STRUCTURE AND BREEDING STRATEGIES IN THE DAIRY CATTLE INDUSTRY

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INTRODUCTION

New Zealand dairy farming is based on seasonal production under a temperate climate, making almost exclusive use of pasture, to produce manufactured dairy products for export to the world market. Prices received by New Zealand farmers are typically one third to one half of those received by Northern Hemisphere dairy farmers. These market and environmental considerations have played a major role in determining the structure of the dairy cattle breeding industry in New Zealand.

STRUCTURE OF CATTLE BREEDING IN NEW ZEALAND

Dairy cattle breeding in New Zealand is based upon the activities of the Dairy Board, Livestock Improvement Associations, Breed Societies, and Artificial Breeding Organisations involved in local semen production, semen exports and semen imports.

The role individual farmers play in this structure is a combination of politics and market forces.

Government plays a regulatory role and has traditionally provided a limited amount of research and educational support.

Role of Livestock Improvement Division (LID)

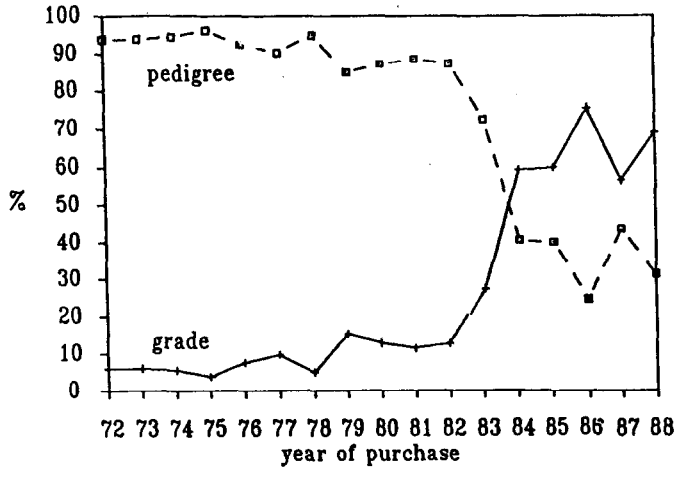
The Livestock Improvement Division (LID) of the New Zealand Dairy Board has had a major influence on the structure of dairy cattle breeding in New Zealand. Until the early 1970's it was the only organisation involved in semen production. It still provides 70% of the semen used in dairy herds. The Dairy Board controls herd testing and with the recent consolidation of Livestock Improvement Associations, the LID has become the only organisation in New Zealand providing herd testing and genetic evaluation services.

The LID continues to conduct a major part of the dairy cattle genetics research. The few programs operated outside the LID have substantial contributions from the LID in the form of finance or information.

Registered cattle

Breed Associations register about 33,000 heifers per year, accounting for less than five persent of the national herd replacements. Up until 1977, Pedigree Herdbooks were the only widely available source of multiple generation ancestry records. It was only in 1972 that the first grade (*not* registered by a Breed Association) bulls were used by the LID in its progeny test program. Since then the proportion has increased dramatically as shown in figure 1. Now seventy percent of new progeny test bulls purchased by the LID are grade.

Figure 1. Percentage of grade and pedigree Holstein-Friesian bulls purchased by NZ Dairy Board for progeny test.



All other artificial breeding organisations market and progeny test Breed Association registered cattle only.

The Breed Associations have for many years operated type scoring systems based on a single final award and varying levels of detail on component traits. The award has become an important criterion in assessing a cow's quality in non production traits by pedigree cattle breeders.

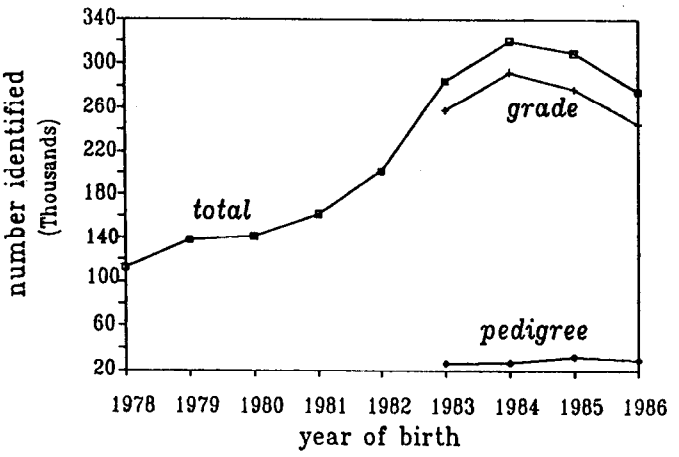
The other notable feature of Breed Association practices has been a heavy emphasis on absolute milk fat production and a reluctance to base breeding decisions on breeding indexes.

Grade cattle

Grade cattle, by definition, are all cattle which are not registered with a Breed Association. Grade cattle make up 95% of the New Zealand dairy cattle population and have traditionally been mated to pedigree sires through artificial breeding. This is changing rapidly with the

widespread adoption of the LID's identification system for grade cattle, and the use of grade bulls in artificial breeding by the LID.

Figure 2. Birth identifications by year.



The recording of the identification of grade cattle has only been widespread in the last nine years and thus only small numbers of animals with three generations of recorded ancestry exist. The next ten years will see a rapid increase in grade cattle with such records and consequently the influence on breeding practices of traditional pedigree cattle is expected to further diminish.

Breed Composition

The New Zealand dairy cow population has changed from being predominantly Jersey prior to 1960 to the situation now where Holstein-Friesians dominate. Ayrshires make up less than 5 percent of the population and other breeds, e.g. Milking Shorthorn, Brown Swiss and Guernsey are found only in small numbers. Figure 3 shows the percentage of total inseminations done by the Dairy Board each year since 1960 for Jerseys, Holstein-Friesians and Ayrshires, respectively.

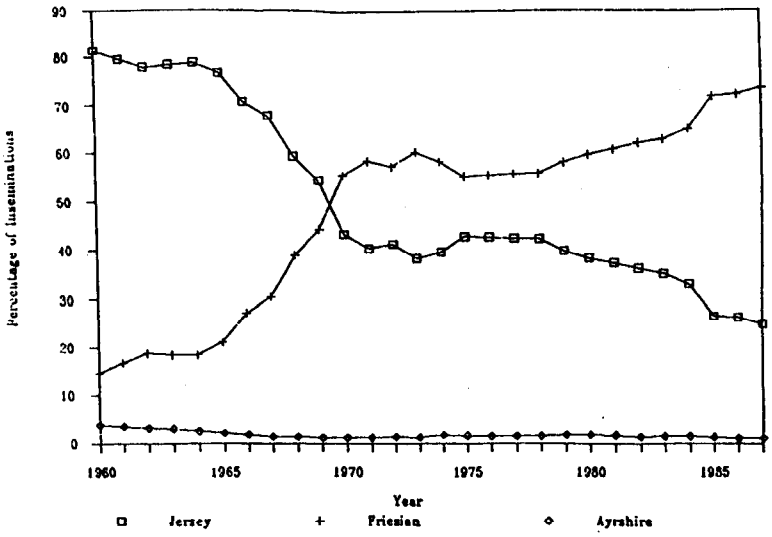
Artificial breeding organisations

Artificial breeding in New Zealand was focused exclusively through the Farm Production Division of the Dairy Board until the early 1970's when American Breeders Service established a semen production centre in New Zealand. Since then the number of other artificial breeding organisations harvesting semen in New Zealand has varied between one and three. Imported semen is used in New Zealand but has never accounted for large numbers of inseminations.

Semen Technology

One of the most significant factors influencing the structure of cattle breeding in New Zealand has been the use of liquid semen. The compact mating season and close proximity of dairy farms in a number of regions make the logistics of liquid semen distribution viable and cost effective. Recent developments in single dose packaging of liquid semen, as opposed to multiple doses in test tubes, appear set to reinforce the role of liquid semen.

Figure 3. Percentage of Inseminations by Breed.



Single dose packaging will overcome some of the high wastage associated with the supply of liquid semen to farmers for the insemination of their own cows.

Associated with liquid semen has been the very extensive use of a few highly selected bulls produced each year by the LID's progeny testing program. This has meant that a few bulls account for a high percent of the female replacements entering the national herd. The selection differentials achieved in this way give the LID's breeding program its major advantage over the programs operated in other countries.

LID database

The information used for cattle breeding in New Zealand is held in a single fully integrated database. The LID shares the database with Breed Associations. The database provides sire and cow evaluations used by farmers and artificial breeding organisations in bull and cow selection.

Progeny testing

The structure of progeny testing used by the LID is unique in that co-operating farmers mate at least 80% of their cows to progeny test bulls. The semen of the bulls used in the progeny test is distributed as liquid semen on a "bull of the day" basis. In this way random mating has been ensured. The progeny test random mating has reduced the need to develop sophisticated sire evaluation systems designed to remove selective mating biases.

Breeder proven bulls have traditionally been relied upon by the other artificial breeding organisations. These are bulls, promoted by a breeder, who have enough daughters spread over enough herds to give a marketable progeny test result. More recently formal progeny tests have been established by both Ambreed and Sire Services.

Imported semen

Imported semen is currently coming mainly from Canada and the United States. Extensive use is being made of sire evaluation conversions to compare imported semen with semen available from bulls progeny tested in New Zealand.

Selection of sires of sons

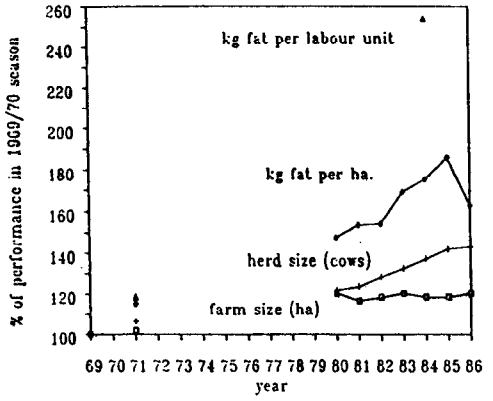
A wide range of sires are used for the bulls entering progeny testing. The LID uses three or four sires yearly for each of the Jersey and Friesian breeds. Few imported Jersey bulls are used. In contrast a substantial number of sons of Canadian Friesian bulls have entered progeny testing in the LID's breeding program.

THREATS, OPPORTUNITIES AND FUTURE STRUCTURE

Changing scale of operation

Figure 4 shows the changes which have occured in dairy farm productivity over the last 19 years. Milk fat per labour unit has increased by 150%, while herd size has increased 40%, farm area by 20%, and milk fat per hectare by 70%.

Figure 4. Changes in farm productivity as percent of performance in 1969/70 season.



As dairy farms get larger the economies of scale result in lower unit costs for herd testing, record processing and artificial breeding. There are now many large commercial herds in New Zealand which are well equipped to make a significant contribution to genetic gain either via progeny testing or bull breeding. These larger herds also have very specific commercial objectives.

There is scope for the development of schemes where some of these very commercial herds become devoted to genetic gain. In the sheep world nucleus flocks play an important role in genetic improvement. Some of the same concepts can be applied in the dairy industry to ensure:

(1) Previous genetic progress is not diluted by mating of high merit cows to low merit sires. This occurs commonly in pedigree herds and most commercial herds.

(2) Information is gathered on the full range of traits other than production. Few bull breeding herds are able to provide good comparative records for traits other the production.

(3) The use of newer reproductive technologies as they emerge. Multiple ovulation and egg transfer (MOET) schemes could easily be adapted for use in such herds, once the price/performance of embryo transfer reaches a satisfactory level.

(4) New breeds, young sires, and imported blood lines are evaluated under normal commercial conditions.

These specialised herds will require information processing facilities and an organisational structure which can provide information to other farmers and organisations. There will thus be a continuing need for a single organisation capable of facilitating the sharing of information between interested groups. Under New Zealand conditions this has already led to a single integrated database which is expected to play an increasingly important role in the future.

International competition

Semen imports threaten local cattle breeding efforts, and provide access to new genetic material. Exports offer the potential to reduce the cost of home country semen and make genetic gains available to other dairy industries. Efforts of the Interbull group have assisted in the development of better methods for comparing material available from different countries. However, there is still substantial scope for increasing the range of traits, breeds, strains, and countries represented. Further evidence of genotype by environment interactions is accumulating and the need for international co-operation in research is great.

The potential for semen production is vast and there are risks that exporting countries will be tempted to release semen onto local markets at heavily discounted prices. While this threat is a good competitive stimulus to local breeding programmes it can also result in their destruction. If genotype by environment interactions are significant then local programs are likely to be easily justifiable in the long term providing they can survive the threat of imports.

There a case for national sire and cow evaluation programmes playing a very active role in providing local farmers with advice on the merit of imported stock.

Information technology

Computers are rapidly improving in price performance. Farmers will soon be able to purchase machines capable of meeting all their processing needs. This development represents a substantial threat to the traditional national breeding programme if it results in a lack of access by the national programme to the production and identification records from an appreciable percentage of the progeny test and bull breeding herds. Already MOET schemes are developing with their own sire and cow evaluation systems. How can farmers evaluate material from these schemes if traditional comparisons are not available?

The traditional national programmes may need to invest substantial resource into developing farm based computer systems which provide protection to the central databases. Alternatively, it may be necessary to institute financial or regulatory mechanisms for ensuring the records are available to the national programs.

A single organisational structure is essential for the coordination and integration of the information essential to the operation of a national breed improvement program. However, such an organisation, because of the power it will hold, must be accountable to dairy farmers for all aspects of the services it provides. In our view their is little role for Government or private enterprise in the setting of policy for national programs.

Reproductive technology

The new technologies of superovulation, embryo transfer, and cloning will reinforce the need for accurate genetic evaluations of cows as well as providing tools to assist in this evaluation. The national programs will be faced with the need to establish cow evaluation procedures which are only justified for a small number of herds. Should the cost of development be carried across the industry or should it be recovered from these herd owners? Alternatively, should the owners of these herds be able to contract the national programs to produce cow evaluations for exclusive use?

A new type of organisation is emerging as a consequence of these new technologies. These companies have their roots in research laboratories and are seeking ways to exploit new and novel technologies. Farmers need good advice on the merits of using the services of these new companies. At the same time it must be recognized that the traditional herd improvement organisations are not well equipped to conduct the needed research. Government funding for applied research is being drastically reduced.

Genetic manipulation technology

Genetic engineering offers the possibility of giving cattle breeders access to genes from other species. While the concept is very exciting, the timetable for commercial returns is expected to be about 20 years, given that a breakthrough is made, and the risks substantial.

Products of genetic engineering, such as recombinant bovine somatotropin, are already under evaluation in New Zealand and Australia. These products are likely to further improve farm production efficiency, and to complicate the operation of traditional national breeding schemes.

Access to genetic markers offers the chance of both reducing the cost of breeding programs and increasing the rates of genetic gains. The markers will represent a substantial new product for incorporation into breeding schemes.

Research & Development

Applied research will be needed to enable farmers to assess the benefits of the new technologies. The National improvement programs have a key role to play in ensuring adequate objective research is conducted. Funding for this work should be either at the dairy industry level or at least partly from the Government.

The end product of dairy cattle breeding is milk and milk products. A fact often lost sight of in the desire to sell more semen. Milk processors and milk marketers need to be more closely involved in cattle breeding policy. Gene transfer technology, for example, may be used to modify milk composition. The information needed to determine the most desirable modifications will come from these sources. There is thus a good case for developing structures which ensure the voice of the end market is clearly heard when cattle breeding policy is being established.

CONCLUSIONS

The population structure of the New Zealand dairy cattle breeding industry is rapidly being inverted with grade animals taking the place of traditional pedigree cattle as the main source of bulls in artificial breeding.

Rapid changes in technology are forecast for the dairy cattle breeding industry. These changes will at the same time reinforce and threaten the present organisational and population structure of the national breeding schemes.

The pressure of scale of operation, and emerging technologies, is leading to an environment in which specialised breeding and progeny testing herds are likely to be favoured over many non specialised commercial milk producing herds, as the basis of genetic improvement programs.

There is a need for a strong national organisation able to coordinate information processing for dairy cattle breeding programs.

Applied research to evaluate the role of new technologies in the dairy industry is under threat and dairy farmers need an organisation and funding system to ensure the future of dairy production is protected by an adequate research program.