An Integrated Approach to Improvement of Dairy Cattle Production

G. I. Alexander, *B.V.Sc.*
Queensland Dept. of Primary Industries
Brisbane, Queensland, Australia

Introduction

Dairy cattle production can be improved by the application of both animal husbandry and animal health techniques. The dairy farmer has usually looked to an animal husbandry specialist for assistance in animal husbandry measures. Similarly, he has sought the assistance of a veterinarian in animal health measures. While treatment of disease and injury continues to be a major role of the veterinarian and it is difficult for the farmer to utilise these services in an orderly and planned fashion, veterinary services are moving increasingly into the field of preventive medicine, allowing them to be programmed in advance.

With this capability for programming also goes a capacity for the development of priorities in the use of these services by the assessment of relative costs and benefits of both husbandry and health services. The increasing availability of computers has made programming and assessment of these services much more feasible.

For quite a considerable time, computers have been used as an aid in the various cattle husbandry programs used by farmers but it is only relatively recently that computer technology has commenced to be applied to the animal health area as an aid to farmers. The data bases used for animal husbandry and animal health services have many common elements so that it is reasonable to explore the possibility of integrating these services into an overall program.

The author has participated in a group examining the feasibility of such an integration for Australian conditions. This paper reviews various facets which have become the components of the scheme and discusses the proposed scheme and its possible operation.

Components of the Dairy Herd Improvement Scheme

Any scheme of this type involves assembly of data, its analysis and interpretation and output of derived information to the farmer and his technical advisers.

The data base involves assembly of data derived from: (i) herd production recording, (ii) artificial insemination centres, (iii) mastitis monitoring, (iv) veterinary clinical and laboratory services, and (v) the farmer himself for both fodder availability and financial information.

This aggregation of data can be used both for the benefit of industry at large and for the farmer himself. One of the major uses for industry at large is its use in genetic improvement of the national dairy herd. The farmer also benefits directly from genetic improvement depending on his level of involvement in such a program.

Most of the uses of the data base, however, are in provision of direct managerial aids to the farmer. Depending on the degree of participation by the farmer and the information input in the program, these can include: (i) aids in culling of non-productive cows and selection of dams for heifer replacement, (ii) aids in selection of sires for use in the herd, (iii) aids in feeding management of the herd, (iv) aids in monitoring reproductive performance of his herd, (v) aids in monitoring mastitis status of his herd, (vi) aids in control of metabolic and other diseases of the herd.

Some of these aids have been in operation as part of husbandry services already provided to farmers; others are still being upgraded and developed. It is pertinent to review these developments to see how they have influenced planning of the overall scheme.

1. Genetic Improvement of Dairy Cattle

Genetic improvement of dairy cattle has come to rest very heavily upon herd recording and artificial insemination services. Research into optimum dairy cattle breeding schemes has developed progressively since the 1950's when rates of improvement in dairy cattle breeding programs for both single-herd and artificially-bred populations were compared. The expected rate of improvement for programs using artificial breeding was found to be markedly greater than those using herd breeding (Rendel and Robertson, 1950; Robertson and Rendel, 1950). This has led geneticists to develop optimum breeding schemes using artificial insemination (Skjervold, 1966; Lindstrom, 1969; Hunt, et al., 1972; Freeman, 1973). Skjervold (1966) showed that, under specific conditions in Scandinavia, expected annual rates of improvement were 1.7% in a population of 2000 milk-recorded and artificially-bred (A.I.) cows, 2.5% in a population of 20,000 cows, and 3.5% in a population of 400,000 cows.

Thus, effectiveness of any program is governed by the number of herd-recorded cows that are also artificially bred; i.e., the active breeding population. Within any active breeding population, factors of importance include: (i) identification and use of cows to produce bulls for progeny testing, (ii) number of daughters used to progeny test each bull, (iii) number

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of young bulls progeny tested each year, (iv) proportion of recorded cows inseminated by these young bulls, (v) proportion of young bulls selected as future sires, and (vi) extent of use of selected sires in the general breeding population.

For best results, only the best two or three bulls should be selected for mating to selected cows to produce young bulls for future testing (Hunt, et al., 1972) and they should be used heavily in the general population either for one year only to minimise the generation interval (Skjervold, 1966) or extensively for up to four years to maximise the selection differential (Hunt, et al., 1972; Hunt, et al., 1974).

Some countries such as Norway, Sweden and Israel have established large successful breeding programs with results coming reasonably close to expected gains. With active farmer involvement in a breed development program based on a Sahiwal x Jersey cross-bred dairy population, Franklin, Hayman and Hewetson (1976) have shown a theoretical rate of improvement of 2.6% per year in an active breeding population of 750 cows.

Active farmer involvement in the whole breeding program is essential for its success. In order to retain farmer participation, geneticists have been examining methods of assessing relative costs and benefits of breeding programs. The method of choice seems to be the discounted cash flow procedure (Hill, 1971; James, 1972). Unfortunately, too few optimum breeding programs have been initiated to date to allow for critical economic appraisal. Nevertheless, the long-term rates of improvement imply an adequate return on investment in such a program.

2. Mastitis Monitoring and Control

Regular monitoring of number of somatic cells in dairy herd bulk milks has become recognised as an indicator of sub-clinical mastitis on a herd basis and has been adopted as a fairly universal practice in most major dairying countries. High cell counts draw attention of the farmer to the need for a more critical examination of his milking methods, hygiene and general mastitis control.

A recent development has been the use of somatic cell counting of individual cows allied with regular production recording programs. Using special procedures, accuracy of the somatic cell count test has been improved so that problem cows can be identified with accuracy for further examination (Bodoh, et al., 1976; Jones, et al., 1977). This technique seems to follow logically from the herd bulk milk as a preliminary means of surveying herds with high bulk milk counts for problem cows instead of using the Rapid Mastitis Test. Once problem cows have been identified, decisions can be made on treatment, culling or other appropriate measures.

Control of mastitis also becomes part of the regular herd health program embarked on by the farmer in conjunction with a veterinarian. Proven mastitis control programs are available for adoption in participating herds (Wilkinson, 1965, 1968; Kingwill, et al., 1970; Hoare, 1973; Blood, 1974a).

Economic loss due to mastitis has been shown to be due to lower production by infected quarters (Blood, 1966; Janzen, 1970) and economic benefits of reducing the prevalence of mastitis have been shown by Morris (1971) to be quite considerable. This shows that there should be a strong economic incentive for farmers to control mastitis even at the sub-clinical level.

3. Herd Health Programs

Herd health programs are concentrated primarily on mastitis and infertility so that the whole mastitis program can be incorporated in the herd health program should the farmer wish to do so. In addition, herd health programs may include veterinary problems such as deaths or poor growth rates in calves, diseases impairing productive efficiency of adult cows and diseases causing death or premature disposal of adult cattle. Williamson (1976) describes the main elements of the program operated by the University of Melbourne:

> "In year-round dairying herds 12 visits occur, but, in seasonally milked herds, only eight or nine visits per year may be necessary.
>
> Reproductive examinations include: pregnancy diagnosis 7-11 weeks after service, post-natal examinations of cows with problems at calving, cows not seen on heat for more than seven weeks, , and cows not pregnant within six months of calving.
>
> Mastitis control is based on: proper milking technique and use of the milking machine, premilking udder washing with running water, postmilking teat dipping, appropriate antibiotic treatment, and a sensible culling policy."

A number of variations to this approach have been described (Morrow, 1966; Sippel, 1969; Cote, 1974; Blood, 1974b). Use of a chemical pregnancy testing service (M.M.B. 1977) could replace manual pregnancy diagnosis and has proved to be quite successful where it has been adopted.

Emphasis in these programs has been to improve the financial position of the farmer and a number of studies have reported on physical and/or economic responses to herd health programs (Herschler, et al., 1964; Morrow, 1966; Grunsell, et al., 1969; Barfoot, et al., 1971).

The Dairy Herd Improvement Scheme

In development of proposals for the Australian scheme, this scheme is envisaged as a series of components all linked by the process of data collection and interpretation and which are directed towards increasing the total net benefits flowing to the dairy farmer from their use.

Two major activities encompassed by the proposed scheme are: (i) genetic improvement of dairy cattle, (ii) improved decision-making by dairy farmers in production and health management.

Inter-relationship of the sources outlined earlier with activities and information flow may be followed most readily by the use of a flow chart (Figure 1).

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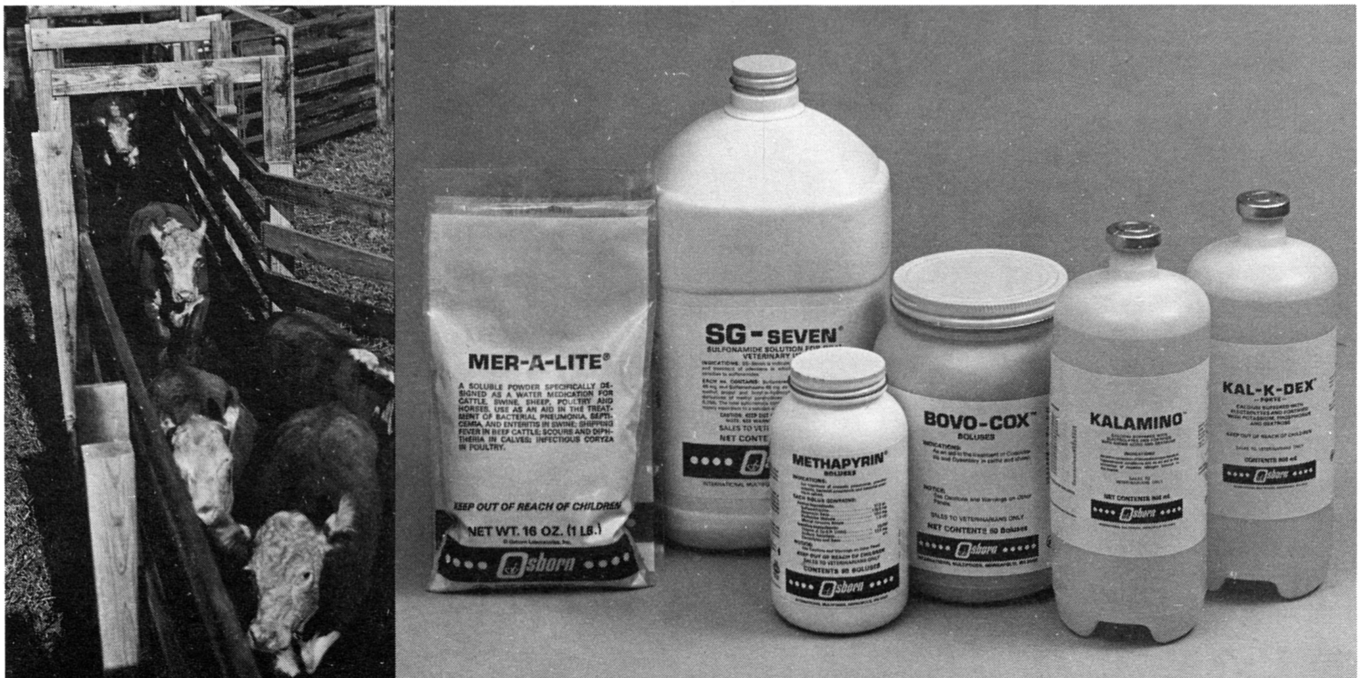

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1. Genetic Improvement of Dairy Cattle

The genetic improvement program will conform as closely as possible to principles outlined earlier in this paper. Because of the diffuse nature of the dairying industry in Australia, it is proposed that progeny testing be carried out on an Australia-wide basis and similarly selection and contract mating of "elite" cows for mating to "proven" progeny tested sires for breeding of the next generation of sires for progeny testing should also be spread over the whole industry.

A central committee administering the scheme should have the opportunity of determining which sires can participate in each stage of the breeding program and, if the committee does not own all bulls undergoing progeny testing, it should have the opportunity of purchasing some bulls to insure that there is adequate representation of sires in the scheme. Further proposals envisage interlocking agreements between the central committee, semen production and distribution units, herd production recording units and farmers participating in the elite cow identification, contract mating and progeny testing phases of the program. Semen from all bulls will be available for widespread use in every state in the year in which initial progeny test matings will be carried out.

Initially it is proposed that the program follow conventional lines with emphais on proven sires, but it is hoped that emphasis will be increasingly placed on use of young sires (sons and grandsons of sires progeny tested through artificial breeding) as a means of optimising the rate of genetic progress through reduction of generation interval.

2. Production and Health Management

In the interests of rapid turn-round of information, it is proposed that a network of mini-computers be established, linked to a central computer for data assembly and interpretation for the genetic improvement program. It is considered that this procedure is preferable to use of a centrally situated computer operated in isolation.

A standard core of software for the mini-computers will need to be developed to insure comparable minicomputer outputs and inputs into the central computer for genetic analysis.

Integration of breeding and production data derived from farmers, herd recording services and the artificial breeding centre provide an opportunity for decisions to be made in animal selection based on fertility and production level. Thus, decisions on culling and selection of dams for breeding of replacement stock are simplified.

Opportunity is also provided to make decisions relating pasture use to animal productivity as well as efficient grazing practice. Herd production data will also serve as an aid in supplementary and rationed feeding of the dairy herd.

One factor operating in favour of the proposed scheme is the trend towards larger herds, so that it is becoming increasingly difficult for individual farmers to maintain an adequate record system to aid in management decisions.

Computer based services envisaged in the scheme will include:

(a) production ranking of cows in a herd to assist in selection decisions,

(b) provision of facility for additional performance data for all farmers, e.g., type data for stud breeders,

(c) calculation of feed requirements for herds based on knowledge of calving dates in relation to time of year and production levels,

(d) calving patterns, reproductive performance of herds and drying off times for cows,

(e) herd health involving mastitis control and early treatment of cows with breeding difficulties.

A key element in the whole management assistance program is speed in making information available to the farmer. This is particularly important in feeding management and in herd health aspects of the scheme.

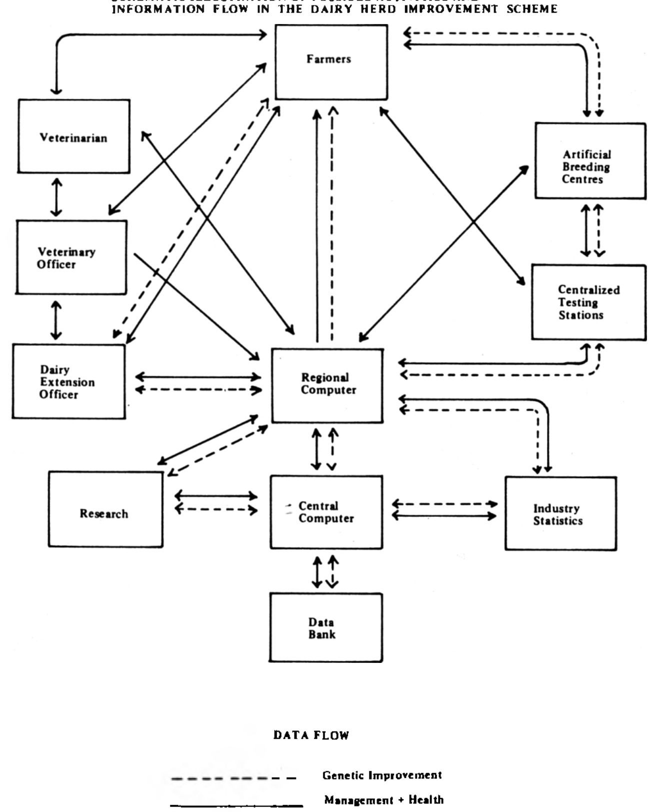
Obviously there are considerable cumulative and interactive advantages for the farmer if he opts for participation in the combined genetic improvement, management and herd health segments of the scheme. However, it is proposed that the scheme allow farmers to determine their own level of participation in any or all of its components.

3. Organisational Structure

Basic to the proposed scheme is the concept of an

FIGURE I

SCHEMATIC ILLUSTRATION OF POSSIBLE ACTIVITIES AND INFORMATION FLOW IN THE DAIRY HERD IMPROVEMENT SCHEME



arrangement bringing together industry, herd recording organisations, A.I. organisations and appropriate state and federal departments. The structure here outlined is directly related to the Australian situation but principles underlying the structure apply generally.

A central committee would be responsible for overall implementation of the scheme and comprise a full-time independent chairman who would also be director of the secretariat, a farmer representative, a representative of the states and a federal representative. The central committee would be assisted by a national secretariat including two technical specialists, one in the areas of herd recording, genetic improvement and herd management and the other in the area of herd health.

At the state and regional levels, the central committee would operate through state liaison committees including the appropriate local organisations. In order to promote adequate farmer liaison state advisory committees would be formed with fairly wide representation from farmer groups and other appropriate industry bodies.

Summary

A proposal is presented for integration of dairy cattle breeding management and herd health services for dairy farmers into a single computer-based data base because both husbandry and health have many common elements making integration of services desirable for efficient use of computers. Dairy herd management and herd health services depend on a rapid turn-round of information to the farmer and his professional advisers necessitating use of regional mini-computers which are linked to a central computer for genetic analysis. Standard computer programs are recommended to facilitate interchange of information and assembly for genetic analysis.

The scheme would be under the overall direction of a central committee assisted by a secretariat comprising appropriate technical specialists and support staff. At the state level, regional management would operate through small state liaison committees. An adequate dialogue with industry will be ensured through state advisory committees.

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