per hectare.

The young stock were given preferential treatment from the beginning of the program. Although scales were not available it was considered on the basis of condition scoring that they were of heavier body weight than had been achieved in previous years. During the winter months the advisory visits made monthly. During these visits we discussed cow condition, feeding levels for each class of stock, pasture cover, and management practices aimed to increase efficiency and to reduce the risk of disease in the herd. The following calving period was also discussed with respect to timing of inductions and projected feed availability. The subsequent average pasture levels are shown in Figure 9.11.

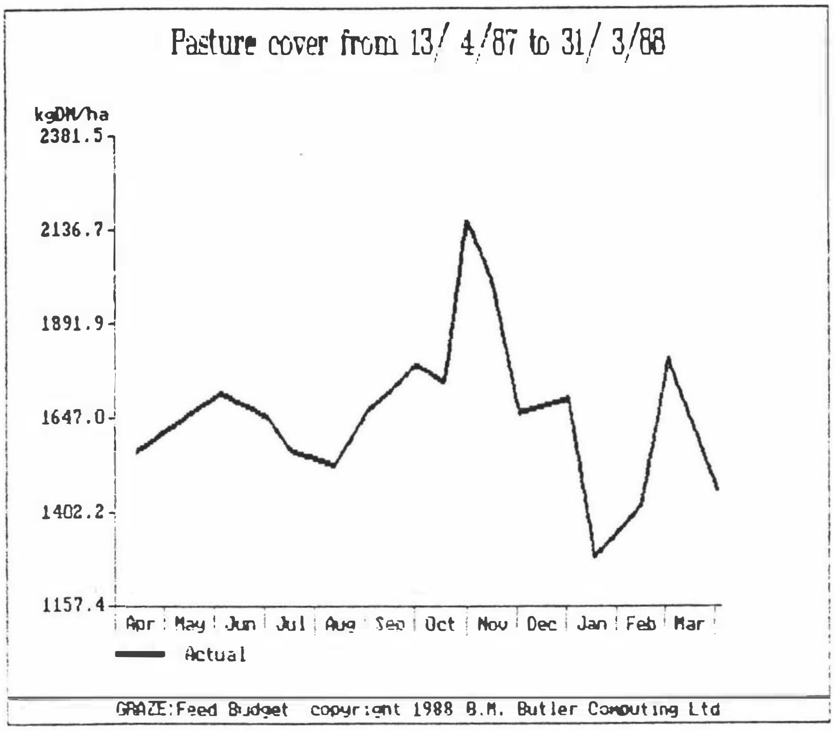


Figure 9.11 Average pasture cover from April 1987 to March 1988.

Calving 1987

It was determined that the cows due for calving induction could be treated earlier this season because there was feed available for them. This was done and 39 (26%) adult cows were induced to calve during the third and fourth week of the calving period. The calving performance is shown in Figures 9.12 and 9.13. It is interesting to note that only two of these cows had retained placentae. During the calving period two deaths occurred, one due to an assisted calving and the other due to milk fever. During the early lactation period the cows were fed behind an electric fence, according to requirements. The farm walks were increased during this period to every two weeks. The aim was to keep the rotation length as long as possible while not compromising the daily intake per cow during August and early September. Depending on the season, pasture supply on this farm does not begin to exceed demand until about mid September.

BURNETT CALVING RATE : Adults 26/ 4/88
Spring Herd

Planned start of calving: Adults = 31/ 7/87

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total	7	20	17	36	21	7	7	8	16	10	2		
Cum total	7	27	44	80	101	108	115	123	139	149	151	151	
Cum %	5	18	29	53	67	72	76	81	92	99	100	100	
Targets			36 %		66 %		83 %		90 %		100 %		
Induced			2	18	13	1				3	2		26 %
Aborted													%

Figure 9.12 The calving pattern for adult cows in spring 1987.

BURNETT CALVING RATE : Heifers 18/ 4/88
Spring Herd

Planned start of calving: Heifers = 24/ 7/87

	Before PSCA	Weeks 1	2	3	4	5	6	7	8	9	10	11+	
Weekly total		8	17	10	7	4	1						
Cum total		8	25	35	42	46	47	47	47	47	47	47	
Cum %		16	49	69	82	98	100	100	100	100	100	100	
Targets			40 %		68 %		84 %		90 %		100 %		
Induced													%
Aborted													%

Figure 9.13 The calving pattern for first calf heifers spring 1987.

Mating 1987

Pre-breeding examinations were carried out on the 9th of October on 17 cows chosen by the DairyMAN program. From this examination 6 cows were found to have problems and were treated accordingly. Pre-mating heats were recorded with the aid of tail-paint, and by the planned start of mating 79% of cows had recorded a pre-mating heat. This compared very favourably with the previous season's pre-mating heat rate of 39%. On the 20th of October 34 cows were examined for "no visible oestrus"; 10 (29%) were found to have luteal tissue present and were left untreated; 8 (24%) were considered to be inactive and in deep anoestrus; 16 (44%) were active and in shallow anoestrus. The 21 non-cycling cows had CIDRs inserted for 7 days and were treated with 400 international units of Pregnant Mare Serum Gonadotrophin (PMSG) on CIDR withdrawal. Thirteen (62%) of the treated cows were detected in oestrus and mated within the following 7 days. The cows not mated by 14 days after CIDR removal were re-examined, by which time only 4 were remained unmated and two of these were considered to have cycled. The procedure was repeated on the 2 cows that had not cycled and on a further 3 cows not mated by 3 weeks into mating. At CIDR withdrawal (7 days later) a further 5 cows were examined. Of these 2 were found to be not cycling and left without further treatment. A summary of the results is given in Table 9.3.

With respect to non-cycling cows, only 14% of the two year old cows required examination compared with 23% of the older age groups. This represents a considerable improvement in the two year old cows' performance when compared with the previous two seasons. Pregnancy testing of 40 cows (these were all the naturally mated cows and those for which heats had been observed since the bull was withdrawn from the herd) on the 12th of April showed that only one cow was empty. A summary of the performance is given in Figure 9.14.

Table 9.3 Results of anoestrous cows treated with CIDR's for 7 days and given 400 IU of PMSG on CIDR withdrawal.

Cows treated with a CIDR and PMSG	21	
Mated by 7 days after withdrawal	13	(62%)
Ovulated by 7 days after withdrawal	15	(71.4%)
Retreated cows	2	

From the report in Figure 9.14, notable areas of improvement in herd performance are, an increase in the "herd-in-calf" rate and a lower empty percentage at the end of the season when compared with earlier seasons (figures 9.3 and 9.7). This has resulted in an alteration in proportions of cows culled for involuntary reasons and those culled for voluntary reasons (table 9.4). In the previous seasons the farmer had heavily culled the poorer producers in order to maintain the rate of herd improvement. Because the involuntary culling level was so high this led to a very high culling level for the herd. This action proved to be expensive, as shown later in this chapter.

Table 9.4 The loss rate from the herd showing the level of involuntary and voluntary losses in the study herd over a three year period.

Season June 1 - May 31	1985/86	1986/87	1987/88
Percent of the herd lost	29%	38%	24%
Involuntary losses (% of herd)	14%	22%	8%
Voluntary losses (% of herd)	15%	16%	16%

During the mating period the farmer made use of one of the management aids produced by DairyMAN (the cows to cycle list). This, combined with his determination to better his thoroughness and accuracy in heat detection, improved an already adequate heat detection efficiency in the herd. The return interval analysis is shown in Figure 9.15.

This season the farmer was able to harvest pasture as silage. A total of 45,000 kilograms of dry matter of silage was harvested. This has never been possible in previous years. The pasture cover has been monitored constantly over the study period. As the information database grows in size, more accurate estimations of pasture growth rates can be made and used in the production of feed budgets. Budgets were used throughout the study period to predict possible feed shortages, and to decide whether or not various possible management strategies would be feasible ways of avoiding periods of predicted feed stress.

Feeding the herd to achieve target reproductive performance also achieves an improvement in herd milk production. The daily production is used as a monitor of daily feeding levels for the herd. The performance over the previous three years can be seen in Figure 9.16. The 85/86 season was a good year for the district and record levels of milk were produced. However what can be seen from the 85/86 production graph is a characteristic slowing of the daily increase in the milk production curve for a period in early lactation (point "a" in figure 9.16). This coincides with commencement of the second round of grazing on the farm. If it commences too early, pasture growth is not yet sufficient to meet cow demand. This in turn leads to a decline in daily cow intakes and an extension of the lactational anoestrus period, thus producing low submission rates (figure 9.3). This supports the hypothesis put forward by Morris (1976) that feed stress early after calving leads to a prolongation of postpartum anoestrus. This manifests itself as a herd problem of high levels of anoestrus or suboestrus, the younger (two and three year old) cows being the most severely affected. A similar slowing of daily gain in production is seen in the 1986/87 (point "b" in figure 9.16) season. The 1987/88 season also has a flattening in the production graph (point "c" in figure 9.16), although it occurs to a much lesser degree and at a later date in the production curve. The later this occurs the less influence the feed stress has on the length of the post-partum interval. The 86/87 season was a very poor season due to an exceptionally dry spring and poor pasture growth rates. This led to inadequate daily intake during the early post calving period and correspondingly low reproductive performance (figure 9.6). The current 1987/88 season has produced the best milk yield result the farmer has had on the farm to date. This, combined with the reduction in compulsory culling level and the improvement in the calving spread for the 1988/89 season, has achieved the objectives set at the commencement of the study period.

BURNETT — REPRODUCTIVE PERFORMANCE MONITOR — 18/ 4/88

Spring Herd

Days since PSM = 179

Planned start calving	Adults 31/ 7/87	Targets			
Cows to calve at PSC	202				
Cows calved	198				
4 week Calving Rate	74 %	66 %			
8 week Calving Rate	94 %	90 %			
Percent Induced	20 %				
Percent Aborted					
Planned start mating (PSM)	22/10/87				
Mating end	21/ 1/88	13.0 week mating			
Cows to be mated at PSM	189				
Cows yet to be mated					
21 day Submission Rate	91 %	90 %			
28 day Submission Rate	94 %	92 %			
First service 28 day NRR	69 %	66 %			
Total service 28 day NRR	69 %	66 %			
4 week Herd-in-calf Rate	69 %	57 %			
8 week Herd-in-calf Rate	89 %	86 %	preg	empty	unkwn
Percent Empty	2 %	7 %	183	3	3

Press any key to continue

Figure 9.14 Summary of reproductive performance 1987/88.

BURNETT — RETURN INTERVAL ANALYSIS — 18/ 4/88

Spring Herd

Days	Total	%	5% 10% 15% 20% 25% 30% 35% 40% 45% 50%	Normal
1	5			2
2-7				2
8-10	4	4	====	8
11-17	2	2	==	3
18-19	30	32	================================	14
20-21	35	37	=====================================	37
22-24	9	10	==========	10
25-31	2	2	==	8
32-38	2	2	==	7
39-45	2	2	==	2
46-59	5	5	=====	
60-66				
67+	3	3	===	

Ratio 18-24 to 39-45 intervals = 37.0 :1 (target: > 6:1)

Figure 9.15 Return interval analysis for 1987/88.

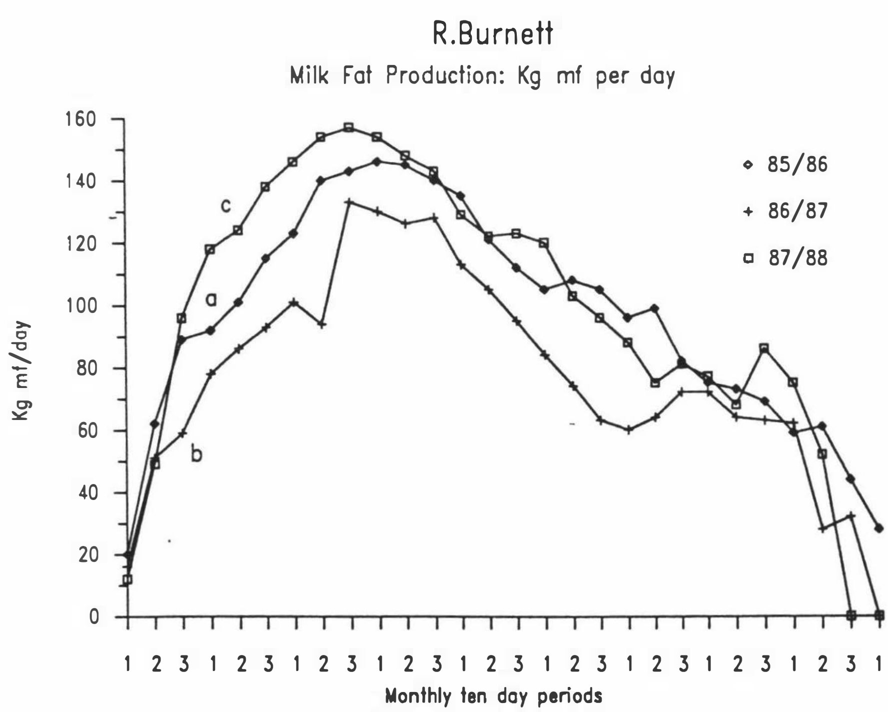


Figure 9.16 A summary of herd production from 1985/86 to 1987/88.

ECONOMIC BENEFITS OF THE SCHEME

Partial Farm Budget

The improved conception pattern this season will produce progressive improvements in herd productivity. From calculations based on the predicted calving performance for the 1988/89 season, without the use of inductions, the herd will have an extra 1505 cow days in milk when compared with the 1987/88 season (figure 9.17).

BURNETT PREDICTED CALVING SPREAD NEXT SEASON 26/ 4/88

Spring Herd

Planned start of calving adults : 30/ 7/88

heifers : 17/ 7/88

Number of adults to calve 153

Number of yearlings mated 52

====

Total cows to calve

Cows to calve during weeks

	before PSCA	1	2	3	4	5	6	7	8	9	10	11+	date unkwn
Weekly no.	7	31	33	25	13	12	6	5	7	4	1	9	
Cum. tot	7	38	71	96	109	121	127	132	139	143	144	153	153
Yearlings													
Cum %	5	25	46	63	71	79	83	86	91	93	94	100	100
Targets			36 %		66 %		83 %		90 %		100 %		

Figure 9.17 The predicted calving pattern for the 1988/89 season.

When this is compared with the actual 1987/88 calving pattern (figure 9.12) the predicted result is an extra 1505 cow-days in milk. Each extra day in milk, because of an earlier calving date, produces 0.7 kilograms of milk (Macmillan 1985c). Thus an increase in herd productivity is achieved because of the tighter calving pattern.

A partial farm budget of this change produces the following results:

Extra income because of improved reproductive performance

Milk production

This is based on the increase in lactation yield of to 0.7 kilograms of milk fat per extra day in milk which is achieved as a result of an earlier calving date. Given a payout of $3.65 per kilogram of milk fat the following calculation of income from additional milk yield can be made:

$$0.7 * 3.65 * 1505 = \$3{,}845.28.$$

Calf sales

Because calves produced from induced cows are a total loss, the extra income from reduced induction can be added into the analysis. In comparison with the 87/88 season where 40 calves were lost, the 88/89 season will have 30 extra calves to sell at $60 a head (if there are 10 cows to be induced to calve in the 1988/89 season). The total additional return equals $1800.

Costs saved as a result of the program

Induction costs for inducing 40 cows in the 87/88 season will be no longer be necessary in the 88/89 season. Assuming 30 fewer cows are induced in the 1988/89 season at $20 per cow this equals a saving of $600.

The contract which the share-milker has with the farm owner dictates that 25% of the herd will be reared as replacement stock each year. At the end of the 86/87 season he culled 66 cows after the 1st of October. He maintained a high level of culling for herd improvement despite a high involuntary loss rate. He then purchased a further 13 cows to keep stock numbers at approximately 200 milking cows for the

87/88 season. In the 87/88 season he has culled 45 cows and it was not necessary to purchase any cows to maintain the required herd size. The change in herd size is shown in Table 9.5.

Table 9.5 Stock inventory from 1986 to 1988.

Winter 1986	220	
	-8	empty cows carried through the winter
	-10	deaths over calving
	202	cows milked
	-66	cull cows
	+52	heifers
Winter 1987	188	
	+13	cows purchased
	-3	deaths
	198	cows milked
	-45	cull cows
	+47	heifers
Winter 1988	200	

For the 1986/87 season the income received from sales of adult stock amounted to 66 cows @ $250 = $16,500. The costs incurred were 13 cows purchased @ $528 = $6,864. This produced a total income of $9,636 from the sale of cows. For the 1987/88 season 45 cows were sold @ $250 giving a total of $11,250 and no cows were purchased. This gives the 1987/88 season a $1614 advantage over the 1986/87 season, when measured strictly as livestock income minus expenditure. As can be seen from Table 9.5, there were also changes in the livestock inventory over the three seasons considered. These are small in their net effect (plus two cows for the two seasons analyzed) and have been disregarded because they are complicated by stocking rate decisions which were being made at the same time. The effect of this decision is to make the calculation of net return more conservative than necessary.

Therefore in 1988/89 the farmer will reduce expenditure on purchase of cows (net gain of $1614) and on induction of parturition ($600), a total reduction in costs of $2214.

Cost incurred because of the program

Extra veterinary costs to achieve the desired results represent the additional costs above those normally incurred in the herd each year. The use of CIDRs cost $242. The consultation fee for the farm walks (charged at $60 per hour for an average time of 3 hours per month) for the year costs a total of $2160 for the first twelve months. It is intended to decrease the intensity of visits in the following years.

Extra grazing of 100 cows for 6 weeks during the winter @ $3.50 per head per week costs $2100. This produces a total cost of $4502.

Summary

Extra income	= $5645.28	Lost income	= $0
Costs saved	= $2214	Costs incurred	= $4502
Total gains	= $7859.28	Total costs	= $4502
Gain	= $3357.28		

This represents a 175% return on money invested. This partial budget has not attempted to quantify the additional economic benefit which is undoubtedly occurring due to improved production of the farm. This is difficult to do with precision because of the dependence of the enterprise on climatic conditions and the variation in payout for milk over the previous seasons from $4.00 per kilogram of milk fat (85/86) to $2.35 per kilogram of milk fat (86/87). Nevertheless, productivity of the herd has certainly improved well beyond the level accounted for in this conservatively estimated budget, meaning that the true return to the farm was well in excess of 200% on invested funds.

<u>Sensitivity Analysis</u>

A sensitivity analysis to determine the robustness of the conclusions in the budget under different assumptions concerning dollar values for milk produced, calves sold and veterinary consultant fees has been calculated. Each factor was considered in a separate analysis in order to keep the interpretation as simple as possible.

The milk payout would have to decrease to below $1.10 per kilogram of milk fat before the program failed to exceed the return that could be obtained by investing the money at current interest rates of 15%. This shows that the program is profitable at all realistic payout prices for milk. If the payout per kilogram of milk fat was $4.00 the return on investment would be 183%.

If the price received for calves is not included in the budget the return on investment would still be 134%.

The veterinary consultant fees would have to be as high as $153.26 per hour before the return fell to 15% on invested funds.

The improvement in calving spread would be too small to justify the investment only if it was less than 30% of the improvement achieved in this study. An extra 455 cow-days in milk are needed to pay for the investment in the service.

This suggests that the economic benefit from the program was very robust on the study farm. For the example quoted, the return on invested funds was excellent at any realistic price structure adopted, and within a realistic range for the expected response to the service.

The contract under which the share-milker farms the enterprise influences the distribution of returns from the program between the herd owner and the farm owner. Under the current contract the herd owner's share of income received is 50% for both milk and calves; and his share of expenses paid is 100% for veterinary fees and 50% for grazing. On these terms the milker could expect a return on investment of 146%. The milk payout would have to drop to $1.62 before he would be better off investing his money at 15%. With the calf income removed the return on investment would be 120%. The response to the program requires an extra 669 cow-days in milk, compared with the 1987/88 season, to pay for the service. This is a response 44% of that achieved in the study. The maximum a veterinarian could charge is $104 per hour for consulting before it would be uneconomic for the share-milker to call him in. This calculation assumes the share-milker pays for all consultation advice. As can been seen from the equation the farm owner has a very high return on investment, under this agreement, of over 275%.

CONCLUSION

In conclusion, the project yielded a net return on investment of 175%. This does not take into account the direct improvement in production because of better feed management. An area that was improved was the proportion of cows that were culled involuntarily. This decreased dramatically allowing the farmer to cull for voluntary reasons, thus increasing value and future productivity of his herd. This is, however, a very difficult improvement to quantify economically. The improvement in calving spread that occurred can be more easily quantified, and has been calculated in the partial farm budget. This improvement, with the associated changes, proved to be financially profitable. The project also proved to be very robust at varying prices for products, and it was concluded to have been a sound investment for the enterprise. The return to the farm owner was nearly double that to the share-milker, although the share-milker bore most of the costs.

CHAPTER TEN

GENERAL DISCUSSION

INTRODUCTION

The objectives of developing the computer program DairyMAN were:

1. To design a health and production recording and analysis system for use on New Zealand dairy farms by farmers, veterinarians and advisors as a management aid to increase the profitability of the enterprise.
2. To develop a system to be of assistance to the farmer in the day-to-day management of his enterprise.
3. To design a program to assist veterinarians in the analysis of reproductive, health and production problems on dairy farms.
4. To design a program that would act as a data collection mechanism for a regional data base on which field-based epidemiological research could be carried out.
5. To implement the use of the program on a small number of farms in the Manawatu region.
6. When combined with advisory input to demonstrate the ability of the program and service approach to meet the clients objectives in the field.

The development of DairyMAN is an evolutionary process. As the designers and programmers gain experience in the operation and field-use of the program, new diagnostic techniques will be developed and the program will become more versatile and sophisticated.

DATA COLLECTION AND DATA ENTRY

The data collection and entry process is an area that could be further improved. However, the present system has met with reasonable success. The compatibility of the collection requirements with current recording systems is satisfactory. The diaries used were found to be easy to complete, and allowed space for the farmer to enter events without the requirement for the use of coded entries. Self-carboning sheets improved the data collection procedures by streamlining the manual recording of events and the delivery of data to the computer operator.

The three main sections of the program cover reproduction, health, and production. It was more difficult to convince the users of DairyMAN to record health data, and production data, than they were for reproductive data. Program operators had similar views on using the three parts of the program. There seemed to exist a common view that there was a diminishing return on time invested in the collection and entry of these two sections.

One negative factor is the requirement for the duplicate recording of data; once for the New Zealand Dairy Board and once for DairyMAN. The linking of the New Zealand Dairy Board database with DairyMAN will considerably improve this aspect of the program. The link will make the program more attractive to on-farm users and reduce the time required to enter the data into the program for bureau operators. The collection and entry of data into the program is, in the author's opinion, the major impediment to the easy and widespread operation of the program. The future development of data loggers to record events as they happen, and the application of automatic data collection techniques will improve further this aspect of the program. It will be important to have a software system in operation to receive and use this information when it becomes available.

The correct entry of data into the program has been made easier by the intuitive design of the data input screens. The user is alerted to erroneous data with explanations of why the data has generated an "error message". This gives the data entry operator greater confidence in data entry. During the design of the input screens the possible uses of the program were kept in mind, hence the development of the different areas of data input (reproduction, health and production). The majority of users have tended initially to restrict the use of the program to a problem solving function, generally in the area of reproduction. The program can accept the data required for problem solving simply and easily, without the necessity of collecting data irrelevant to the problem at hand. This has added to the attractiveness of the program. With more experience, the program expanded into a monitoring role with more users.

An improvement in data entry could be made in the form of a "look up table" for codes for disease conditions, treatments and results of examinations. If these codes could be selected from a list shown on the screen through a "window", and the code selected with an arrow key from this list, the necessity of remembering and typing in codes would be avoided. Moreover the accuracy and speed of data entry would be improved.

PROGRAM DESIGN AND FILE STRUCTURE

Herd recording programs by their nature have to process a large quantity of data. The design of the file structure used to hold the data is of critical importance both in ensuring that the program is fast in operation, and that editing of data is simple and free from major problems.

The file structure adopted for DairyMAN is much simpler than in equivalent programs developed elsewhere in the world, yet it is able to meet the demands of the seasonally calving dairy herd well. Because the majority of New Zealand dairy farms are of this type the file structure has not so far been a limiting factor. The structure, designed around year-directories, is easily understood and can be used in either a problem solving mode or total farm monitoring approach. It has become apparent, however, that in order to accommodate all possible management systems on New Zealand dairy farms the file structure will have to be altered. There are basic design limitations inherent in the chosen approach which in the longer term will adversely affect the flexibility and versatility of the program. Between-year comparisons are difficult, and life time cow histories would be difficult to produce. As discussed in Chapter four, DairyMAN uses many fields with fixed content, supplemented by some dynamic fields which require a decoding system for interpretation but are more flexible for data storage. With the current structure the number of fixed fields is getting too high and this reduces the efficiency of storage space. These problems will intensify in severity as the program is further developed.

The file structure in use was chosen because it made program writing easier. Creation of a totally dynamic file poses much more difficult programming problems, and at the time, this was considered too difficult to attempt.

It is intended at a later date to redesign the file structure to create for each cow a single dynamic record including all events, to encompass the complete lifetime of the cow. Each event would have a code to identify it, a date of occurrence and additional information about the event which would be interpreted in the light of the event code with which it was associated. This design philosophy is in agreement with other such programs (Cannon et al, 1978; Stein, 1985; Williamson, 1986). The new file structure would be able to handle seasonal calving herds, year round calving herds, or combinations thereof. The structure would reduce the number of fixed fields required per cow and also reduce the size of the file considerably. Fixed fields, whether they are empty or full, require space in the file.

The requirement for an annual update program would no longer exist, error checking would be simpler and more efficient, and new event types could be added easily through the addition of new input procedures. All types of management systems would then be able to be entered into the program. If the performance indicators were not appropriate, new report programs could be written for the same data file. Disadvantages would be that the program would probably be somewhat slower to run. An advantage of the current system is that the entire data file is read into the computer's memory before data entry or report production commences. This memory-based system speeds up the computation time considerably. The program design proposed as an improvement would be a disk-based system, which is inherently slower than an identical memory-based system. However programming improvements can often mask this change, and the gains in flexibility and data security outweigh the disadvantages. The herd size is restricted to a maximum imposed by the capacity of the computer's memory in memory-based systems, this is in contrast to disk-based systems where there is no restriction on herd size. Moreover in a memory-based system, as the program expands in size, it becomes more complex to handle the larger herds. The development of disk-based system is the next logical step in the evolution of the DairyMAN program. However, had this been chosen from the beginning, I doubt that there was the expertise necessary at the time to have developed the program successfully.

The addition of a section of the program to handle replacement stock on the farm would add to the usefulness of the program for farmer operators. The file structure would essentially be the same as the one proposed above for the adult herd. Members would be created and added to the file as they were born on the property or purchased from outside the property. As the replacement stock calved, the entire record for the animal would be transferred into the adult file. This would complete the individual animal recording system for the enterprise and aid the user in selection of replacement stock.

REPORTS

The information derived from information systems such as DairyMAN should be used as a guide to the five management objectives: planning, monitoring, analysis, evaluation, and support.

The reports generated by the program should be designed in such a manner that they aid the user in the analysis of problems. To do this, the reports have to be uncluttered and laid out in a structured format capable of supporting hypothesis testing and the solving of epidemiological problems. The use of the system reported by Stein (1986) in the development of the PigCHAMP program has been adopted, and the author feels his reports approached these aims in a structured and organised manner. The application of epidemiological techniques to the solving of potentially difficult problems is possible using the structured diagnostic profiles which Stein suggested. The philosophy behind those reports has been adapted to New Zealand dairy herds. The system of cohort comparison to test the hypothesis under consideration is used successfully to progressively narrow the diagnostic list of possible causes of the problem being investigated. This technique of hypothesis formation and elimination is similar in concept to that used for individual animal problem diagnosis, but is applied at the population level. The technique can be applied to analyses not traditionally subjected to this level of scrutiny. For example the return interval analysis could be analyzed using sire cohorts if it was suspected that a venereal disease was introduced into the herd by an infected bull. The confounding effects of sire fertility on technician performance could be eliminated by analyzing technician performance within each sire cohort.

The New Zealand dairy herd's seasonal calving and mating has an advantage for this purpose over the year-round calving herds, as there is a larger population size on which the diagnostic reports are run. This allows for more stratification and cross classification to be done than would be possible in the same size herd if it was calving throughout the year.

The clarity of reports is important to avoid information overload for the user. The author feels that adoption of graphical presentation of results where possible would greatly enhance the diagnostic use of the reports, and possibly improve pattern recognition for problems encountered.

The management reports remove the necessity for manual selection of cows for evaluation or veterinary examination. This has proven to be very useful in the larger herds. I feel the ability to alter the selection programs to suit individual farms is important, as the service provided to each farm is modified to that particular farm, and the flexible selection criteria allows for this accommodation.

The setting of target values is an area that deserves a great deal more work. There is not a lot of work to support the existing values chosen. The DairyMAN environment would be suitable to evaluate different targets values for different regional areas or management systems.

Possible Role Of Expert Systems

The process of report interpretation can be further aided by the use of programs that analyze the performance and provisionally interpret the results for the user. Such programs are termed "expert systems". They make use of the collective knowledge of "experts" in the area under consideration. This knowledge is included in the design of a program that aims to interpret information presented to it by asking questions of the user or interrogating a data base. The final product from the program is an appraisal of the relative likelihood of various possible answers to the problem with which it was confronted. The programs are limited only by the knowledge of the experts and the design capabilities of the programmer. One such program, DairyFIX (Fertility Investigation eXpert), is being developed in association with the DairyMAN program. This program reads the data file of a herd, then analyses it and interprets the results automatically. It produces a list of the problems found, together with a weighting score which provides a guide to the severity and effect of each of the problems found on herd performance. It then suggests possible causes of the problem. Initial testing of DairyFIX on known problem herds has proved very encouraging. Once development has been completed it is intended to run the program as an independent program on a micro-computer, or as an option within the DairyMAN program. The program is written in the artificial intelligence language PROLOG to run on a mainframe computer, but no major problems are envisaged in converting it to run in Turbo Pascal language on a micro-computer.

Improved Diagnostic Indicators

By the use of an information system such as DairyMAN the correctness and appropriateness of the algorithms used to calculate indicators can be ensured by careful design, supported by extensive checking of the accuracy and repeatability of each calculation. This gives the user confidence in the figures produced. One such algorithm is that used in the calculation of the non-return rates. Previous hand calculated values were not always consistent in the methods used, and in the inclusion and exclusion rules for each service interrogated. This prevented the measure from being able to be used for within herd cohort comparisons or between herd comparisons. The algorithm for non-return rates in DairyMAN, although more difficult to calculate, improves the versatility and consistency of the results obtained. The use of a computer to do the calculation also removes human error from the calculation, which can lead to inconsistent results produced from the same data base.

The calculations of rates of disease occurrence may on the surface seem a simple task, but there is difficulty in determining the correct size of the population at risk. It is the population at risk that should be used as the denominator for estimating the percentage of occurrence. For the most part in seasonal calving herds in New Zealand the population at risk is the same as the cows that calved for the season plus any purchases. This figure has been used in the calculations of rates of occurrence in DairyMAN. This is a simplified method of calculating the true population at risk, and adoption of the strictly correct approach would increase the value of the figures and allow more valid comparisons to be made. The populations at risk in a dairy herd as defined by Williamson (1987) would be more correct to use even in a seasonal calving dairy herd, and would be essential for a year-round calving herd.

The development of new diagnostic indicators is always likely in such a program as DairyMAN. One such indicator is the 18-24 day non-return rate used in an attempt to distinguish between the affect of heat detection accuracy and bull infertility/inseminator error on the non-return rate. The objective is to develop a method for measuring the non-return rate only in those cows considered genuinely in oestrus at the time of service, and to compare that figure with the one which includes all services. The comparison will help to distinguish male problems from heat detection problems. The problem is to identify as reliably as possibly, solely from the records, which services have almost certainly been in oestrous cows. It may be more accurate to measure the non-return rate of only those services that had a service 18-24 days prior to the service under investigation, rather than, as currently done, to measure the non-return rate of only those services that have either a return to oestrus 18-24 days after the service under investigation, or no return to service within the time period chosen. The program allows such alternative indicators to be tested without the cost of further investment in data collection or analysis.

RESEARCH PROMOTION

As the use of the program increases and the data base grows it will become possible to undertake research projects investigating the magnitude of the effect of a possible causal factor using pre-existing data, thus reducing the cost of the exercise. New values for targets may be set in the light of experience gained from such work. The establishment of targets for the age cohorts in a herd is just such an example.

On-farm trials are encouraged as there is already in place a data collection and analysis system. The requirement for manual analysis is largely removed thus making the undertaking of trial work more attractive. New procedures carried out on the farm may also be more effectively evaluated to determine their efficiency or effectiveness under field conditions. An example is use of CIDRs in anoestrous cows to stimulate cycling. This was reported in Chapter nine.

FIELD USE OF DairyMAN

It was found that farmers who were using the program in combination with professional advice maintained their data collection routines and kept the data current and accurate. They were making decisions based on this data and therefore realised the value of accurate and up to the minute information. However farmers who used the program as a recording service alone, via a bureau agency, failed to continue to supply data in a regular and accurate fashion. The author feels that until the program is linked with existing data bases and/or the farmer uses the program in an on-farm system this type of user will not be enthusiastic about using the program.

The field use of the program in conjunction with an advisory service was reported on in Chapter nine. The results from this chapter support the findings of a number of similar much larger trials (Moller, 1978a; Morris et al, 1978; Williamson, 1980a), that this type of veterinary service is economically rewarding for the farmer. The return on investment of 175% reported is a conservative estimate of the gain made on the farm. The return was due to a tighter calving spread producing more cow-days in milk; more calf sales because of the reduced need of the calving induction technique; and the removal of the requirement to purchase cows to keep the required herd size. The area of greatest improvement on the study farm was in the level of involuntary losses from the herd. They were decreased from 22% to 8% over the study period. In order to meet his primary objective of steady improvement in his herd the farmer was maintaining a high voluntary culling rate despite the high involuntary loss rate. This produced a total herd loss rate of 38%, which was not consistent with maximum economic efficiency (Macmillan and Murray, 1974).

Why then has the adoption of this type of service by New Zealand veterinarians not occurred with greater enthusiasm? There has been in the rural sector a decline in the number of calls per veterinarian, and a larger number of farmers are now carrying out routine veterinary procedures themselves. This has led to a marked decline in the work of the average rural veterinarian in the dairy sector.

There also exist a number of service organizations that are offering on-farm advisory work on animal health and management.

Unfortunately there has not been the data analysis system in operation to back up proposed full animal health and management services. This is needed to provide the veterinarian with information, which has to be used to convince the farmer that a problem even exists. The DairyMAN program goes a long way towards providing this much needed equipment for the modern veterinarian who is servicing dairy farmers.

A matter of concern, in the author's opinion, is that many veterinarians lack the ability to convince farmers of the economic benefits of participating in such animal health management services.

It is vital that education should be directed towards helping veterinarians to develop these skills. This could be done through post graduate programs. Further as new graduates who have been introduced to these skills become available for employment the service is likely to be more widely accepted; so that ultimately DairyMAN type programs, and its modifications, will become an integral part of veterinary service and contemporary dairy farming.

SUMMARY

The development of the DairyMAN program has been in response to the need for an information system to support the activities of veterinarians involved in provision of health management services to dairy clients. I feel the program, although not meeting all the objectives set out in Chapter

three, is a significant step in the development of a successful information system designed to support the promotion of health management services to the New Zealand dairy industry.

APPENDICES

APPENDIX I

Management Codes

Input code	Report format
BHGTL	Bought in milk
BGHTD	Bought dry
NURSE	Nurse cow
INMILK	Rentered herd
INDLAC	Induced lac
TOCULL	To be culled
WITHLD	Not to mate
AUTUMN	Autumn cow
SPRING	Spring cow
TREAT1	Treatment 1
TREAT2	Treatment 2
TREAT3	Treatment 3
CNTRL1	Control 1
CNTRL2	Control 2
CNTRL3	Control 3

APPENDIX II

Reason For Veterinary Visit Codes

Input code	Report format
PD	Pregnancy test
PPE	Postpartum ex
PBE	Prebreeding ex
NVO	Anoetrus

NYMPHO	Nymphomaniac
FTC	Repeat breeder
ODDEVE	Odd event
NOEVEN	No event
NEWCOW	New cow
RECHEC	Recheck
FREQST	Farmer reqst
VREQST	Vet reqst
DISCHA	Vaginal disch
ABORT	Abortion
OTHER	Other reason
PBENVO	PBE & NVO
LATECA	Late calver
OVERDU	Overdue

APPENDIX III

Reproductive Examination Results

Input code	Report format
PREG	Pregnant
EMPTY	Empty
UNKNOW	Test unknown
TOTITE	Too tight
NSF	No sign' findng
PROVAG	Prolpse vagina
PROUT	Prolpse uterus
TWINS	Twins
RFM	Ret afterbirth
DISCHA	Vaginal disch

VAGINJ	Vaginal injury
CVXLGE	Cervix large
CVXINF	Cervix inflam
UTINJ	Uterus injury
UTABN	Uterus abnorm
REPDIS	Repro disease
METRIT	Metritis
ENDO	Endometritis
PYO	Pyometritis
ABORT	Abortion
FMUMMY	Fetal mummy
CLEAR	Clear
SPEC+	Speculum +ve
SPEC-	Speculum -ve
INACTI	Inactive ov
ACTIVE	Active ov
CYCLED	Cycled ov
CYSTIC	Cystic ov

APPENDIX IV

Sample Taken Codes

Input code	Report format
BLOOD	Blood
URINE	Urine
FAECES	Faeces
MILK	Milk
HAIR	Hair
SWAB	Swab

FOETUS	Foetus
LIVER	Liver
TISSUE	Tissue
OTHER	Other sample

APPENDIX V

Treatment Codes

Input code	Report format
ANTIBI	Antibiotics
PEN	Penicillin
STRPEN	Streptopen
OXYTET	Oxytetracyclne
PESSRY	Pessary
ANTIFU	Antifungal
ANTHEL	Anthelmintic
ANTIBA	Antibacterial
IRRIGA	Irrigation
TOPICA	Topical treat
WASH	Wash
ANTIPA	Antiparasitic
DRENCH	Drench
MINERA	Mineral suppl
VITAMI	Vitamin prep
INTRAM	Intramamary
SPMC	Streptopen MC
ORBENI	Orbenin LA
CLOXAG	Cloxagel
MASTAL	Mastalone

INDUC1	1st induction
INDUC2	2nd induction
INDUC3	3rd induction
PG	Prostoglandins
GNRH	GnRH
OXYTOC	Oxytocin
HORMON	Hormone prep
METSOL	Metabolic sol
CABORO	Calcium borogl
MAGSUL	Magnesium sulf
DEXTRO	Dextrose
COMPLE	Complex treat
FLUIDS	Fluid therapy
TOMANO	Tomanol
MISCDR	Miscell drugs
PROCED	Procedure
ADVICE	Advice given
ACTION	Action taken
SURGER	Surgery
EUTHAN	Euthansia
TRIM	Hoof trim
SHOOF	Shoof applied
CIDRIN	CIDR in
CIDROU	CIDR out
PMSG	PMSG
VACCIN	Vaccination
FINAJE	Finaject
CSTER	Corticosteroid

APPENDIX VI

Disease Codes

Input code	Report format
DIFCLV	Assisted calv
CDOWN	Cow down
CLVPAR	Calv paralysis
METDIS	Metabolic dis
MFEVER	Milk fever
KETOSI	Ketosis
GSTGRS	Grass staggers
WTLOSS	Weight loss
OFFOOD	Off food
NOMILK	No milk
TOXAEM	Toxaemia
MAST	Mastitis
TETDIS	Teat disease
TETINJ	Teat injury
UDDERD	Udder disease
HISCC	Hi cell count
LAME	Lame
ARTHRI	Arthritis
UPLIMB	Upper limb dis
EYEDIS	Eye disease
CANEYE	Cancer eye
PINKEY	Pink eye
RESDIS	Respiratory ds
PNUEMO	Pnuemonia
COUGH	Cough

SKNDIS	Skin disease
PHOTOS	Photosensitive
ABSCES	Abscess
CANCER	Cancer
INJURY	Injury
POISON	Poison
FECZEMA	Facial eczema
WORMS	Worms
LIVERF	Liver fluke
LICE	Lice
OSTERT	Ostertagia
SCOUR	Scour
JOHNES	Johnes disease
SALMON	Salmonellosis
OLDAGE	Old age
LOCINF	Local infect'n
ORLINF	Oral infection
WOODYT	Woody tongue
LUMPYJ	Lumpy jaw
CNSDIS	Nervous dis
CVDIS	Vascular dis
ANAEMIA	Anaemia
DIGDIS	Digestive dis
BLOAT	Bloat
ABDDIS	Abdominal dis
URNDIS	Urinary dis
REDWAT	Redwater
GENINF	General infect

OTHER	Other disease
ABNORM	Abnormal
NORMAL	Normal
BEEF	Beef
DAIRY	Dairy
SLOWMI	Slow milker
PRTYPE	Poor type
PRPROD	Low production
LATECA	Late calver
PRTEMP	Pr temperament

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