

WHERE ARE THE USEFUL GENES?

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SUMMARY

The efficiency and competitiveness of livestock industries depends on the identification, measurement and utilisation of useful genes in the existing populations. World trends in movement of genetics through frozen cattle semen are illustrated with information on Canada, USA and Australian in 1990. Both Canada and USA demonstrate a strong trend towards marketing their genetics to other countries. Australia, with a distinct import trend, has now a wide source of cattle genetics which can be used to improve its production efficiency and marketing opportunities for the future.

INTRODUCTION

Livestock breeders and breeding organisations throughout the world devote enormous energy and intuition to the process of seeking out superior or useful genes. To most, useful genes produce a measurable improvement in the profitability or performance of animals in their herd or flock.

The worldwide pool of cattle genetics is difficult to quantify but involves many hundreds of millions of domesticated animals in many countries. India alone has in excess of 200 million cattle, North America has in excess of 100 million animals. Australia's relatively small industry (approximately 22 million animals) is probably better known because of our significant participation in the world meat market.

Objective Measurement

A large proportion of the world's cattle are not involved in measurement of production, or if they are measured, are subject to overwhelming environmental influences which mask the value of their genes. Where cattle are managed individually or in small herds or groups, comparison of production of individuals has little statistical significance. In these cattle industries genetic improvement can occur, but very slowly and often due to introduced genes, rather than selection within the population.

The most widely acclaimed system of genetic evaluation of cattle traits is currently based on the BLUP (Best Linear Unbiased Predictor) method. This involves enormous numbers of computer based comparisons of animals within a population to develop rankings and values for various traits of genetic origin, whilst eliminating the background environmental "noise".

BLUP based programs are now widely used, with Breedplan and the Australian Dairy Herd Improvement Scheme (ADHIS) being Australian examples in the beef and dairy industries respectively. The BLUP system has had application for nearly 15 years in the dairy industry, with countries such as USA, Canada, Australia, Italy, France, Scandinavia, Holland and Israel now involved in relatively similar uses of the technology. These countries combined have in excess of 25 million dairy cows, most of which are production recorded and artificially bred. Traits commonly measured are milk volume and quality. Many other countries are measuring similar traits with analysis involving systems such as contemporary comparison and least squares analysis.

The beef industry is now using a number of genetic measurements and analysis systems involving traits such as growth rate, milking ability, fertility and carcass conformation. Generally operating through Breed Societies, performance recording systems are being developed more slowly in the beef industry due to management intensity and economics. Linked BLUP based programs are now operating in Australia, New Zealand and United States.

Genetic linkages

Recent developments in disease testing, quarantine and breeding technology are now allowing greater movement of genetic material between different countries. In genetic terms, the greatest volume of movement is through frozen semen, with a growing emphasis now with frozen embryos. In the past, all genetic exchange was through live animals.

Exchange or trading of frozen semen between countries in the world involves tens of millions of doses per year. As sires of merit are recognised, international demand for their semen now results in their use in many countries. The sire linkages created by the progeny of these bulls are of great benefit, resulting in a large world "pool" of genes allowing wider selection and more rapid genetic gain in desirable traits for the linked countries.

This process has developed quickly in the dairy industry, with the wide marketing and use of a selection of North American Holstein sires in a number of countries. Genetically superior sons of these sires are now being produced outside the North American population which in turn are potentially available for use within the world "pool" of Holsteins.

In the beef industry, linkage of the performance recorded populations is developing but is unlikely to reach the extent within the dairy industry. Level of use of artificial breeding and compatibility of information on sires between countries will influence this process.

Gene Movement

Countries involved in large scale genetic improvement have adopted different approaches to the opportunities presented by the world genetic trading. Countries with relative cattle disease freedom have had the best opportunities for widespread trading, but the process has also been influenced by the marketing "culture" within the country. Three examples are presented - Canada, USA and Australia.

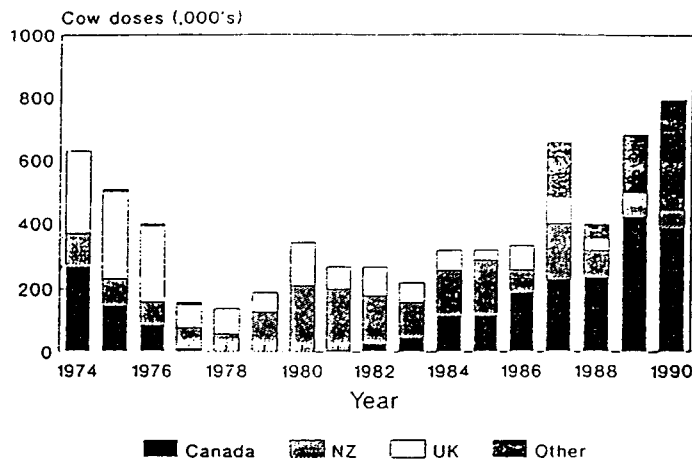
Canada

Canada's livestock improvement and genetic trading is more nationalised than most, with Government involvement and regulation. Fortunately, Canada also publishes precise reports annually on artificial breeding, including imports and exports. Canada has approximately 1.5 million (Table 1) dairy cows and 4.5 million beef cattle. Canada has become an aggressive marketer of genetics due to the advantages of an intensively managed and measured cattle industry, the relative freedom from disease, and an organised national approach to marketing.

feeding with some supplementation. As the Australian industry is more extensive, there has been an emphasis on cattle gene blending to ensure that cattle can meet a range of environmental and meat quality requirements. Australia's dairy industry is largely in the temperate south. Australia was relatively isolated genetically in the 1960's and gradually gained access to genetics from Great Britain, New Zealand, Canada and USA over the last 20 years.

Unfortunately published national statistics are not available in Australia for all imports and exports in 1990, but using Canada and USA figures as a base, it can be assumed that Australian imports in 1990 were between 700,000 and 800,000 doses of cattle semen, with over 600,000 doses from North America. This is supported by ARCBA statistics for bovine semen imports. The ARCBA study shows that Australia has imported between 4 million and 5 million doses of semen during the 1980's. Australia has also been at the forefront of gene importations from high disease risk cattle populations, with Boran and Tuli being a recent example.

Figure 1. Bovine semen imports from 1974 to 1990



Source: ARCBA 1991. Update of Dairy Breeding Trends

Australia's potential for export to Europe and North America is somewhat restricted by Arbovirus requirements. However there are few restrictions to developing countries, particularly South East Asia. It is estimated that Australia's total semen exports in 1990 did not exceed 100,000 doses, and were less than 600,000 during the 1980's.

CONCLUSION

As can be seen from the statistics, USA and Canada fit into a strongly export oriented mode, whilst Australia has been a net importer for the last 20 years. Where are the useful genes? Useful genes are being sourced in a growing number of countries as measurement and analysis of cattle traits, and world trading of genes from the best animals develops.

Table 1. Canadian cattle semen imports and exports 1990.

	<u>Industry</u>	<u>Semen doses</u>		
IMPORTS	Beef	145,244)	
	Dairy	252,589)	397,993
EXPORTS	Beef	198,433)	
	Dairy	2,373,758)	2,572,191
BEEF MARKETS	<u>Country</u>	<u>Doses</u>		<u>%</u>
	Australia	80,272		41%
	USA	50,147		25%
	New Zealand	31,824		16%
	Others	<u>36,190</u>		<u>18%</u>
		198,433		100%
DAIRY MARKETS	<u>Country</u>	<u>Doses</u>		<u>%</u>
	Great Britain	423,460		18%
	Australia	313,691		13%
	USA	295,741		12%
	West Germany	147,895		6%
	Thailand	90,025		4%
	Others	<u>1,102,946</u>		<u>47%</u>
		<u>2,373,758</u>		100%

Source: Agriculture Canada
Artificial Insemination in Canada
Annual Report 1990

Canada also sold 8,092 frozen cattle embryos in 1990, with Australia (54%), Great Britain (14%), New Zealand (10%) and United States (5%) being the major markets.

USA

United States has a large cattle industry much of which is intensively managed, and particularly with the dairy industry, carefully production recorded. The US system of semen marketing revolves around the competitive efforts of independent breeding companies.

USA has approximately 89 million cattle, with about 79 million beef cattle and 10 million dairy cattle. Unfortunately, there are few available rational statistics on semen trading in USA, but dairy sales estimates will help illustrate the scale of the activities. Estimates are that USA sold between 4.5 and 5.0 million doses of dairy semen in 1990. This includes large shipments to nearby markets in Mexico and South America, as well as growing markets in Europe. Australia is estimated to have received over 200,000 doses of US dairy semen in 1990 with approximately 100,000 doses being sold in that year. Beef semen imports from USA to Australia in 1990 were estimated at 100,000 doses.

Australia

Australia has approximately 22 million cattle, with 20 million beef cattle which are largely extensively grazed supplying local and export meat markets, and 2 million dairy cattle which rely mainly on pasture

At a time when world markets for cattle products are becoming more precise in specifications and quality, the genetic makeup of herds becomes more important. Breeders and industries are needing to focus carefully the market specifications of their final product while they choose and blend the genes to produce a profitable herd. Unfortunately, the correct genes are not sitting ready on the shelf. They are waiting, in the better performing animals in many herds to be measured and utilized through breeding programs.

Countries such as Canada, USA and Australia which have participated in long term genetic trading have an enormous range of useful genes, in many cases hidden in the livestock population. This is particularly the case with traditional gene importers such as Australia.

More widespread measurement and recording of cattle traits, as well as identification and understanding of the desirable genes will ensure that they are put to best use for the profitability of the industry.