HERD LEVEL LIMITATIONS TO EFFICIENCY OF LIVESTOCK IMPROVEMENT IN THE DAIRY INDUSTRY

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A wide variety of dairy production (per cow and per hectare) occurs under Australian conditions. A study on typical Victorian commercial dairy farms showed a wide range of productivity. (Habgood *et al*, 1981).

TABLE 1:

	Mean	-80% Range- Upper	Lower
Butterfat per cow (kg)	135	167	106
Milk per cow (litres)	3008	3729	2146
Butterfat per hectare (kg)	156	299	84
Butterfat per man per year (kg)	9166	14655	5408

Much higher production per cow figures are quoted for some overseas countries. This is used by some people to point out the need to improve the quality of our livestock. This is, of course, an over-simplicfication. Production on the dairy farm is limited by:-

* Nutrition
* Management
* Disease
* Breeding
* Financial constraints within which the dairy industry must operate.

Because the Australian Association of Animal Breeding and Genetics is primarily concerned with breeding, I shall spend much of the time that I have been allocated discussing factors which have limited our efforts at the dairy herd level. Before I do this I would like to make a couple of points .....

* Rapid increases in productivity are readily achieved by improving nutrition, management, and disease control, whereas improvement through breeding is relatively slow. This is particularly so with a species such as cattle where the generation interval is relatively long. That is not to say that genetic gain is not worthwhile. Such gains are additive and can be built into total management systems.

* There is evidence that increased production in high breeding index cows when compared with low breeding index cows, is partly a result of greater feed intake and partly a result of increased efficiency of utilization of feed during lactation. (Bryant *et al*, 1981).

Unfortunately, different efficiencies in energy utilization cannot account for the large differences in milk production noted between high breeding index and low breeding index cows. (Trigg *et al*, 1981).

More research is needed to accurately measure the difference in efficiency of energy utilization of different groups of cows. Available evidence indicates that increased production from genetically superior cows is not obtained at no cost. These higher producing cows have higher feed requirements.

CONSIDERING THESE FACTORS BRIEFLY IN TURN .....

1. Nutrition

Large differences occur in per cow production between different herds in Australia and between Australian herds and overseas herds. (e.g. United States and Canada) I believe that a large percentage of these differences can be explained in terms of the level of nutrition of these various herds.

Financial constraints are often a limiting factor of nutrition. Per cow production could be markedly increased by feeding large amounts of concentrates. In the Victorian situation however, the cost of concentrate feed is high relative to the price received for milk. Continued high level of concentrate feeding is likely to be, in most situations, uneconomical.

These economics to date, have dictated that pasture is the main source of feed in Victorian dairy cows and financial constraints are likely to ensure that this continues. The good dairy farmer, even with high stocking rates, is able to achieve herd averages in excess of 200 kg of butterfat from grass where the State average is only 140 kg.

The complexities of ensuring that cows are fully fed and methods of growing and maintaining an adequate quantity of high quality pasture at minimal cost are obviously outside the scope of this paper, but they are of vital importance to the commercial dairy farmer.

2. Management

Management involves intangible factors like cowmanship and such obvious factors as selecting the correct calving pattern relative to feed availability. It involves making many varied decisions at the right time and requires flexibility in approach to meet changing circumstances.

The management aim to use production recording information to cull low producing cows from the herd and replace them with superior heifers may be negated by the fact that not enough superior heifers were raised or by the fact that the loss of cows from the herd due to factors such as old age, mastitis and infertility are such that almost all culling is done on these grounds with insufficient replacements to allow culling on the grounds of production.

Frequently, over 75% of the cows sold each year from many dairy herds are disposed of for reasons other than production. This allows only a small percentage of the herd to be culled on the basis of production. The opportunity to remove genetically inferior animals from the herd by culling is thus very limited.

3. Disease

The losses due to lame cows and diseases such as clinical mastitis, milk fever, bloat, etc. are obvious. Less obvious diseases such as sub-clinical mastitis and reduced reproductive performance can seriously reduce farm productivity. Diseases such as sub-clinical mastitis or parasitism can lower per cow production to the extent that, in the environment in which affected cows are to be used, they will produce less than their potential. This could well lead to their being assigned a lower genetic rating than their true genetic merit.

Poor reproductive performance can mean that cows do not calve at the optimum time of the year, with respect to available pasture. Non pregnant cows or very late cows may be culled. This reduces the amount of culling that can be carried out on the basis of poor production.

Many instances of the inter-relationships which occur between disease, management and nutrition can be cited, as can cases where rapid improvement in efficiency of livestock production in the dairy herd has occurred with changes in these factors.

4. Breeding

Geneticists have predicted that for a reasonable size recorded population, genetic improvement of 1.5% to 2.5% per year is possible. But in practice, the actual rate of genetic gain is considerably less than this: more commonly of the order of 0.5% per year.

TABLE 2: (from Everett, 1981)

Relative Contribution (%) of each Pathway to Genetic Improvement in Recorded Populations

Path of Progress	Bull to Breed Bull	Cow to Breed Bull	Bull to Breed Cow	Cow to Breed Cow
Robertson and Rendal (1950)	43	33	18	6
Schmidt and Van Vlek (1974)	39	32	27	2

Table 1 is interesting in that it demonstrates that in a large scale selection program, the major gains are made by pathways outside the control of the individual farmer, (i.e. the selection of the bulls to breed bulls and the selection of cows to breed bulls).

4.1 Clearly defining goals

Before adequate selection programs can be developed, a suitable breeding goal must be determined. Our milk pricing structure makes life difficult for the dairy cattle breeder. Some of our payment is for milk in terms of kilograms of butterfat, other payments are for litres of milk of specified quality. Selecting intensively for one may well reduce the rate of progress for the other. There is a further complication in that payment for protein may be included in the future.

Breeding is a long term project so there is a need to predict milk payment systems in the future and breed for these requirements.

It is important in the definition of goals to come to terms with the relative importance of traits other than production versus production. Many dairy farmers are interested in a very limited number of traits other than production - e.g. temperament, ease of milking and satisfactory feet. Other commercial people and many registered cattle breeders place far more emphasis on type. As the correlation between many of these characteristics and milk production is limited, or even negative (Arnott, 1981), selection for a large number of traits other than production will markedly decrease the selection pressure which can be applied towards economically important factors such as milk production.

4.2 Selection of bulls to breed bulls

The greatest percentage of the genetic gain can be seen to come from the selection of proven bulls to sire young bulls. (See Table 2).

This requires adequate evaluation of large numbers of young bulls so that a high degree of selection can be applied to select a small number of top bulls. This implies a well organised progeny test scheme which is well supported by the entire industry.

Ideally, there should also be adequate methods introduced whereby the breeding value of bulls in other schemes can be accurately compared with bulls in our scheme in Australia. Semen exchanges between breeding schemes can provide 'links' which will allow more accurate evaluation of bulls in other schemes.

Maximum gain through this pathway requires widespread use and progeny testing of young bulls, together with accurate methods of assessment of the genetic worth of these young bulls. The selected top bulls should then be used for breeding the next generation of bulls for progeny testing and used as widely as possible over the dairy population.

4.3 Selection of dams to breed bulls

This is the second most important pathway in genetic improvement and one which is currently being subjected to very severe and unreasonable limitations. In particular, I refer to the need in most States to breed bulls for A.B. from only registered animals. I am not anti registered animals, but I am anti discrimination against the much larger commercial sector of the industry.

The registered sector has done a grand job in the development of their various breeds. But in many cases they have been slow to accept new technology and to fully co-operate in large scale selection programs. Perhaps most importantly, the number of registered cattle available to breed daughters for A.B. industry is only a very small percentage of the total Australian dairy cow production. Everett (1981) states that 9% of Australia's dairy cattle are registered and only 28% of these 9% are milk recorded - limiting selection of cows to breed bulls to 2.5% of the population. I for one, believe that there are suitable non-registered dams available to breed bulls for A.B. programs and this could increase the selection differential that can be applied in the selection of cows to breed bulls. National cow BLUP's will allow comparison of cows in different herds to help in this selection.

Over-reliance on the registered sector has been shown to have other problems.

* In general, the registered sector places a higher importance on traits other than production than do commercial breeders. This limits their rate of progress towards increased production.

* There is more likelihood of preferential treatment of favourite cows and this can artificially lift the genetic rating of these cows.

* In general the registered sector places less emphasis on the efficiency of milk production than the commercial sector because of other considerations, e.g. cattle sales in which 'show type' is taken into account, retaining cows of low reproductive performance because of ancestral backgrounds, etc.

The registered sector can play a very important part in the breeding program in the future. They should be encouraged to work with the commercial sector in optimising the rate of genetic gain. They should also encourage commercial breeders to register (perhaps via an appendix system) high producing cows that meet specified breed criteria - a genetic recovery program. They will have to gear their industry to meet the needs of the commercial dairy farmer and not expect sole rights to involvement in a program designed to breed genetically superior bulls.

Specifically, dams selected for breeding bulls to enter the test scheme should be the best cows available regardless of whether or not they are registered animals.

The use of embryo transfer procedures could be used to get more bulls from elite cows. But this may have a disadvantage in that errors in the accuracy of selection of these cows (as may occur under some specific feeding regimes) may have serious effects when a small number of cows are used.

4.4 Selection of bulls to breed cows

This can be divided into several components.

4.4 - 1 It is necessary for the average dairy farmer to understand the information that is presented to him and relate it to economic criteria.

I believe that many dairy farmers understand very little about R.B.V.s' and even less about terms such as reliability. R.B.V.s' are used primarily by farmers to rank the genetic value of bulls; reliability is largely ignored.

With the introduction of BLUP evaluation of bulls, it may be possible to introduce more meaningful figures expressed in terms of production, e.g. progeny difference in terms of kilograms of butterfat or progeny difference in terms of litres of milk. A proper extension program to help dairy farmers to select bulls that are to be used would be necessary to ensure that this information is fully understood and efficiently used.

4.4 - 2 It is necessary to ensure that sufficient cows in the herd are mated to the selected bulls to produce enough replacement daughters to meet the farmers' needs. There is merit in considering using A.B. proven bulls on maiden heifers. The technology is now available to make this practical.

A.B. heifers have advantages in that, if the breeding program is effective, the heifers should, on average, be genetically superior to their dams. Against this, heifers represent an unselected population whereas in older groups, some poor producers will have been culled.

4.5 Cows to breed cows

The amount of selection that can be practised via this route is limited. If all heifers and cows are mated to selected bulls (either proven bulls or bulls in the progeny test team) a greater opportunity exists to select daughters from genetically superior animals.

The importance of this pathway could be further increased if embryo transfer was used on superior cows in the herd. At the current time I believe that the real cost per calf (cost of pregnancy, maintaining donors and recipient cows, etc.) of embryo transfer calves is too high to make this situation an economically viable option. Further work could well prove me wrong on this point.

Progress by this route can also be increased by reducing to a minimum, loss due to disease (e.g., mastitis and reduced reproductive performance).

SUMMARY

The wide variation that occurs between Australian farms to indices such as production per cow and production per hectare is due to factors such as management, nutrition, disease, breeding and the financial constraints under which the farmers operate. These factors are often inter-related and a total farm approach must be taken when attempting to increase herd productivity.

Better rates of genetic gain could be made by:-

* Accurately defining the criteria for which we are selecting.

* Institute measures to more accurately determine the genetic merit of bulls and cows.

* Progeny test a large group of young bulls each year using these criteria as a basis for selection.

* Widespread use of the very best of these progeny test bulls.

* Apply a greater selection pressure over a much wider range of cows to select dams to breed sires.

* Educating the farming community in the use of the genetic principles and available information to increase the rate of genetic gain at the farm level.

Finally, realisation of the potential gains that can be achieved through a sound breeding program depends on account being taken of the related factors of nutrition, management and disease control - a total farm approach to the problem of increasing farm productivity.

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