The Application of Australian-Developed Performance and Genetic Technology to the Chinese Beef Industry.

A dissertation submitted by

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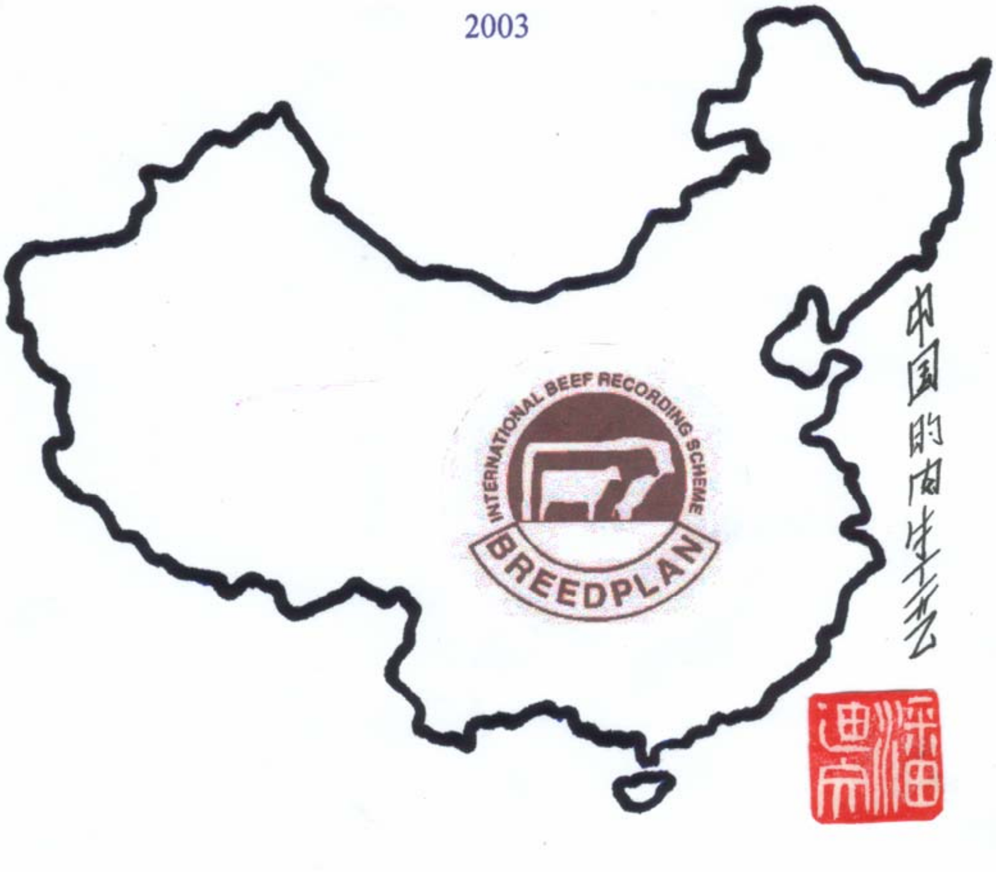

University of Southern Queensland

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

Signature of Candidate — Date: 2 - 4 - 2004

ENDORSEMENT

Signature of Supervisors — Date: 05/04/04

08/04/04

Abstract

In terms of numbers and volume of meat produced, the Chinese beef industry is one of the largest in the world. Development of the industry has only occurred within the last thirty years, and despite extensive cross-breeding programs with imported breeds, performance of Chinese cattle is low, and the industry is still subject to traditional farming methods.

This study looks at the Australian-developed genetic evaluation system BREEDPLAN, which is regarded worldwide as one of the best systems for assisting with selection of beef cattle for increased performance by evaluating genetics and identifying superior animals, and asks if BREEDPLAN can be successfully applied to the Chinese beef industry. Issues discussed include the complementarity of BREEDPLAN to existing Chinese breeding programs and the benefits of BREEDPLAN if introduced, as well as opportunities for Australians to provide consultancy services to facilitate introduction. The marketing of Australian genetic material in China, and cross-cultural marketing issues are also considered. Field research was conducted in China using itinerant interviews and observational research, together with unstructured, informal interviews and discussions with Australian beef industry experts.

It is found that breed improvement programs in China are controlled by the Ministry of Agriculture, and management practises within the government-run herds make them eminently suitable for the application of BREEDPLAN. The objective measurements of BREEDPLAN would provide observable genetic gain, resulting in increased industry productivity and profitability. In addition, it is found that a need exists within the Chinese beef industry for consultants not only with expertise and knowledge about BREEDPLAN, but also with an understanding of Chinese language and culture, which would be an advantage for dealing with cross-cultural difficulties. Market opportunities for Australian genetic material are considerable, but not unlimited, and further research is required to assess the size of the market. It is recommended that immediate steps be taken to introduce BREEDPLAN to the Chinese beef industry.

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Nigel Park

List of Abbreviations

ABRI	Agricultural Business Research Institute
AGBU	Animal Genetics and Breeding Unit
AHB	Animal Husbandry and Veterinary Bureau
AI	Artificial insemination
BLUP	Best Unbiased Linear Predictions
CABS	China National Animal Breeding Stock Import Export Corporation
CCP	Chinese Communist Party
EBV	Estimated Breeding Value
ET	Embryo transfer
FAO	Food and Agriculture Organisation
HRS	Household Responsibility System
MoA	Ministry of Agriculture
NBRS	National Beef Recording Scheme
NFI	Net Feed Intake
Rmb	Renminbi
SARS	Severe Acute Respiratory Syndrome
UNDP	United Nations Development Program
UNE	University of New England
WTO	World Trade Organisation

Chapter 1.

Introduction

Despite being one of the largest in the world, the Chinese beef industry is a relatively new industry and still at an immature stage of development. In contrast, the Australian beef industry is comparatively small, but one of the world's major players. This is a result, not only of a long history of astute management, but also of research and development of new technology that has placed the Australian industry at the forefront for the implementation of world's best practice throughout every sector of the industry.

This study firstly looks at performance and productivity of Chinese beef cattle, and secondly, the seedstock sector of the Australian industry, to assess how instrumental the Australian-developed genetic technology BREEDPLAN has been in lifting performance and profitability of Australian beef cattle. BREEDPLAN technology has been exported to many countries throughout the world, including developing countries such as Thailand and the Philippines. So the major focus of this study is to gauge the feasibility of introducing BREEDPLAN into the Chinese beef herd to lift the performance of Chinese cattle.

Research Questions

Central questions addressed by this study are:

1.0. Given the vastly different management practices and farming methods of the Australian and Chinese beef industries, can BREEDPLAN technology be successfully integrated into breeding programs within the Chinese beef industry?

2.0. Is the BREEDPLAN system a viable alternative to current programs for beef cattle improvement in China, as an aid for the selection of sires and the prediction of their breeding value and measurement of genetic merit?

2.1. Would the BREEDPLAN system complement existing and/or new research and development of the Chinese beef industry?

3.0. Are there opportunities for Australians with experience and expertise in the Australian seedstock sector to facilitate the application of BREEDPLAN technology to the Chinese beef cattle breeding sector, and to assist in devising suitable, holistic breeding programs based on performance, aimed at producing a higher quality and more efficient article under local conditions?

4.0. Is it feasible for Australian genetic material to be introduced widely into the Chinese industry to lift the level of performance of Chinese beef cattle?

4.1. What is the most appropriate method for introduction of genetic material; live animals, semen, and/or embryos?

4.2. What are the marketing opportunities for Australian genetic material in China?

4.3. What are the cross-cultural implications for Australians wishing to become involved in marketing or consulting in China?

5.0. What are the likely benefits to the Chinese beef industry and how can they be measured, if BREEDPLAN, and Australian genetics were introduced?

Justification for the Research

There are volumes of literature about the Chinese beef industry and much research has been conducted into almost every sector providing an abundance of information about production, geographic distribution and changes in distribution, breeds and breeding, consumption, processing, transportation, economics, marketing and others. However, a need has been identified within the Chinese industry in the area of selecting animals for breeding purposes on the basis of known, superior genetics. Consequently, a gap in the literature exists with regard to the scope for improvement of the performance and profitability of Chinese cattle through the application of genetic evaluation technology. The aim of this study is to contribute to the closing of this gap, justify the need for introducing the technology, assess the possible benefits, and provide information that will assist with its implementation.

Implications of the Research

Breed improvement is an area in which foreign participation is encouraged by the Chinese government. Because the government is keen to commercialise and modernise the beef industry, preliminary research by Longworth (1997) suggested pasture and cattle management, and breeding programs were areas where foreign expertise would be useful. Longworth, Brown and Waldron (2001, p.353) identify cattle breeding as 'representing one of the most significant opportunities for overseas interests in the entire [Chinese] cattle and beef industry'.

Preliminary research for this study has found that there has been extensive development of the Chinese beef industry, particularly with the importation of overseas breeds to upgrade the indigenous Yellow Cattle through cross-breeding programs. However, although these programs have been successful in producing higher quality cross-bred cattle, they have been somewhat indiscriminate without any real data as to the genetic merit of the animals produced. Generally, the programs appear to be aimed at breeding increased numbers of the imported breeds with infusions of the local cattle. There seems to be little effort to genetically improve the local cattle as pure breeds through the application of genetic evaluation technology. Research for this study has identified a need for BREEDPLAN to be introduced widely into the Chinese beef industry, not only to assist with the selection of superior sires for cross-breeding, but also for the identification of genetically superior animals within the indigenous population that could be widely diffused to hasten the development and improvement of local breeds. A need was also identified for the introduction of animals with known genetics as measured by BREEDPLAN, and for individuals with knowledge and expertise to oversee and assist with its application.

In conclusion, the study asks if more research needs to be conducted, particularly in the area of marketing. Government policy at present is to increase numbers of better quality cattle as quickly as possible mainly through the use of imported breeds, suggesting marketing opportunities for Australian genetic material, but at the highest level, there seems to be a lack of awareness by officials of the value of BREEDPLAN technology and its ability to measure, compare and predict the breeding value of beef cattle. Apart from marketing research, the study asks whether there is a problem with low fertility of breeding cows in agricultural areas, and suggests this is an area where further research is needed. Follow-up analysis of data obtained from the application of BREEDPLAN to the Chinese industry with regard to the economic benefits or otherwise if it is introduced, is also suggested.

Limitations

Preliminary fieldwork for the study was conducted by the author in China's Henan Province over a five-month period in the first half of 2002. In-country fieldwork included visits to the Henan Purebred Beef Cattle Breeding and Artificial Insemination Centre, small and medium-sized feedlots, a breeding program in Eastern Henan Province aimed at upgrading Yellow cattle using the Simmental breed, as well as visits to farms and villages throughout Henan Province. However, further research in China planned for 2003 had to be cancelled due to travel restrictions caused by the outbreak of Severe Acute

Respiratory Syndrome (SARS). In terms of production, Henan Province is the largest of the beef-producing provinces, but representative of other major areas. Recommendations from this study relate specifically to the application of BREEDPLAN in Henan Province, but with the support of literature reviewed, the findings can be taken to apply to the Chinese beef industry in general. Although the research covered all sectors of the Australian and Chinese industries to gain a broad overview, the main focus is on the seedstock and production sectors, and findings are limited to the role of BREEDPLAN technology and its potential benefits for the Chinese beef industry, and Australian involvement both in the areas of services and the export of genetic material.

Methodology

The central questions addressed by the study were researched using a multi-method approach. Research was conducted by:

1. Review of published primary and secondary literature resources;
2. Extensive, unstructured interviews with Australian researchers and industry experts;
3. In-country fieldwork in China to gain qualitative data, using observation and interviews to confirm and complement existing data and provide additional information.

Discussions and interviews provided data in the following areas:

- the need for increased performance of Chinese beef cattle;

- attitudes about, and interest in the use of performance technology by Chinese beef producers, and Animal Husbandry and Veterinary Bureau (AHB) and Ministry of Agriculture (MoA) officials;
- the economics of producing better performing cattle. Will the higher costs of imported genetic material and possible higher feed costs be justified?;
- current breeding and management practises;
- use of imported breeds;
- marketing strategies of Chinese producers; and
- opportunities for involvement by Australians, and the export potential for Australian genetic material.

Marketing research for this study to assess the feasibility of exporting BREEDPLAN technology and Australian genetic material to China, was conducted using statistical, qualitative and observational methods. Statistical data was obtained from reviewed literature, databases, and selected internet resources. This data demonstrated the need for a lift in performance of Chinese beef cattle, and suggested there were opportunities for foreign involvement in the area of management, and implementation of breeding programs to evaluate and improve the genetic merit of indigenous and imported cattle.

Itinerant and observational research was conducted in Australia and also as part of the in-country fieldwork in China’s Henan Province. Itinerant research in China included informal interviews and discussions with MoA and AHB officials regarding beef cattle breeding programs, relevant government policy, knowledge of, and attitudes to, performance evaluation technology, and the need for increasing performance of the Chinese beef herd. Informal discussions were also held with feedlot managers and staff, and farmers, about performance, productivity, and quality of Chinese cattle and the need for improvement. Informal, unstructured discussions were also held with Australian beef industry personnel including technical experts and beef producers about BREEDPLAN, its application, benefits, and continuing development. Information from observational research was collected randomly from visits to various enterprises throughout Henan Province such as Artificial Insemination (AI) Centres, feedlots, farms and supermarkets. The research pointed to a need and expressed desire for a dramatic lift in performance and productivity of Chinese beef cattle, with excellent market opportunities for Australian genetic material, and the supply of consultancy services for assistance in management and the application of genetic evaluation programs.

Literature Review

In terms of herd numbers and production, the Chinese beef industry is one of the largest in the world and has attracted a vast amount of research and literature. The University of Queensland's School of Natural and Rural Systems Management has for a number of years been to the forefront of conducting in-depth research, and has produced numerous papers about many different aspects of the industry. Together with the author's own field research in China, and in-depth knowledge of the Australian industry from personal experience as a seedstock producer, these papers provide the basis for placing each sector of the Chinese and Australian beef industries in perspective. Although the findings of this study relate to the genetic improvement of Chinese beef cattle, all aspects of the industry must be considered. It is necessary to take a holistic view as any recommendations to one sector would have ramifications for the industry as a whole. For example, cattle that are more productive may need a higher level of nutrition which may mean they are not profitable for Chinese farmers under local conditions in the agricultural areas. Other relevant literature covering aspects which include integration, transportation, marketing, current Chinese breeding programs, and also research and development of genetic technology in Australia has been reviewed to provide an overview of the Chinese and Australian beef industries.

Key Literature Works

Information for this study draws heavily on two key works. A comprehensive and wide-ranging analysis by Longworth, Brown and Waldron (2001), from in-depth research conducted over four years ending in June 2000, provides a unique and detailed assessment of the Chinese beef industry. The fieldwork in China was conducted by a joint Sino-Australian research team, with Australian researchers from the China Agricultural Economics Group at the University of Queensland, together with Chinese researchers from the Institute of Agricultural Economics within the Chinese Academy of Agricultural Sciences, and from the Rural Development Institute within the Chinese Academy of Social Sciences. The project was fully supported by the Chinese MoA and other Chinese government agencies and research bodies, with core funding provided by Meat and Livestock Australia, and the Australian Centre for International Agricultural Research.

A companion volume by Brown, Longworth and Waldron (2002) was also produced which uses the in-depth research into the beef industry as an example to look at broader issues of regionalisation and integration throughout China. The book also contains an Annex of a series of self-contained chapters describing cattle and beef production, marketing, distribution systems and consumer attitudes in each of the major beef producing Provinces and regions. These two definitive works are extremely valuable sources of information for anyone interested in the Chinese beef industry, and because of their wide-ranging nature are relevant to each of the central questions addressed by this study.

Chinese Beef Industry

Because of the vastness and size of the industry, the overriding feature is the lack of integration. This lack of integration may pose some difficulties for the widespread diffusion of genetic technology throughout the industry as addressed by central questions 1.0 and 4.0. Liang & Smith (1998) suggest that at a provincial level, there has been some attempt to integrate production systems, and see the improved transport system as providing links between different areas. Brown, Longworth & Waldron (2002) see deregulation and political issues as a reason for the lack of integration. The literature suggests that involvement by Australians in beef cattle improvement should be at the Provincial Government level through the MoA and AHB.

In the past, pastoral areas such as Inner Mongolia, Gansu and Xinjiang were the largest beef producing provinces. Zhang & Longworth (1998) have investigated the relocation of production systems from the large pastoral areas to the grain and straw-surplus agricultural areas of central and North East China. Individual households each feeding 2-3 head on a high-roughage low-concentrate diet, supplemented by small to medium-scale feedlots form the basis of production in the agricultural areas. This is an important feature considered by questions 1.0 and 3.0 of this study, as beef production in Australia is mainly in the larger pastoral areas so some breed improvement programs may not be appropriate for Chinese conditions. Zhang (1999) and Ke (1997) also note similar changes in recent years, and see a greater role for government control. Lin & Jarratt (1998) also see a greater role for government, particularly in the areas of health and hygiene, and standardised administration of markets.

Apart from geographical changes in the production systems, there has also been rapid development and improvement of the industry in the last 20-30 years. Zhang & Longworth (1998) found that most development has been through the use of imported breeds in crossbreeding programs with local cattle. Very little effort appears to have been made to try to improve the beef characteristics of indigenous cattle. Longworth, Brown & Waldron (2001) in their extensive analysis of the Chinese beef industry say that the government has encouraged foreign participation in breed improvement. These volumes provide the basis for the present study and relate directly to each of the central research questions as they show a need for an investigation of the opportunities for Australians to become involved in improving the Chinese beef herd through the introduction of genetic technology.

With the emergence of the beef industry as a new mega-industry in China, it was essential that the beef characteristics of local breeds be improved. Animals had only ever been bred for draught purposes as beef was not considered a consumable item. As a result, there has been extensive breed improvement over recent years, mainly relying heavily on imported genetic material for crossbreeding. Live sires were generally imported rather than semen or embryos. Zhang & Longworth (1998) and Longworth, Brown & Waldron (2001) see the improvement through crossbreeding as somewhat indiscriminate, and found there was a widespread lack of skills and resources for selecting suitable sires, and for the performance testing of bulls. Research for the present study as addressed by questions 2.0, 2.1 and 5.0 supports these views and agrees that opportunities exist for foreign involvement in the area of genetic improvement.

One of the driving forces behind breed improvement is the rapid rise in beef consumption of recent years. Although accurate statistics are difficult to obtain, Longworth, Brown & Waldron (2001) note a rise in per capita consumption of beef from 0.3kg in 1980, to 4.0kg in 1999. This is a significant increase for a country with such a large population. Their research is supported by Cai, Longworth & Barr (1999) who have investigated the demand for beef and beef offal in major cities of Eastern China. The dramatic increase in per capita consumption of beef in recent years is an important factor to be considered in relation to genetic improvement. China is a developing country, and history has shown in other developing countries that as the standard of living improves and there is a lift in disposable incomes, consumption patterns change as the population switch from staple foods such as rice, wheat and vegetables to consuming more animal protein. This indicates that beef consumption in China will continue to increase, giving a degree of urgency to the need for improving the productivity of the national beef herd. Question 5.0 relates to the likely benefits if BREEDPLAN was introduced into the Chinese beef industry, so given the restricted amount of land now available for beef production, it could be expected that genetic improvement would lift the efficiency and edible meat yield of cattle so that production would be increased without necessarily increasing numbers.

A second factor driving breed improvement is the shift of production systems to agricultural areas. The surplus of straw provides an abundant supply of fodder but the quality is extremely low. The treatment of the straw with ammonia as detailed by Han (1995), and Li, Zhang, Guo & Waldron (1999), dramatically increases the nutrition value of straw, and provides scope for a major increase in production. Straw is the major feed source for cattle in agricultural areas, and the study must consider genetic improvement in the context of local conditions as addressed by questions 1.0 and 3.0.

Although Chinese breeds of cattle generally lack satisfactory beef-producing qualities, with breed development some breeds do have the potential for acceptable yield. Cheng (1985) discusses indigenous Chinese breeds of cattle and their geographical distribution, and describes four breeds that could have the potential to equal the best beef-producing breeds in the West. Chinese cattle vary greatly because of the influences of climate, feeding, management and selection resulting in obvious breed differences. However, the indigenous cattle have adapted well and Longworth, Brown and Waldron (2001) note that some Chinese experts argue that the Qinchuan breed can often out-perform introduced breeds in the less than favourable conditions. The Nanyang breed of Henan Province is also highly regarded as a producer of excellent beef with good yield. If genetic evaluation technology is introduced into the Chinese beef industry, these indigenous breeds would be targeted and the literature reviewed provides invaluable information about various breeds and their characteristics for formulating recommendations from the research for this study.

Australian Beef Industry

As one of Australia's major industries and an important export earner for the Australian economy, the beef industry is highly developed and the beneficiary of considerable research that places the industry to the forefront throughout the world with regard to efficiency, hygiene standards, and technological development. Coombs, ed. (1993) presents a comprehensive overview of the Australian beef industry with chapters devoted to performance recording, genetic improvement, and the adoption of technology in the future, that are particularly relevant to the major focus of this study. The achievements of many of Australia's leading studmasters and beef producers are outlined by Edwards and Owen, eds.(1990) which provides insights into their philosophies and strategies that has made the Australian beef industry so efficient and respected worldwide. The vast majority of stud breeders in Australia use the BREEDPLAN system, with some of the major, long-established studs having been involved with performance recording since the 1950s. This indicates the depth of knowledge, expertise, and acceptance of genetic technology within the Australian seedstock sector. It provides a solid foundation for discussion directly related to the issues raised in questions 3.0 and 4.0 of this study.

Australian Genetic Technology

BREEDLAN, an international beef performance and genetic evaluation scheme based and developed in Australia is highly regarded worldwide. Sundstrom (2000, www) and Pettiford (2002, www) provide explanations of BREEDPLAN and how it can be applied to the industry. Skinner (2001, p.2) for the Charolais Society of Australia, as do all major breed societies, also provides detailed information and explanations about traits recorded, and how to read the mass of figures in a BREEDPLAN genetic evaluation report. These explanations provide excellent information to assist with a clear understanding of the BREEDPLAN system so that recommendations from the research for this study for application of BREEDPLAN to the Chinese beef industry can be more beneficial and authoritative. The value of genetic evaluation programs such as BREEDPLAN as addressed by questions 1.0, 2.0, and 5.0, is supported and recommended by Australian and overseas scientists and animal husbandry experts such as Charteris (1996 & 1999), Goddard (1997), Johnston (1995, 1997, 2001), Herring (1995), Parnell (2001) and others, in technical notes and advice to beef producers on a wide range of topics including breeding programs, sire selection, feed conversion, and progeny testing. Much of the advice is directly relevant to the developing Chinese beef industry and has been utilised and adapted as a major component of this study.

Outline of the Chapters

Beef has emerged as a major industry in China. Chapter 2 discusses the history of beef production in the People's Republic of China, from being practically non-existent when the Republic was declared in 1949 to become a significant contributor to the national economy by the end of the twentieth century. Also presented is a broad overview of the industry with emphasis on the breeding and production sectors. Building on the writer's own intimate knowledge and experience, in addition, the chapter looks at the Australian beef industry, in particular the seedstock sector as the basis for herd improvement.

Chapter 3 takes an in-depth look at the Australian-developed beef cattle genetic evaluation technology, BREEDPLAN, and other recent developments that may assist the development of the Chinese industry, whilst Chapter 4 discusses the application of this technology and potential benefits to the Chinese beef industry if it is introduced.

The culture of doing business in China is considerably different from the way Australians are accustomed to conducting their business operations. Chapter 5 looks at cross-cultural issues including the similarities and differences between Australian and Chinese cultures, as an aid for those contemplating involvement in the marketing of genetic material, and providing consultancy services to the Chinese beef industry. A summary of the findings from this study is presented in Chapter 6, together with recommendations for the introduction of BREEDPLAN technology into the Chinese beef industry. A full list of references appears following the general summary at the end of Chapter 6.

Chapter 2.

An Overview of the Chinese and Australian Beef Industries.

Introduction

The beef industries of China and Australia are both important for their respective countries' economies. In terms of total output, the Chinese industry is one of the largest in the world, whereas Australia is the largest volume exporter of beef worldwide. The Chinese industry is a relatively new phenomenon as up until the 1980s, beef was not generally considered a consumable item. However, the last 20-25 years has seen extensive research and development aimed at producing a higher quality article, and more profitable and efficient cattle, though most development has been through the indiscriminate use of imported breeds for cross-breeding. Following the end of the Cultural Revolution in 1975 and the introduction of the Household Responsibility System (HRS) in 1978, bovine (Beef Cattle, Dairy Cattle, Water Buffalo and Yak) numbers began to rise rapidly (see Figure 2.1, p.21). This was a result of promotion and assistance from all levels of government. From approximately 72 million head in 1979 numbers had risen to about 130 million head in 1999, of which almost 80% were beef cattle. Most of the expansion occurred in the early 1990s and of the 55 million head increase from 1980 to 1999 around 47 million were beef cattle (Longworth, Brown and Waldron, 2001, p. 15). In terms of numbers, this places China as equal to major beef producing nations such as the United States and Brazil.

To the present time, numbers have continued to grow. Kelf[1] (ABC Radio, 2003), puts current numbers of beef cattle (excluding Dairy Cattle, Water Buffalo and Yak) at approximately 110 million. Kelf also believes that with genetic improvement and more attention to producing a higher quality product, the Chinese industry could be a major competitor in world markets.

The Australian beef industry began when cattle arrived with the first fleet. Further importations followed regularly, with some of the early settlers being astute cattlemen who contributed much to the foundation of the industry as it is known to-day. Although relatively small in terms of numbers, being the largest volume exporter of beef worldwide, the Australian industry is extremely efficient and employs world's best practice by using the latest technology in every sector of the industry.

This chapter discusses the history, and recent research and developments within both the Chinese and Australian industries, and also looks at various aspects that affect the performance and efficiency of cattle, and thus the profitability of beef producers. Of particular focus is the breeding sector of the Chinese industry and the need for improvement of the overall quality of Chinese cattle.

The Chinese Beef Industry, 1949-1978

At the time of the declaration of The People's Republic of China by Mao Zedong in 1949, the majority of Chinese farmers were extremely poor. Dietrich (1998,

[1] Tim Kelf is Regional Manager, South Asia Representative Office, Meat and Livestock Australia.

p.12) says that about 94% of the total population lived in rural areas, but almost 50% of the land was owned by the wealthy 10% who were rich farmers and landlords. The economic gap between the rich and the poor was huge, and it is clear that the vast majority of the world's most populous nation would be classed as poverty-stricken. Animal protein was rarely, if ever eaten, and basically restricted to pork, and sometimes chicken. Farming methods were primitive, but yields achieved were high, especially in rice production due to the attention lavished on the small plots. However, in terms of labour inputs, yields were low and only achieved through long hours of back-breaking, unremitting toil. Many of the peasants tilled the soil by hand with their own hand-made tools, but some used an animal for pulling a plow.

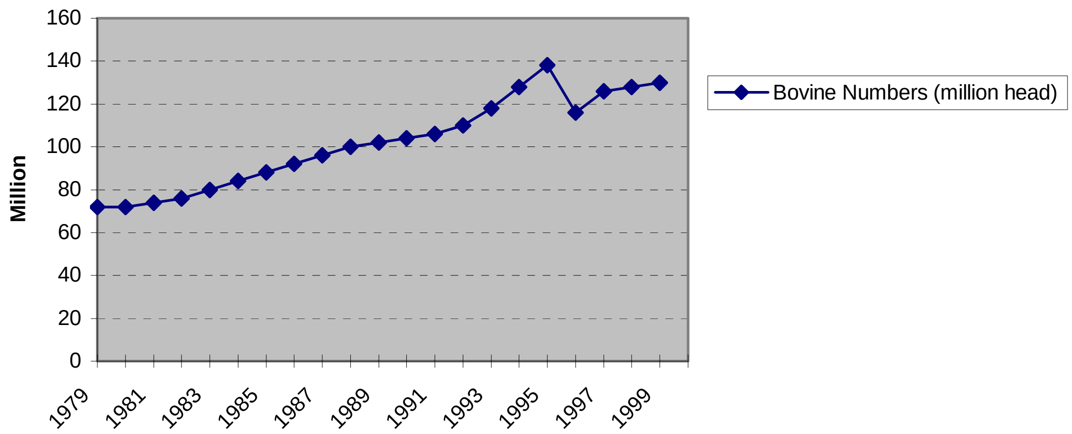
Cattle were kept exclusively for draught power and apart from the minority Muslim Hui community, beef was not considered a consumable item. Many farmers, as they still do to-day, used a cow for plowing, pulling carts, and any other farm work. It was most common for only one cow to be owned, though farmers with larger plots may keep two head. The cow was kept in a stall, usually in the owner's courtyard, and rarely allowed to graze freely. Straw from the crops was retained, and together with freshly cut fodder from the roadsides when available, remained the cow's staple diet. The diet was satisfactory for body maintenance but the level of nutrition was too low for fattening. All manure, including "nightsoil", was spread on the farming plots, and other fertiliser or chemicals were never used.

Although the coming to power of the Chinese Communist Party (CCP) in 1949 saw major changes in the ownership of land, and the ability of individual farmers for a time to be responsible for their own management decisions, the traditional way of farming has generally remained the same to the present day. Some mechanisation has been introduced, but many farmers still retain one or two cows for draught work. Until 1978, their cows were only sold for slaughter if injured, or became too old for work. Specialised beef raising households and feedlots in agricultural areas were virtually non-existent, with the only larger herds raised on state farms in the northern and western grasslands.

Overall, government support for the beef industry was minimal, with any direct involvement in cattle production restricted to the 2200 state farms (Kunkler, 2002, www). Under the commune system, which was a feature of the Great Leap Forward introduced by Mao in 1957, and only dismantled following the economic reforms began in 1978, all decisions were controlled by the State. Farmers were told what crops to grow and when they were to be planted. The grain produced was purchased by the government at a price set by the government. All land was state-owned and individuals were not allowed to own livestock. Animals were kept for the benefit of the commune and used for draught purposes. As a result, there was a complete lack of control of meat handling and quality. The few cattle available for beef were processed by slaughtering households in rural areas with most consumption occurring near where the cattle were slaughtered. Slaughtering households were operated by the minority Muslim Hui community, who were also the major consumers.

Numbers of bovines (cattle, water buffalo and yak) in 1949 were approximately 42 million head. As noted by Longworth, Brown and Waldron, (2001, p.14), by 1980 numbers had climbed to about 72 million head (of which slightly less than 40 million head were beef cattle), but only 5% of these were slaughtered or sold.

Figure 2.1 Bovine Numbers in China 1979-1999



*Following the National Agricultural Census in 1996 official statistics were revised downward.
Source: Selected figures from Longworth, Brown and Waldron, 2001, p. 15.

Until 1980 there was no real beef industry in China. It was only after the reforms introduced in 1978 that the beef industry, along with other industries, began to move forward to become a major contributor to the national economy.

The Chinese Beef Industry After 1978

The rapid development of the beef industry which began in the early 1980s can be linked directly to the economic reforms introduced by the Chinese government under Deng Xiaoping in 1978. One of the most important features of the reforms was the HRS, in which collective land was assigned to households, and local governments took the initiative of transferring production decisions and profits from communes to households. Zhou (1996, pp.70-71) argues that the reforms were forced on the government by a bottom-up process. The failure of the communes - the system imposed on farmers by Mao Zedong in 1958 - to increase food production sufficiently to keep pace with population growth gave the farmers incentive to resist the commune system. Without leadership or organisation, a movement spontaneously began where the farmers bribed corrupt cadres for illegal control of small plots of land with freedom to make their own management decisions as to what to grow and how to market their produce which was in excess of quota requirements. This effectively bypassed government control over production and marketing resulting in greatly increased output. The commune system was oppressive, and an affront to the traditional family system of land ownership and autonomy. Even from the earliest days of the Communist regime as farmers began to see their autonomy being taken away, they found ways, mainly through bribery and corruption, to buffer the worst excesses of the commune system. They were able in some instances, with the assistance of corrupt cadres, to retain excess production for sale, thus providing incentive for higher production.

Following the death of Mao in 1976, the political environment changed. The degree of confusion that reigned as various leaders vied for the position of succeeding Mao gave provincial leaders the opportunity to reduce the harm inflicted by Mao’s radical agricultural policies. Zhou (1996, p.60) sees these reform initiatives as providing an umbrella for the rapid spread of the HRS. Until 1980, the country’s leader, Deng Xiaoping strongly opposed the HRS, but by 1982 the dramatic rise in grain production in areas where farmers were given responsibility and autonomy could no longer be ignored. In 1982, Deng and others leaders lent their support to the farmer's movement for decollectivisation, and as part of economic reforms, early in 1983 gave legal recognition and encouragement to the HRS (Zhou, 1996, p.69).

As the communes disappeared and individual households were assigned land, farmers in the major agricultural areas were once again able to keep one or two cows for work, with the progeny not required as replacements made available for sale. This encouraged farmers to breed their cows on a more regular basis and was one of the factors resulting in the dramatic increase in numbers at that time. The other major factor that saw the Chinese beef industry develop rapidly in the 1980s was a change in government policies to free-up and strengthen the prices of livestock products, and direct support and encouragement by central and local governments (Zhang and Longworth, 1998).

Straw for Ruminants Program[2]

With technical and financial assistance from the United Nations Food and Agriculture Organisation (FAO) and the United Nations Development Program (UNDP), in the mid 1980s China began to introduce the technique of straw ammoniation (Han, 1995, p.66). The technique refers to treating straw from cereal crops with anhydrous ammonia and urea to improve the digestibility and palatability to produce excellent cattle feed[3]. In China, the ammoniation of straw delivers many benefits which have implications for much more than just the

[2] For further details about the Straw for Ruminants Program see Longworth, Brown and Waldron, (2001, p.31), and Li, Zhang, Guo and Waldron, (1999).
[3] The ammoniation of straw to increase its nutritional value is common throughout the world. In Australia, urea is mixed with molasses and fed as a supplement rather than treating the straw, to produce the same result.

feeding of livestock. Apart from the improvement of dietary patterns, large quantities of grain that would otherwise have been fed to livestock can be retained for human consumption. Han (1995, p.68) states, 'In 1993, a total of 11.7 million tons of straw was ammoniated throughout the country, resulting in a savings of 4.68 million tons of feed'. This is a significant saving as China's population continues to grow, yet available arable land continues to decrease each year. In the past, as the straw was considered a waste product it was common practise to burn crop residues which contributed to the massive environmental pollution problem that has plagued China for many years. Yet despite the success of straw ammoniation and ensilage, and that in 1992 more that 2 million rural households used straw, Han (1995, p.68) says this only represented approximately two percent of total rural households. In that year, China produced more than 400 million tonnes of grain which left a residue of about 570 million tonnes of straw. This clearly indicates there is much scope for continued development of the Chinese beef industry as straw is the main component of the diet for beef cattle.

Location of Major Beef Production Areas

The rapid expansion of the Chinese beef industry since the 1980s has seen the major production areas for beef shift from the vast Western pastoral region to the agricultural land of the Central Plains (see Table 2.1). With the growth of the industry, bovine numbers and production increased in all areas, but the percentage of output changed significantly. In 1980 the Western pastoral region, which includes the provinces of Inner Mongolia, Ningxia, Gansu, Xinjiang, Qinghai and Tibet, produced 44% of total output, but in 1999 had dropped to 12% (see Appendix 1 for Map of China).

Table 2.1 Regional Distribution of Bovine Numbers, Turnoff, and Meat Production in China, 1980, 1990 and 1999.

Beef Zone (provinces)	**Year**	**Year-end bovine inventory**		**Bovine turnoff**		**Average carcase weight**	**Meat output**	
		Million head	%*	Million head	%*	kilograms	'000 tonne	%*
Central Plains	1980	16.1	23	0.5	15	79	39	14
Henan, Hebei,	1990	29.6	29	4.8	44	126	604	48
Shandong, Anhui,	1999	45.7	36	18.5	49	148	2742	54
Jiangsu, Hubei,								
Shanxi, Shaanxi								
North-east	1980	3.5	5	0.3	8	113	28	10
Heilongjiang, Jilin,	1990	5.8	6	0.9	8	135	122	10
Liaoning	1999	11.0	9	6.0	16	137	824	16
South-west	1980	22.8	32	0.7	22	72	54	20
Sichuan, Guizhou,	1990	30.7	30	1.6	14	96	149	12
Yunnan, Guangxi,	1999	33.6	26	5.0	13	107	533	11
Chongqing								
Western Pastoral	1980	17.9	25	1.4	43	83	118	44
Inner Mongolia,	1990	21.3	21	2.7	25	107	293	23
Gansu, Ningxia,	1999	20.4	16	5.2	14	121	630	12
Xinjiang, Qinghai,								
Tibet								
Other	1980	11.4	15	0.4	12	69	30	11
Beijing, Shanghai,	1990	15.5	15	0.87	8	101	88	7
Tianjin, Fujian,	1999	16.2	13	3.0	8	108	323	6
Hunan, Zhejiang,								
Jiangsu, Hainan								
Guangdong,								
Total for all	1980	71.7	100	3.3	100	81	269	100
China	1990	102.9	100	10.9	100	124	1256	100
	1999	127.0	100	37.7	100	134	5054	100

*Percentage of China's total.
Source: Longworth, Brown and Waldron, 2001, p.16.

In contrast, the Central Plains region covering Henan, Hebei, Shandong and Anhui Provinces, together with neighbouring provinces of Jiangsu, Hubei, Shanxi and Shaanxi, produced only 14% in 1980, but by 1999 had leapt to an incredible 54% of total meat production for the whole of China.

The “Straw for Ruminants” program was a major factor in locating beef production away from pastoral to agricultural areas. Overgrazing of grasses combined with drought in the Western pastoral region has seen much of the land denuded of vegetation and production reduced. The abundance of straw in the Central Plains region ensures an abundance of feed, but also these provinces have a milder climate, and a number of native breeds, more suited to beef production.

Northern and Western Pastoral Areas

Prior to the 1980s, approximately half the beef output for the whole of China was produced in the Northern and Western pastoral regions. However, Zhang and Longworth, (1998) found that by 1990 this share had declined to 23%, and by 1996 to just 10%. Beef cattle are still the main source of income for farmers in the pastoral areas and also provide milk for sustenance, but production systems have undergone some changes due to the degradation of the land. Whereas in the past, production relied solely on grazing, since the 1980s supplementary feeding has been adopted, particularly in winter. Cattle were also slaughtered without further fattening, but since the 1990s, the pastoral areas have become a major supplier of feeder cattle to the agricultural areas for fattening, mainly in feedlots. The sale of the young feeder cattle reduces the number of head to be held through the winter period thus relieving the pressure on the fragile pastures (Zhang and Longworth, 1998). Imported breeds have also been introduced for cross-breeding to improve the efficiency of the indigenous breeds. The Simmental breed has been used widely for its dual purpose capabilities, with early imports of various breeds dating from the 1950s (Zhang and Longworth, 1998). Simmentals are known not only for their excellent meat yield percentage, but also for their high milk producing qualities.

Central Plains Agricultural Area

Being the smallest in total land area of the Central Plains agricultural provinces, Henan Province with almost 13 million head of cattle is the largest cattle and beef producing province in China. The immense grain industry with its approximate amount of 42 million tonnes of crop residue is the key to increased production. Encouraged by the "Straw for Ruminants" program, the production sector is dominated by small households. Many of the farmers keep one or two head for draught work, while others have moved to specialised beef production. Despite around 1 000 households leaving the industry in Henan because of depressed prices for cattle from 1995 to 1997, Brown, Longworth and Waldron (2002, p.135) note that, 'between 1997 and 1998, a further 5 000 households that raised between four and 10 cattle entered the industry, to reach a total of 20 000'.

Production Systems

The majority of beef produced in China as noted by Zhang and Longworth, (1998), is in the agricultural Central Plains Provinces of Henan, Shandong, Anhui and Hebei and generally of very low quality. The low quality is partly because of the long history of breeding cattle for draught purposes, but a number of other reasons have contributed. As stated previously, development of the industry has only occurred within the last 20-30 years, which is too short a time for major improvement. But to get a clearer picture it is necessary to look at how beef is produced.

Unspecialised Households

It is generally accepted that the majority of cattle - about 90%, are raised by unspecialised households and sold to specialised households for fattening, low-grade abattoirs or slaughtering households, either directly or through dealers (Longworth, Brown and Waldron, 2001, p.73). A household is classed as "specialised" if more than 60% of income is derived from beef production, whereas "unspecialised" households engage in crop production and keep 1-3 cows for draught work. Apart from the occasional female retained as a replacement, the calves are usually sold at approximately 9-12 months of age. The older females are sold for slaughter when no longer required for work. The stock are fed a diet of straw and sometimes a small amount of grain or other supplements, and usually tethered or confined in the owner's courtyard. At times they will be tethered or minded along roadsides as feed becomes available, though generally the level of nutrition is extremely low. At a village level, cattle are usually local Yellow Cattle, and calves are most commonly sired by the village bull owned by one of the farmers. Artificial insemination from better quality sires is available in most areas and farmers are strongly encouraged to make use of the service, though the village bull is still preferred. As beef production is only a secondary consideration for unspecialised households, there is no real incentive to breed a better type of animal.

Specialised Households

Specialised households, as described by Longworth, Brown and Waldron, (2001, p.124), are more commercialised than unspecialised households and allocate the majority of their resources to fattening rather than breeding. The stock are purchased from unspecialised households or at large cattle markets and fed for 120 days. Up to 12 head are fed at one time and turned over three times a year. Specialised households also engage in speculative trading and can hold up to fifty head at any one time. There is a preference for cross-bred cattle, and because of the better feeding regime, the quality of the meat is a little higher and commands a higher price than meat from unspecialised households.

Image 2.1 **Specialised household feedlot.** A group of twelve animals with both entire males and females of the Nanyang breed being fed, remaining tethered individually to poles in the open for up to six months.

However, the majority of cattle are local Yellow cattle (see image 2.1), due to the reluctance of farmers to use AI. The meat is sold at wet markets or through supermarkets. Usually one cow will be kept by a specialised household for draught work, and other animals such as pigs and chickens will be raised for own consumption. Wheat is grown in winter and corn in summer, but is insufficient for feeding requirements so considerable quantities need to be purchased. Straw from the crops is retained and is the main ingredient of the feed mix.

Feedlots

The feedlot industry in China is growing rapidly with about 50,000 units, and Longworth, Brown and Waldron (2001, p.140), found that the sector is dominated by small feedlots (51-100 head), and medium feedlots (101-1000 head). There are very few feedlots with over 1000 head. The medium and larger size feedlots are often integrated with abattoirs, and feedlots at present only make up a minor proportion of the beef production sector. However, they aim for a better product to supply the growing premium market as demanded by five star restaurants, the new wealthy class of consumers in the large cities, and also for export to Hong Kong.

Image 2.2 Medium size feedlot, Eastern Henan Province. About 100 head are fed at one time, with these cattle transported from Inner Mongolia. After being fed for 120-150 days, they are delivered to the premium Hong Kong market.

A feedlot visited by the author near Shangqiu (see Image 2.2), in the east of Henan Province is fairly typical of a small-to-medium size feedlot. In addition to local cattle, stock are sourced from the pastoral areas of Inner Mongolia. Charolais, Limousin and Simmental breeds were introduced in the early 1980s and used widely in the larger herds of the pastoral areas resulting in a more efficient animal with a higher yielding carcase. The cattle enter the feedlot in mobs of approximately 100 head at about nine months of age and fed a high protein ration for 150-180 days, with an exit weight of about 500 kgs. They are trucked to Hong Kong where they are slaughtered and the meat marketed. The Hong Kong market is a premium market so the feedlots demand high quality cattle to feed.

Artificial Insemination Centres

Bull breeding stations, more commonly known in Australia as artificial insemination centres, are state-owned and form the basis for breed improvement in China. The purpose of these stations is to provide AI facilities for farmers and state-run breeding herds, and some have their own breeding stock to breed replacement sires.

Image 2.3 Henan Purebred Bull Breeding Centre. A Simmental donor AI sire imported from Canada.

AI centres are sited throughout China including the northern and western pastoral areas as well as agricultural areas where most beef is produced. The Henan Purebred Beef Breeding Centre just outside the Provincial capital Zhengzhou, and also visited by the author, has almost 100 bulls for semen production. These bulls have been imported from Canada or are progeny of imported stock. Breeds represented are, Simmental (see image 2.3), Charolais, Limousin, Red Angus, Gelbvieh, Piedmontese and Blonde d'Aquitaine. The centre also runs about 100 purebred breeding females of various imported breeds (see image 2.4), for replacement breeding stock and for breeding donor bulls, with surplus young bulls sold throughout China to other breeding stations and large cattle breeding enterprises. An extensive embryo transfer (ET) program is also run at the Henan Bull Breeding Centre, which in addition to quickly increasing the number of superior stock, allows for research into improving the technique of ET.

Image 2.4 Henan Purebred Bull Breeding Centre. Some of the Simmental and Limousin dams for breeding replacement sires. Other females at the centre were Charolais and Piedmontese.

Bull Breeding Centres are being pressured to become more cost-effective and self supporting. Longworth, Brown and Waldron (2001, p.69) say that financial responsibility for the centres and their services are being handed down from the central government to provincial and lower levels of government. Longworth, Brown and Waldron also suggest that subsidisation of AI services could be wound back in the future. This may open the way for a free market to develop for cattle breeding services, but would first need a major change in local development strategies and perceptions. However, a negative factor could be that unspecialised households may have little incentive to use unsubsidised semen for upgrading their cattle, and continue to favour the village bull for breeding. These are important issues to be considered by foreign players wishing to become involved in consulting or marketing to the Chinese beef industry, and should be subject to in-depth market research prior to involvement.

Artificial Insemination System

Bull stations such as the Henan Bull Breeding Centre and its AI system are state-owned, and are controlled by the provincial AHB. The price of frozen semen and insemination fees are heavily subsidised by the Provincial government. Longworth, Brown and Waldron (2001, p.68) note that the price of semen is about Rmb1.2-1.5[4] per straw, and with the insemination fee included, totals about Rmb15-20 per service, usually paid when the pregnancy is confirmed. Semen

[4] As at the 4th July 2003, the exchange rate between the Chinese Renminbi and the Australian dollar was A$1 = Rmb5.63, making the cost of a straw from 18-27cents, and service fee from $2.66 – $3.55.

from the AI centre is channelled through Prefectures, Counties and then Township livestock service stations from which trained inseminators provide the service to the farmers. Lower-level service stations at times may buy semen direct from other AI centres either inside or outside their own province, but to qualify for the substantial government subsidy they must be approved by provincial authorities.

The Role of Government

For overseas consultants and marketers to become involved with the introduction of genetic technology, and the marketing of genetic material into the Chinese beef industry, it is necessary to gain an understanding of the industry's organisational structure and culture. The most important factor relating to involvement is the role of governments, both local and central, in their planning and control of the industry. Despite not having a long history of state influence and regulation because of its relatively recent evolvement, Longworth, Brown and Waldron (2001, p.13) state, 'Nevertheless, governments at all levels have dominated - and will continue to dominate - most aspects of the cattle and beef industry'. The industry has been driven by a top-down approach as most policies and plans are first developed at central and provincial levels and then passed down to county, township and village levels for implementation.

The MoA is the most important ministry in relation to decision-making within the cattle and beef industry. As stated by Dai[5] (pers. comm. 2003), in Henan Province, matters in relation to the cattle and beef sector must first be discussed

[5] Dai Huafeng is legal advisor to the Henan Provincial Ministry of Agriculture.

with the head of the AHB (a department of the MoA), who would then make recommendations in a report to the Director of the MoA. If the report receives a favourable decision, it is then channelled through the Provincial Governor direct to the third highest ranking member of the central government, the Minister for Agriculture. Dai suggests that it is essential to meet with and develop a good relationship with both the head of the AHB and the Director of the MoA at a provincial level for anyone wishing to become involved in the cattle and beef industry anywhere in China. Longworth, Brown and Waldron (2001, p.70), also agree that it is necessary for foreign interests to establish relationships with the relevant government departments as key decisions are made at provincial and central levels in the AHB bureaucracy. Cultural issues regarding the developing of contacts and doing business in China will be discussed further in Chapter 5.

Specific Programs to Assist the Beef Industry

In 1992 the then Premier, Li Peng, expressed his strong support for the cattle and beef industry. This heralded a widespread positive attitude towards the industry and ushered in a period of dramatic expansion and development. One of the most important and valuable programs to be introduced was the Straw for Ruminants program in 1992. Longworth, Brown and Waldron (2001, p.31) state, ‘By 2000, the central government, under the auspices of the Straw for Ruminants program, had granted a total of Rmb367 million to 380 “demonstration” counties and 13 prefectures’. The majority of funds were used in the agricultural areas to increase cattle production, and the central government expenditure was matched on a ‘one to one’ basis by local government. The government also invested heavily in the construction of bull stations and the development of AI networks, and for research and development into beef production such as cross-breeding programs. In addition, the industry benefited greatly from the broader economic development as part of the reform process after 1978[6].

Beef Cattle Development Programs

Extensive programs involving the use of imported breeds have been implemented to improve the beef-producing qualities of Chinese beef cattle. Prior to 1986, three new dual-purpose breeds (Shanhe, Xinjiang Brown and Caoyuan Red) were developed involving intensive breeding and selection using imported genetic material, but no new breeds have been developed following these initial programs (Longworth, Brown and Waldron, 2001, p.51). Although some programs have aimed at "fixing" improved strains of local breeds by incorporating a percentage of imported blood, in recent years the major focus of breed improvement has been either restricted to cross-breeding, or grading up indigenous breeds to a high percentage of an imported breed. For example, the author inspected a program near Shangqiu, in Eastern Henan Province, involving Simmental and Yellow cattle. Through a system of crossing and back-crossing, the Yellow cattle were being upgraded and resembled purebred Simmentals. The stated aim of the program was to improve the milking ability of the local cattle, but the increased muscling was also obvious. Despite the excellent results of beef cattle improvement, programs tend to be indiscriminate and localised, with no basis for measuring performance or evaluation of genetic gain. The introduction of a genetic evaluation system such as the Australian-developed BREEDPLAN performance technology (see Chapter 3), would not only assist

[6] For a full discussion of the broader economic issues affecting the beef industry see: Longworth, Brown and Waldron, 2001, pp.26-30.

with the identification of superior animals and measurement of genetic gain, but also provide a coherence for the consolidation of national goals and objectives within the Chinese beef industry.

Consumption Trends

The rapid growth of the Chinese economy and improved standard of living for the population since 1980 has been matched by an equally dramatic increase in meat consumption. It is a common pattern in developing countries to see a gradual shift from staple foods such as rice to more expensive animal products as the standard of living improves and consumers have a higher disposable income. Cai, Brown, Wan and Longworth (1998), see this same pattern reflected in China. They say that the majority of the increase in total meat consumption has been achieved by a greater demand for beef, and to some extent chicken, resulting in a substantial decrease in consumption of the dominant source of animal protein, pork. From a base of almost zero consumption in 1980 the amount of beef consumed had risen to four kilograms per annum per head of population in 1999 (see Table 2.2). With approximately 1.3 billion people, this equates to a huge amount of beef to be produced to satisfy the demand.

Table 2.2 Increase in per capita meat consumption (kgs) in China from 1980 -1999.

Year	Pork	Beef	Mutton	Poultry	Other	Total
1980	11.5	.03	0.4	1.0	0.0	13.3
1990	20.0	1.1	0.9	2.8	0.2	25.0
1999	31.8	4.0	2.0	8.9	0.6	47.3

Source: Longworth, Brown and Waldron, 2001, p.24.

Most of the increase in beef consumption has occurred in urban areas, while the rural population continues to favour pork. Cai, Longworth and Brown (1998), suggest a strong social and cultural tradition may cause rural residents to be reluctant to eat beef as cattle were an indispensable asset for the farming community and never thought of as food. In contrast, the population in the many large cities are more accustomed to a changing environment and more conscious of the health benefits from eating beef as compared to the much fatter pork. The author found in Zhengzhou, a city of more than six million people and the capital of Henan Province, that beef dishes were common in the better quality restaurants, but rarely served in the smaller, common eating places that seem to pervade almost every street and alley. Beef was never seen for sale in rural areas or served in countryside restaurants. The increase in beef consumption has occurred despite beef being priced significantly higher than pork and other meats. Although not often found in suburban supermarkets in Zhengzhou, beef of an indeterminate cut was priced (in April 2002) from Rmb35-40 per kilogram, while a similar piece of pork was priced from Rmb20-25 per kilogram. The eating quality of the beef purchased was considered excellent. From informal discussions with urban residents, it was found that pork, followed by chicken and fish was the most common animal protein eaten, but the majority of people indicated a growing preference for beef as they liked the taste and considered beef a healthy alternative. Many urban residents now live in modern apartments with excellent cooking and refrigeration facilities, so preparation of beef for cooking is considered just as convenient as for other meats.

The dramatic increase in consumer demand for beef demonstrates the necessity for the Chinese beef industry to be more efficient so that the expected continued growth in demand can be matched by increased production. Available land for a large increase in cattle numbers is restricted, so beef cattle must be improved to become more efficient beef producers. They must be able to convert available fodder into beef more efficiently with a higher yielding carcase. This can be achieved through selection with the aid of genetic evaluation technology.

Chinese Beef Cattle Breeds

Indigenous cattle breeds, commonly known as Yellow cattle, are found in every part of China. There are obvious breed differences, which Cheng, (1985, p.2) see as a result of the ecological conditions under which they are found. Yellow cattle, as distinct from Water Buffalo and Yak, can be classified into two main types; common Yellow cattle (bos taurus) which make up the majority, and humped cattle (bos indicus), mainly found in southern areas. Chinese cattle can roughly be divided into three categories, northern, central plains, and southern Yellow cattle. Their body size relates to the conditions of climate, ecology, and available feed. Zhang and Longworth, (1998), and Cheng (1985, pp.3-7), describe Northern Yellow cattle, which includes breeds such as Menggu

(Mongolian), Hazake (Kazak), and Yanbian as having medium body size and weight, while Central Plains cattle are described as possessing a relatively larger body size and weight. Cattle in the south are fine boned and comparatively much smaller in body size and weight, making them more adaptable to the mountainous grazing areas of the tropical belt. All Chinese Yellow cattle have poor body conformation from the point of view of beef production, with drooping rumps and thin hindquarters lacking muscle expression. Their conformation is basically the shape of a draught animal with large shoulders and narrow hindquarters.

Four well known and popular breeds from the Central Plains area, the Qinchuan and Jinnan from Shanxi Province, Nanyang from Henan Province, and the Luxi of Shandong Province, together with the Yanbian breed from close to the Korean border in Jilin Province, are recognised as having better meat production performance. Zhang and Longworth (1998), believe that performance indicators for Qinchuan cattle 'can approach or even exceed that of famous exotic beef breeds'. They suggest that if the breed was selected and bred to improve conformation faults, early maturity and meat and milking performance, Qinchuan cattle could become a world famous breed.

Australian Beef Industry[7]

Australia, like China, is a vast country with a wide array of climatic conditions

[7] Issues not relevant to the key questions, such as the processing sector, beef exports, transportation, industry structure, and domestic consumption, are not discussed.

from tropical to temperate, and high altitude to desert, and for both countries, the beef industry is vitally important and a major contributor to their respective economies.

Imported breeds have been used extensively in Australia and China and much research is carried out to improve the productivity and efficiency of beef cattle. But there the comparisons end. Research in China has been aimed at improvement through cross-breeding with imported breeds, with very little work done to genetically improve, and at the same time, maintain the purity of indigenous breeds. Extensive cross-breeding is a feature of the Australian beef herd, but research has been more specific. For example, cross-breeding with Brahmans in Northern areas has been used because of their hardiness and resistance to disease and parasites, to breed cattle more suited to tropical and arid areas. A major focus of research in Australia over the last 50 years has been the development of programs for improving performance through the measurement and comparison of the genetic merit of beef cattle. The author has been unable to find evidence of similar programs in China. All beef cattle in Australia were originally imported, mostly from Europe, as there were no indigenous cattle prior to White settlement, and unlike China, have always been bred for beef production. In turn, Australian-bred cattle have been readily exported overseas, due to the country's clean, disease-free status. Because of its geographic isolation, Australia has been able to remain free from serious livestock diseases such as Mad Cow and Foot and Mouth diseases.

Another major difference is that whereas Chinese production is based in agricultural areas, Australian production is largely pastorally based. In the temperate Southern areas, beef is usually produced in mixed farming and grazing enterprises, while in the north, particularly in the largest beef-producing state of Queensland, it is noted by Coombs, ed. (1993, p.33) that in the vast areas of Northern pastoral country beef is produced as the sole commodity. Southern beef herds tend to be much smaller in comparison to those in the north, with southern beef from the improved pastures generally intended for domestic consumption. The larger northern properties mostly aim to produce beef off native pastures for the export market, and animals are heavier and older when sold. There is also a marked difference in the type of cattle between southern and northern regions. Southern producers prefer a predominance of British Breed (bos taurus) blood for the more favourable temperate climatic conditions, whilst in the tropical and sub-tropical northern areas, a high proportion of Tropical (bos indicus) blood is necessary to combat ticks, heat, and a lower level of nutrition from the native grasses.

Australian Beef Cattle Breeds[8]

The first cattle to arrive in Australia, a bull, four cows and a bull calf, came in 1788 with the First Fleet, and were Africaner cattle brought from Cape Town. Of these original cattle, one cow was destroyed, and the remainder escaped into the bush. Some years later they were spotted west of the Nepean River, and by 1808, the herd had grown to about 5000 head (Edwards and Owen, 1990, p.9). In 1791 and 1792, a further 15 head arrived from South Africa, and in 1795 a

[8] Breeds discussed are restricted to major breeds in Australia, and those which have been introduced into China or may have potential to be widely used to improve Chinese cattle.

substantial shipment of 131 head arrived from India. By 1804, the official herd, excluding the wild cattle that had escaped, had grown to more than 2000 head. In 1800, some Shorthorn cows and a Devon bull were the first purebred stock to be introduced. Edwards and Owen, eds. (1990, p.10) note that in 1813, 'Governor Macquarie introduced a number of sound management procedures to improve the herd, including the segregation of heifers until a good breeding age, the mating of bulls to groups of 30 cows and the selection of superior bull calves as future sires'. These are fundamental breeding imperatives and still used in modern cattle breeding. Thus it can be seen that herd improvement was initiated from the earliest days of the beef industry in Australia. Pedigreed herds, and to a lessor degree a number of herds of superior commercial purebred cattle, form the basis of the seedstock sector, and are the nurseries for the majority of replacement sires used throughout the industry.

Shorthorn/Beef Shorthorn[9]

Shorthorns made up most of the early importations of purebred beef cattle into Australia. The early pioneers took them to all corners of the country thus laying the foundation for the beef industry as it is known today. Shorthorn cattle are red, white or roan in colour, and are docile, versatile animals eminently suited to the open, western plains of Queensland and New South Wales. They have been used as the basis for the development of a number of new breeds. With the introduction of North American genetics and the application in recent years of the genetic evaluation technology, BREEDPLAN, Shorthorn cattle have become extremely popular. Their structural soundness and the ability to produce high

[9] Information about breeds discussed draws heavily from Coombs, ed. 1993, pp.15-28.

quality, well marbled meat has made them one of the favoured breeds for the lucrative Japanese market.

Angus

Angus cattle are black in colour and were introduced into Australia around 1840. They are the most popular breed in temperate areas, but have also adapted to sub-tropical conditions where they are widely used for cross-breeding. Performance recording has been practised by many breeders of Angus cattle for many years, and the Angus Society were the first breed society to produce a sire summary using the Group BREEDPLAN genetic evaluation system. The Angus breed has a strain, brownish-red in colour, known as Red Angus.

Murray Grey

Similar to Angus cattle in conformation, and developed in the early 1900s from an Angus base, the Murray Grey breed has dominated carcase competitions in Australia for many years. Respected for their high yield of high quality meat, Murray Greys, like Angus and Shorthorn cattle, are the favoured breeds for the Japanese market. The Murray Grey breed, which ranges in colour from dark grey to silver, was the first breed of cattle to be developed in Australia and has been exported to many other countries including Canada, United States, Great Britain, New Zealand, Fiji, Japan and China.

Hereford/Poll Hereford

Originating in England, Herefords were introduced in 1826, making it one of the oldest established breeds in Australia. Poll Herefords, the hornless strain of purebred Herefords and noted for their docility, were introduced from the United States in 1920 to reduce losses and wastage from horn damage, a major cause of bruising and hide down-grading. The Poll Hereford Society is the largest of all beef groups in Australia.

Charolais/Limousin/Simmental

Collectively know as "European Breeds", Charolais, Limousin and Simmental cattle have become very popular in Australia, and just as they have in China, used extensively for cross-breeding. European breeds are heavily muscled, large framed animals exhibiting high growth rates, and produce a high-yielding carcase of meat with a low percentage of fat. Other European breeds popular in Australia include, Gelbvieh, Piedmontese, and Blonde D'aquitaine. These breeds are also commonly used in China.

Brahman

The most important of the Tropical Breeds, Brahman cattle were first imported into Australia in 1933. Originating in the United States in the early 1900s, Brahmans were developed from the progeny of four Indian breeds with some infusion of British bred cattle. Their resistance to internal and external parasites, heat tolerance, and ability to graze in hot weather and walk long distances to feed and water, was instrumental in helping to revolutionise the northern cattle industry. Brahmans and their crosses are now the most numerous of the tropical breeds, representing more than 70% of the Queensland beef herd. Queensland has the highest number of beef cattle of any Australian state with approximately half the national total.

Santa Gertrudis

Developed in the United States from a Brahman and Shorthorn base and recognised as a pure breed by 1940, Santa Gertrudis were first imported into Australia in 1952. They are cherry red in colour and have adapted well to a variety of climatic conditions. Since its inception, the Santa Gertrudis Breeders' (Australia) Association has enforced a rigid classification system with all animals subject to inspection for quality and breed characteristics before they are accepted for registration. Santa Gertrudis breeders have been to the fore in performance recording and genetic evaluation through the BREEDPLAN system.

Brangus/Braford/Droughtmaster

Developed breeds such as Brangus, Braford and Droughtmaster have made a great contribution the Australian beef industry. By crossing individually Angus, Hereford and Shorthorn breeds with Brahmans, these new breeds were fixed through an intensive and well documented cross-breeding program. They combine the natural hardiness of the Brahman breed with the beef-producing qualities of British breed cattle, and are keenly sought by feedlots and fatteners.

Composition of National Beef Herd

Growth of northern beef cattle herds, and requirements of the feedlot industry and live export trade has driven changes in the make-up of Australia's national beef herd in recent years (see Table 2.3). Delforce, Martin and Riley, (2001, p.20), see the increase in Angus and British breed cross (especially Angus cross) from 4.2% (Angus) and 1.1% (British breed cross) in 1990 to 9.1% and 11.0 % respectively, by 2000, as a reflection of the increased demand for these breeds from the feedlot sector to supply the important Japanese market and the high quality restaurant trade. Both these markets demand the best quality marbled meat for which the Angus breed is renowned. The increase in percentage of tropical breeds is a result of growth in northern beef herds partly due to the growing live cattle export trade. Live cattle exporters require a minimum of 50% Brahman content and is reflected in the increase from 8.8% in 1990 to 13.2% in 2000 for the Brahman breed.

Table 2.3 Percentage Composition of the Australian Beef Herd from 1990 - 2000

	1990 %	1994 %	1997 %	2000* %
Hereford	26.7	22.1	19.7	11.2
Angus	4.2	5.7	9.0	9.1
Other British Breeds	11.2	6.8	6.5	5.8
European Breeds	3.1	1.3	0.6	2.1
Brahman	8.8	13.4	17.4	13.2
Santa Gertrudis	2.8	3.8	5.2	5.0
Other Tropical Breed	6.3	4.0	4.6	6.2
British Breed Cross	1.1	9.6	11.0	11.0
British/European Cro	7.4	5.2	4.2	5.5
Tropical/British Cros	22.8	19.2	14.6	26.4
Other**	5.5	8.9	7.1	4.6
Total	100	100	100	100

*Preliminary estimate
** Includes mainly dairy breeds used for beef production and dairy-beef cross cattle
Source: Delforce, Martin and Riley, 2001.

The figures in Table 2.3 provide an insight as to the breeds most likely to assist the development of the Chinese beef herd. If the high quality, top end of the beef market is to be targeted, Angus type cattle may be the most beneficial. However, if the requirement is for the development of more efficient cattle suited to the rigorous local conditions of feeding low quality crop residues, then a percentage of Brahman content may be necessary.

Summary

There is immense potential for development of the Chinese beef industry and for foreigners to become involved in the provision of services and the marketing of products. Although the last 20-30 years has seen much development within the industry, mainly through the introduction of imported breeds for cross-breeding purposes, there appears to be little effort to improve performance of Chinese cattle through the use of genetic evaluation programs. The majority of beef in China is produced in the agricultural central plains area, and most comes from unspecialised households where 1-2 cows are kept for draught work. This concentration of cattle in agricultural areas provides scope for assisting farmers to improve their cattle through the use of AI and the provision of higher quality sires. Many households are turning to specialised beef production, and require a better class of animal to feed for premium markets, thus giving a sense of urgency to producing more efficient and profitable cattle.

The Chinese beef industry is dominated by government through bodies such as the MoA and the AHB, who control bull breeding centres and the provision of AI services. Thus, responsibility for breeding programs to improve cattle productivity is the role of government departments, and foreigners wishing to become involved are strongly advised to develop contacts with the appropriate department. The Australian beef industry is highly developed, using the latest technology in every sector, and many Australian beef producers have not only the expertise, but also genetic material equal to the best in the world, which could contribute greatly to the Chinese beef industry.

Chapter 3

Sire Selection and Genetic Technology

Introduction

The basis for genetic improvement of beef cattle throughout the major beef producing nations is the seedstock sector. The Australian seedstock sector consists of pedigree, or registered herds of a recognised cattle breed, commonly known as studs. Most of the popular breeds that formed the basis of the Australian beef industry such as Shorthorn, Hereford and Angus, were developed in England, with breeds "fixed" to the degree that by the early 1800s herdbooks were published. This enabled pedigrees to be recorded and animals to be officially registered. Particular families within a breed became popular and sought after by other breeders because of their superior performance and many of these families have remained popular to this day. The seedstock sector has a long history of astute studmasters with a good "eye" for cattle. They, and many present day studmasters, were, and still are, able to select and breed superior animals through their extensive knowledge of pedigrees and the ability of being able to see the future breeding potential of individual animals. Today, each recognised breed, of which there are more than thirty in Australia, is controlled by a breed society which maintains a registry and official records of animals nominated by individual studs. To continually improve performance and productivity, commercial cattle beef producers look to the studs for their replacement herd sires. Charteris (1999) regards it as essential for seedstock producers to base their selection objectives on the requirements of commercial beef producers. The worldwide recognition of the quality of Australian beef and the high performance and productivity of Australian beef cattle is without doubt due to the knowledge and expertise of the many studmasters who have bred cattle to suit commercial producers utilising the latest technology for selection and genetic evaluation.

In Australia, beef cattle production is pasture-based. Breeding cows are run on improved pasture and native grasses in hilly areas, and on the vast open plains of the inland which is unsuitable for cropping. Progeny are either grown to 2-3 years of age and fattened for the export market where they are raised, or sold as yearlings to fatteners on the flatter more productive agricultural land and fattened for domestic consumption on forage crops such as winter oats, or legumes and sorghum in summer. Alternately, increasing numbers are fattened in feedlots for both the domestic and export markets. Thus, selection objectives can be many. For example, cattle destined for the export market are older and heavier and usually grown out on grass until about 2-3 years of age or even older, whereas cattle for the domestic market are mostly fattened and slaughtered before the age of two years. Therefore, some cattle are selected for late maturity with heavy mature weights, whilst others are selected for growth and ability to fatten at an early age. Although experienced cattlemen can select for early or later maturing cattle, the superiority of individual animals for their future breeding value is difficult to assess. As an aid to selection, the genetic evaluation program, BREEDPLAN, has been developed and introduced widely into the beef industry in Australia and most major beef producing countries around the world.

Selecting the Best Sire

How does the commercial cattleman know which is the most appropriate replacement bull to purchase that will meet the breeding objectives for that particular herd? Buying at multi-vendor sales where some animals are often over-fed to make them look more attractive, can greatly compound the problem. Is a certain animal heavier because it was reared in a more favourable environment, or is it genetically superior? Is a bull exhibiting superior muscle expression or does it appear to carry more muscle but in fact is excessive fat? Which bull is more likely to boost growth rates, improve carcase attributes, and lift the level of fertility and milking ability of females? These are vital questions facing commercial cattle producers when selecting replacement sires that will improve the productivity and profitability of their herd. The bull buyer can visually assess subjective characteristics such as structural soundness, temperament and quality of coat, but BREEDPLAN, the system for Estimating the Breeding Values of cattle can provide assistance to select the most appropriate sire, and give the confidence that progeny will meet breeding objectives.

BREEDPLAN

In the early 1970s a number of progressive Australian cattle breeders began performance recording as part of the National Beef Recording Scheme (NBRS). NBRS was a within herd system, comparing weights using a simple ratio system with some adjustments - for example, the weight was adjusted depending on the age and sex of the calf and age of the dam. The performance figures provided were simply a comparison of individual weights as compared to others in the same group without links to relatives through the pedigree system. Following on from NBRS, by 1985 the Australian developed BREEDPLAN system evolved, and became one of the most popular genetic evaluation systems in the world. BREEDPLAN, using Best Linear Unbiased Prediction (BLUP) technology which has been accepted as the best method of such evaluations for more than three decades, internationally and across all domestic livestock, was developed by geneticists at the Animal Genetics and Breeding Unit (AGBU) located on the campus of the University of New England (UNE), Armidale, New South Wales. BREEDPLAN is commercialised by Agricultural Business Research Institute (ABRI, a company on the UNE campus) and as described by Pettiford (2002, www), is a 'beef performance recording and evaluation scheme which uses a computer-aided model that generates estimated breeding values of cattle'. Pettiford (2002, www) further describes Estimated Breeding Values (EBVs) as, 'predictions of an animal's genetic merit based on available performance data on an individual animal and its relatives and on correlations with other traits'. EBVs are the basic component of Breedplan, and relate to the heritability and measurement of traits such as birth weight, weight gain and mature weight, milking ability of females, and carcase characteristics. Heritability, or the percentage of a trait that is passed from one generation to the next, for individual traits have been estimated by geneticists and expressed as a numerical figure. Heritability estimates remain constant until re-estimated. EBVs are therefore a prediction of the genetic value of an animal and thus its ability to pass on certain traits to its progeny.

Almost all breeds of cattle in Australia use BREEDPLAN, and for most it has been integrated into the pedigree system. Through corporate membership arrangements with breed societies, there are approximately 2150 members of BREEDPLAN in Australia, and a further 1350 in New Zealand. Rather than dealing with individual members, BREEDPLAN is increasingly contracting with breed societies so that the societies have control of their databases, and decide policy on which traits to include for providing EBVs, and accuracy levels for publication. Societies also decide fee structures for their members, which includes built-in costs of conducting Group BREEDPLAN analyses and publication of Sire Summaries. Thus the cost of BREEDPLAN to the individual producer is included in registration fees paid each year for animals held on the breeders' inventories, and paid direct to the breed society concerned. There is no additional cost payable to ABRI. Most stud and commercial cattle breeders accept BREEDPLAN as a vital selection tool in their breeding operations. In the Hereford breed for example, approx 70% of bulls sold in Australia come from the largest 10% of herds, all of which are in BREEDPLAN. The participation of Hereford and Poll Hereford herds in BREEDPLAN is over 85%. Over 95% of all Angus seedstock herds producing 100 or more calves a year utilise BREEDPLAN, and the vast majority of all Angus bulls are sold with BREEDPLAN EBVs (Sundstrom, 2003).

BREEDPLAN is highly regarded overseas and is made available under licence to Breed Societies or to individual herds in countries such as the United States (US), Canada, Mexico, Argentina, Brazil, New Zealand, and Great Britain. The technology has also been introduced into South Africa and other developing countries in South East Asia including Thailand, and the Philippines. Overseas participation is important as it allows the cost of BREEDPLAN overheads to be spread over more herds, but more importantly it provides international evaluations and the easier exchange of genetics and genetic information. BREEDPLAN now conducts combined New Zealand-Australian analyses for nine breeds, and the Murray Grey breed also includes herds from Great Britain, US and Canada in its analysis and sire summary. The US Salers, Shorthorn, and South Devon, and American Hereford, Canadian Angus and US Braunvieh pedigree systems are all run by BREEDPLAN (Sundstrom, 2003).

GROUP BREEDPLAN

The difference between within-herd BREEDPLAN and GROUP BREEDPLAN, is that GROUP BREEDPLAN can be used to compare animals in different herds and under different environmental conditions, whereas within-herd BREEDPLAN is restricted to analysis of animals of the one herd only. A GROUP BREEDPLAN analysis includes known performance information from all relatives, and is achieved through the use of common sires across herds. For the purpose of this study, references to BREEDPLAN should be taken to mean GROUP BREEDPLAN, unless stated otherwise.

Calculating EBVs in Linked Herds

One of the great strengths of BREEDPLAN is that animals of the same breed in different herds and from different environments can be compared. This is achieved by herds using common sires to form links. For example, a group from an Angus herd in arid western Queensland (herd A) can be compared accurately with a group from an Angus herd run on the lush pastures of central Victoria (herd B). Genetic heritability is not influenced by environmental factors, so if both herds use one or more common sires (through artificial insemination) with known performance figures, comparisons can then be made. For example, the average weight of a group of progeny from herd A is 300kgs at 400 days with the best performer recording a weight of 350 kgs. If, because of the better environment, the average weight for a group of progeny of similar age from herd B was 400 kgs at 400 days, the best performer may have recorded a weight of 430 kgs. For calculating EBV figures, each animal is compared directly within its contemporary group, but because animals are related through the use of common sires, they are also compared with the known performance and heritability of the particular trait for the sire. The final EBV figure is not equivalent to the amount of weight that an individual is heavier or lighter than the average, but is adjusted by the computer program to allow for known performance of all relatives. So the EBV for 400 day weight for the best performer in herd A could be +25, whereas the EBV for the best performer in herd B could be +18, even though its final weight was 80 kgs heavier. This is because the performance level of the best performer from herd B as compared to its contemporary group is much lower than the performance of the best performer from group A as compared to its own contemporary group. Sundstrom (2002) says the current wide use of AI in stud herds has increased the links between herds in most breeds, and the integrated pedigree system greatly facilitates the tracing of these links. Across-herd comparisons are now by far the most popular component of BREEDPLAN.

Understanding EBVs

EBVs are expressed in the unit of measurement for each particular trait and can be either positive (+ve), or negative (-ve), depending on whether the genetic potential of an animal for a particular trait is above or below the base figure. The base figure remains constant and is set at zero for each breed. However, as an indicator of genetic progress, an average figure is provided for all animals each year, so animals can be compared to the current average rather than the base (see Figure 3.1). EBVs for weight, which includes birth weight, milk, 200, 400, and 600 day weights, mature weight, and carcase weight is expressed in kilograms; gestation length and days to calving is expressed in days; scrotal circumference, and eye muscle area is expressed in square centimetres; rib and rump fat is expressed in millimetres; and retail beef yield and intramuscular fat are expressed as a percentage. (See page 63 for discussion on traits recorded).

Figure 3.1 Example of Selected EBVs of Two Murray Grey Bulls Born in 2000.

SIRE	BIRTH WEIGHT (KG)	SCROTAL CIRCUMFERENCE (CM)	600 DAY WEIGHT (KG)	EYE MUSCLE AREA (CM)	RUMP FAT (MM)
Bull A	-1.8	-0.7	+3	+0.8	-1.1
Bull B	+8.1	+1.8	+82	+1.1	-0.5
Average*	+1.9	0.0	+25	+0.7	0.0

*Average EBV for all bull calves born in 2000

Figure 3.2 Example of Selected EBVs of Two Murray Grey Cows.

DAM	BIRTH WEIGHT (KG)	CALVING EASE (%)	600 DAY WEIGHT (KG)	EYE MUSCLE AREA (CM)	RUMP FAT (MM)
Cow A	+3.6	-2.2	+76	-0.3	-0.7
Cow B	+3.0	-1.2	+59	+1.4	+0.9

Source: Randomly selected from Murray Grey 2002 International GROUP BREEDPLAN Report.

EBVs are provided for both males and females, and are an effective tool to help make a more informed decision when selecting breeding stock. On average, a calf receives half its genes from its sire and half from its dam. For example, if Bull B (Figure 3.1) is mated with Cow A (Figure 3.2), then the resultant calf could be expected to be approximately 79 kilograms [(82/2) + (76/2) = 79], heavier than the fixed base for 600 day weight for the Murray Grey breed. Alternatively, if Bull A (Figure 3.1) was mated to Cow B (Figure 3.2), the resultant calf should be approximately 31 kilograms [(3/2) + (59/2) = 31], heavier than the fixed base. If the breeding objective for that particular herd was to breed heavy bullocks for the export trade, bull B may be the more appropriate sire to use. However, selection decisions should not be made on one trait alone. Bull B has a very high birth weight EBV, and if mated to cows which also had high birth weight EBVs, or very low mature weight EBVs indicating very small framed cows, there could be a high level of dystocia (calving difficulties). If Bull A was used, the herd would still achieve genetic progress, but without the problems of dystocia. When selecting a sire, all traits should be considered as part of the breeding objectives, and a decision made depending on the genetic level of the cows to which the bull will be mated, and only after a thorough eye appraisal for structural soundness, maturity, frame size, coat quality, and other subjective factors preferred by the bull buyer.

***Accuracy*[10]**

It is not possible to predict with 100% accuracy the genetic merit of an animal or the genetic merit of the progeny of a particular mating. Therefore, breeding values can only be estimated.

The accuracy of an EBV depends on two major factors:

1. The heritability of the trait, or the proportion of an animal's genetic merit that is passed on to its progeny; and
2. The amount of performance information known about an animal and its relatives.

The known performance of relatives is added to predict, and increase the accuracy of an EBV for a particular animal. The more that is known about an animal the better and more accurately the BREEDPLAN system can predict how the animal's progeny will perform. Figure 3.2 indicates how accuracy is related to progeny numbers and relatives.

Figure **3.3 Accuracy of EBVs for a trait with heritability of 30% (400-day weight)**

INFORMATION AVAILABLE	ACCURACY (%)
Individual	**55**
Individual + 10 PHS* + 2 MHS**	**61**
Individual + 20 PHS + 4 MHS	**64**
Individual + 10 Progeny	**67**
Individual + 10 PHS + 2 MHS + 10 Progeny	**77**

* Effective Paternal Half Sibs
** Effective Maternal Half Sibs
Source: 2002 Murray Grey International GROUP BREEDPLAN Report, p.3.

[10] Information taken from the 2002 Murray Grey International GROUP BREEDPLAN Report, p.3.

If the only information provided is the animal's own performance, the accuracy for a trait with a heritability of 30%, will be 55%. If information for 10 paternal half sibs and 2 maternal half sibs is added, accuracy increases to 61%, but with information included for about 10 of the animal's progeny, accuracy would be boosted further to 77%. High accuracy EBVs for the parents of the animal would increase its degree of accuracy even still higher.

From data collected by breed societies over many years it has been shown that highly accurate EBVs are very reliable. There is little risk that the performance of progeny of a sire with high accuracy EBVs will be much different than the EBVs indicate. The accuracy for a measured trait of each animal is shown as a percentage figure directly under the listed EBV in the GROUP BREEDPLAN report.

As noted above, the degree of accuracy is an indication of the amount of information known about an animal. Bull buyers should be aware that bulls with low accuracy figures have more chance of an EBV changing as more information becomes available, and that the change could either be positive or negative. Alternatively, for bulls with high accuracy figures, there is much less possibility that the EBV will change as further information is collected. Figure 3.3 summarises the accuracy of EBVs in relation to the amount of information available, and is a useful tool for bull buyers when comparing different animals.

Figure 3.4 Summary of the Accuracy of EBVs.

<60%	The EBV should be considered a preliminary estimate, which could change substantially as more performance information becomes available. Most animals without progeny will fall within this range.
61-74%	Low accuracy EBV useful for screening “best bet” animals. Still subject to considerable change as progeny records become available for the analysis.
75-89%	Medium accuracy, which includes some progeny information. The EBV is becoming a reliable indicator of the animal’s value as a parent, but still subject to change.
90-95%	High accuracy EBV and unlikely to change much with the addition of more records.
>95%	Very high estimates of the animal’s true breeding value, a case of “what you see is what you get”.

Source: Pettiford, 2002, www.

It is always important to remember that the EBV figure is still only the best estimate available, and subject to change as further information becomes available. It is always important to remember that EBVs, whether of high or low accuracy, should only be used as a tool to assist eye appraisal when selecting stock. For an animal to be a trait leader for its breed, the accuracy figure must be greater than 75%, or as determined by the breed society in consultation with ABRI, for that particular trait.

Correlation of Traits

When analysing data for a BREEDPLAN report, the computer program accounts for known genetic and non-genetic relationships (correlations) between related traits. Coombs (1993, p.178) says, ‘For example, it is known that weight gains to yearling and to two year old generally “go together”’. The GROUP BREEDPLAN report for the Angus breed takes into account correlations between various birth, growth, carcase and fertility traits which have been calculated by AGBU researchers from the Angus database. As an example of some of the key genetic correlations built into the Angus GROUP BREEDPLAN analysis, the relationship between 200 day weight and 400 day weight is +.75, and between 200 day weight and 600 day weight +.70 (high). The correlation between 400 day weight is a high +.70, however between 400 day weight and rib fat thickness a low -.10. The analysis also uses non-genetic (environmental) correlations to assist in the calculcation of EBVs for each trait. As part of the continuing upgrading of BREEDPLAN technology, these relationships are regularly re-estimated as additional performance and research data results becomes available (2003 Angus GROUP BREEDPLAN Directory, p.7).

Heritability of Traits

In addition to correlations between traits, BREEDPLAN also takes into account the different degrees of heritability of the various traits (see Table 3.1). Due to variation in the heritability factor of different traits, the degree to which performance is influenced by genetic differences varies from trait to trait. Traits relating to growth and carcase measurements tend to have moderate to high heritabilities (i.e. 20 to 60%), whilst maternal traits have low heritabilities of 10% or lower (2003 Angus GROUP BREEDPLAN Directory, p. 7). Trait heritabilities are built into the BREEDPLAN calculations and do not need to be considered by breeders using EBVs.

Table 3.1 Heritability of Traits.

Trait	%
Calving Ease	10
Gestation Length	22
Birth Weight	38
200-Day Weight	18
400-Day Weight	25
600-Day Weight	34
Mature Cow Weight	42
Milk	10
Scrotal Size	39
Days to Calving	8
Carcase Weight	42
Eye Muscle Area	20
Rib Fat	24
Rump Fat	36
Retail Beef Yield %	54
Intramuscular Fat (Marbling)	37

Source: 2003 Angus GROUP BREEDPLAN Directory, p. 7.

***Traits Reported*[11]**

The traits listed below indicate the amount of valuable information available about the genetic merit and predicted breeding value of individual animals. This information is available to all beef producers and is a useful tool for management decisions, and when replacement sires need to be purchased.

The following are the most common traits reported by the majority of breed societies:

Calving Ease: based on calving ease scores, birth weights and gestation length information. Calving Ease EBVs are estimates of genetic

[11] Information for this section is taken directly from the 2002 Australasian Charolais Genetic Evaluation Sire and Dam Summary, published by the Charolais Society of Australia, Armidale, from information supplied by ABRI. Most breed societies publish a similar summary each year which is available to members and other interested persons.

differences between animals in the ability of two-year-old heifers to calve unassisted.

Gestation Length: indicates lighter birth weights, easier calving and increased growth after birth.

Birth Weight: indicates the genetic potential for birth weight.

200-Day Milk: reflects extra calf weaning weight which is due to the genetic influence a sire has on his daughter's milking and mothering ability.

200-Day Growth: an estimate of an animal's genetic potential for growth to weaning.

400-Day Weight: an estimate of an animal's genetic potential for yearling weight.

600-Day Weight: an estimate of an animal's genetic potential for growth to maturity.

Scrotal Size: an indicator of fertility in males, which passes on in part to female relatives.

Days to Calving: an indicator of female fertility based on the time between the cows first exposure to a bull and when she subsequently calves. Cows that calve late or fail to calve are penalised.

Carcase Weight: an indicator of the genetic difference in carcase weight at a standard age of 650 days.

Eye Muscle Area: indicates an animal's genetic potential for eye muscle area on a standard 300kg carcase. Sires with relatively higher eye muscle area EBVs are expected to produce better-muscled and higher percentage yielding carcases in their progeny.

Rib and Rump Fat: indicators of an animal's genetic potential for subcutaneous fat depth on a standard 300kg carcase.

Retail Beef Yield: indicates genetic differences between animals for retail yield percentage in a standard 300kg carcase.

Intra Muscular Fat Percent: indicates genetic differences between animals for intra muscular fat percentage (marbling) in a standard 300kg carcase.

The Limousin breed have introduced EBVs for docility, and the Angus and Hereford breeds include EBVs for Feed Efficiency.

Applying BREEDPLAN in the Field - Requirements of the Studmaster

It is the duty each year of studmasters to accurately record various weights, and other factors such as scrotal, muscle and fat measurements, service dates and birth dates, of their animals for submission to ABRI either direct or through breed societies in conjunction with registration requirements. Once the figures are processed, a report is issued giving EBVs for traits reported. The recording of 200 day, 400 day and 600 day weights are not mandatory, although it is recommended that performance is recorded for as many animals and for as many traits as is possible. The taking of birth weights is also recommended. For carcase information, technicians trained and accredited by ABRI visit properties to scan animals, using ultrasound equipment to measure eye muscle area, and rib and rump fat thickness. As part of management procedures, the studmaster must also ensure that animals are run in contemporary groups, and these groups are identified when submitting data, to enable the processing of the BREEDPLAN report.

It is vital for individual animals for which EBVs are to be calculated to be run within a contemporary group. Each animal can then be directly compared to the average of the group as a whole. A contemporary group consists of animals of the same sex and age class within a herd, run under the same management conditions and treated equally from birth until the final weighing. This is a key step for the calculation of EBVs. Animals in larger groups obviously have more accurate figures as each animal is compared to a greater number of contemporaries. Individual animals, such as bulls that may be hand-fed for the show ring, can have EBVs generated, however, the accuracy will be low as they are treated as a separate group. To measure performance, an animal's own performance including weights at different ages, scrotal size of bulls, and other factors are recorded, together with the performance of all close and distant relatives such as parents, siblings and progeny in all linked herds. Thus, much more than just an individual animal's own performance is used.

Net Feed Intake EBVs

As part of continuing development of BREEDPLAN, on-going research is conducted to upgrade existing knowledge as well as develop new traits to further assist beef producers and others in the beef industry. A recent development is the availability of trial Net Feed Intake (NFI) EBVs. The ability of an animal to efficiently utilise available feed resources is, economically, one of the most important production traits. It has a direct effect on profitability, not only for producers, but also for feedlots and fatteners. Trial NFI EBVs provide the means to select animals that can maximise profits from available feed resources, as the cost of feed is a major expense in most beef cattle production systems.

Using NFI EBVs, more efficient cattle can be selected, regardless of the size, or range of sizes of the cattle a breeder wishes to select to meet the breeding objectives for a particular herd. NFI is calculated from the amount of feed an animal eats, under or over, that is expected for its weight and gain. Unlike the common measure of gross feed efficiency which is a measure of feed intake compared to the rate of gain, a measure of net feed intake is independent of weight and gain. Selection on gross feed efficiency would also rapidly increase mature weight, which may not always be desirable (Sundstrom, 2003, www).

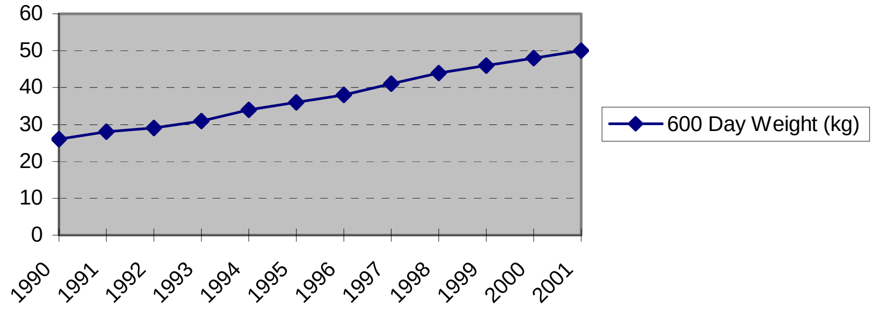
Measuring the feed intake of individual animals is extremely difficult. Electronic tagging and the use of automated electronic feeders, but the cost of equipment and staff time is considerable (Charteris, 1999, www). Tests could be done manually on farm with self-feeders, but once again would be very time-consuming and involve considerable cost.

Yearling bulls are most commonly tested, and the test is over a set period of 50 to 70 days using a standard, medium energy ration. A negative EBV indicating an animal consumes less feed for its weight and rate of gain is desirable. As yet, only a limited number of breeds include NFI EBVs, but due to its economic importance, other breed societies are soon likely to introduce the trait.

Genetic Trends

The immense value of BREEDPLAN as a contributor to increased profitability in the Australian beef industry is clearly illustrated by figures released each year by breed societies.

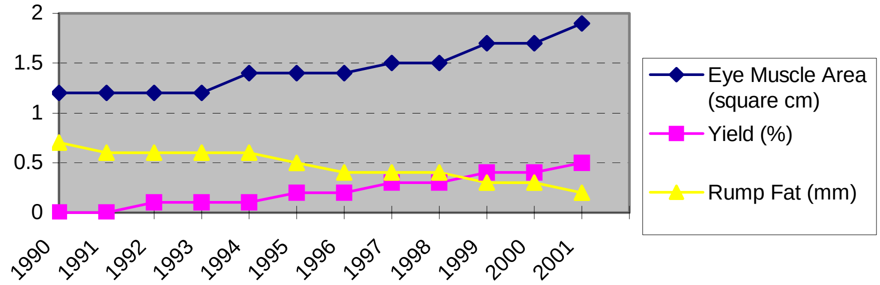
Figure 3.5 Trend in Hereford Bulls for 600 Day Weight EBV, 1990-2001



Source: BREEDPLAN NEWS, 2002, p.8.

Over the last 10 years the average 600-day EBV weight for Hereford bulls has increased by 25 kilograms (see Figure 3.5), yet at the same time the average fat depth EBV reduced from 16mm to 4mm (see Figure 3.6).

Figure 3.6 Trends in Hereford Bulls for Eye Muscle Area, Retail Beef Yield and Fat EBVs, 1990-2001



Source: BREEDPLAN NEWS, 2002, p.8.

When combined with the dramatic increase in size of the eye muscle area, these figures show that the Hereford breed has increased weight at 600 days, while becoming leaner and more muscular. This has led to an increased yield percentage of saleable meat thus making the animal more efficient and profitable for both the producer and the butcher. If the producer is able to breed and market higher yielding stock, fewer animals need to be carried to produce the same amount of beef and the better quality animal will command a higher price. Higher yielding carcases are more profitable for the butcher as dressing charges are the same for both high and low yielding bodies. Also, fewer carcases need to be purchased to produce a similar amount of saleable meat. Consumers gain some benefit as well because a more efficient and profitable industry provides a degree of product and price stability.

BREEDPLAN, with its continuing upgrades such as multi-breed EBVs, and BreedObject, which puts a dollar value on individual traits, is an extremely valuable tool to aid cattlemen in their management decisions. It is not designed to replace subjective selection as it cannot measure factors such as structural soundness and walking ability. An astute cattleman will always combine BREEDPLAN figures with eye appraisal to select the most suitable sire to match the breeding objectives for that particular herd.

Commercial Acceptance of BREEDPLAN

The value of BREEDPLAN to the Australian beef industry is illustrated by the number of commercial producers who purchase replacement sires on the basis of their BREEDPLAN EBVs. This is particularly evident in Queensland, which accounts for almost half of the national beef herd. There has been a dramatic increase in the use of BREEDPLAN in the northern Australian beef herd in recent years. Condon (2003, p.8) states, ‘One of the big drivers of this increase is a growing recognition among commercial beef producers, lotfeeders, processors and others in the beef supply chain of the major impact of genetic selection, based on objectively-recorded traits under BREEDPLAN can deliver to the northern industry'. An indication of the acceptance of BREEDPLAN by commercial producers is the herd improvement program of one of Australia's largest beef producers. S. Kidman and Company, who run 156,000 head of commercial breeders over eleven properties in south west Queensland and northern South Australia have increased breeder numbers by 7% as a direct result of improved productivity allowing steers suitable for the Japanese market to be turned off in half the time than they were six years ago. Speaking for the company, livestock marketing manager, Will Abel-Smith (2001, p.38) said, 'S. Kidman and Company began a herd improvement program six years ago to improve the fertility of the breeding herd and boost the muscling and growth rates of the steers'. Initially the program involved culling females for structure, type and fertility, but it is the use of BREEDPLAN performance recorded bulls that now drives the genetic improvement of the Kidman herds. Abel-Smith (2001, p.38) states, 'BREEDPLAN has become a vital selection tool for us. Visual appraisal is still very important but we need every advantage we can get and BREEDPLAN definitely gives us this'.

Central Queensland cattleman, Burnett Joyce of Gyranda, Theodore, has been with BREEDPLAN since its inception, and records an average of 500 calves a year. As a seedstock producer, Joyce is a volume supplier of performance tested bulls throughout northern Australia, as well as breeding replacement sires for his large commercial breeding operations. Joyce (2003, p.10) states, 'Ninety percent of our clients are commercial producers from Queensland and the Northern

Territory'. Since using BREEDPLAN recorded bulls in his own commercial herds, Joyce says they have delivered 'positive, reliable and measurable progress in growth and carcase traits'.

Value of BREEDPLAN Questioned

Despite the widespread acceptance of BREEDPLAN throughout the stud and commercial sectors of the Australian beef industry, some concerns have been expressed relating to the value of performance recording as a basis for breeding and selecting cattle. The majority of these concerns are expressed by hobby farmers, i.e., professional and business persons who have farms of varying sizes, and others whose income is not derived from their "cattle" interests. Those hobby farmers whose interest is in beef cattle generally have small acreages, and their cattle are run under intensive, non-commercial conditions[12]. Their stock are usually hand-fed separately, often for showing purposes, and are not a viable contemporary group for either within-herd, or group BREEDPLAN recording. Thus, they have no incentive to gain an understanding of BREEDPLAN technology and its benefits if used correctly. However, hobby farmers generally mate their cows artificially or use a home-bred bull resulting from AI. Most AI sires are BREEDPLAN recorded, so hobby farmers still benefit directly from the use of BREEDPLAN in seedstock herds.

A number of concerns have been expressed strongly and publicly by medical

[12] Most hobby farmers are genuinely interested in their cattle and contribute substantially to breed development through support and involvement in promotion, advertising, sales, exhibition of stock, and other activities. Many have large herds which are run as viable, self-supporting enterprises, and are a vital and integral part of the Australian beef industry.

practitioner Dr. Rob Scanlan regarding the value and accuracy of BREEDPLAN technology. Scanlan's main concerns (pers. comm., 2003) are that data supplied to ABRI is not accurate, EBVs for two-year-old sale bulls is misleading, and statistics generated are not acceptable as scientifically reliable.

Scanlan believes that ABRI statisticians assume that:

1. All animals have the correct sire and dam recorded.
2. All birth dates are accurate.
3. All weights are measured on accurate scales when all cattle are empty or all full, and none have recently been sick or injured.
4. Weights are measured and not invented.
5. All dams of unknown performance are roughly equal as mothers.

These concerns are based on: a) show ring experiences, where it is well known that certain individuals alter birth dates to gain an unfair advantage, and b) that beef producers who utilise BREEDPLAN technology are equally dishonest. Just as those involved in unacceptable practises, whether in the show ring, business or any other activity, are exposed and unable to successfully remain in business, producers who falsify performance records for short-term gain very quickly become known and soon leave the industry as they are unable to sell bulls. Genuine producers who make their living from breeding and selling bulls maintain the highest standards of integrity and honesty. Bulls fed separately for showing, even from BREEDPLAN enrolled herds, are treated as a separate group and not included in the BREEDPLAN analysis.

The BREEDPLAN system has a number of in-built checks and audits to help minimise the inclusion of inaccurate data. For example, if the weights submitted for an animal or animals in a group were unusually high, the system would flag a query so that those animals were reassessed as further data was submitted. Because of the correlations between traits, inaccuracies would be reflected in EBVs for related traits. The heritability factor also acts as a check for inaccurate data. If an animal's EBVs were outside the parameters expected in relationship to the known EBVs of its sire and dam, a query would again be flagged. However, as information from the progeny of the animal became available, any inaccuracies would be exposed. Furthermore, if a producer continually sold bulls that failed to breed to an acceptable level of performance in relation to EBVs provided, that producer would quickly become known throughout the industry as dishonest and untrustworthy, and unable to sell bulls easily.

Scanlan (pers. comm., 2003), is concerned that EBVs for young bulls are misleading and believes they are not worth considering when selecting a sire. The majority of bulls sold in Australia are sold as two-year-olds or younger. At this age they do not have recorded progeny, so their EBVs are based on their own performance and known performance of all relatives. Consequently, their EBVs only have an accuracy of 60% or less, and subject to change as more information becomes available. BREEDPLAN stresses that EBVs with an accuracy of 60% or less are a preliminary estimate and subject to change. The value of EBVs for two-year-old bulls is that it gives the purchaser the confidence to back his subjective eye appraisal. If the EBVs of the parents are considered, due to the heritability factor the buyer can be reasonably confident that the EBVs of the young bull are unlikely to change substantially, and he will maintain or improve the traits for which he was selected.

With regard to the concern that statistics generated by ABRI are not scientifically reliable, Rickards (2003, p.10) states, ‘BREEDPLAN evaluations use best linear unbiased prediction (BLUP) techniques which have been accepted as the best method of such evaluations for more than three decades, internationally and across all domestic livestock’. Rickards (2003, p.10) further states, ‘The scientific literature review behind the method is encyclopedic’. BREEDPLAN is regarded world-wide as one of the best systems for evaluating the genetics of beef cattle, and if used correctly has the ability to increase productivity and profitability above what can be achieved by subjective selection alone.

Continuing Development of BREEDPLAN

BREEDPLAN evaluation technology is used to compare animals of one breed only, either in a single herd, or across herds using link sires. EBVs of one breed cannot be compared with EBVs of another because the base for each breed is different, and there is very little genetic linkage between breeds. However, many commercial beef producers cross-breed to gain maximum benefits from the effect of heterosis. This has created a demand for comparisons of traits between different breeds. The first release of multi-breed EBVs in early 2003 was a major development in the continuing research and upgrading of BREEDPLAN technology.

***Multibreed EBVs*[13]**

Early in 2003 the first multi-breed EBVs were produced for a limited number of traits, and restricted to only four breeds; Hereford/Poll Hereford, Angus, Limousin and Simmental. Data was collected from a Victorian multi-breed EBV project which mated 22 BREEDPLAN recorded sires from each of the Angus, Hereford, Limousin and Simmental breeds, with Angus and Hereford cows in South Australia in 1997 and 1998. Results were included with data from the Beef CRC1 Northern Crossbred Project where nine different breeds were mated to Brahman cows in central Queensland in 1993 and for the following two years. Sires represented in the northern project were Brahman, Belmont Red, Santa Gertrudis, Angus, Hereford, Shorthorn, Charolais and Limousin, with from 8 to 15 sires of each breed used. There were 7 common sires across the two projects to provide the genetic links. At present, EBVs are only available for the four breeds, and for gestation length, birth weight, 200 day weight, 400 and 600 day weights, and carcase weight. As further research is completed additional traits and other breeds will be included (Johnson and Sundstrom, 2003, www).

Breedobject

For a number of years, AGBU has been further developing BREEDPLAN technology so that a number of combined traits can be expressed as a $Index. The new technology is known as Breedobject, and addresses the genetic potential of progeny to perform in a commercial operation. This is a result of increased

[13] For a full discussion on multi-breed EBVs and the methodology used to develop the technology, see; Graser, H., 2002, *Multibreed EBVs - Where are we up to with the science*, available at:
http://breedplan.une.edu.au/MultibreedEBVs.htm

demand from beef producers for balanced genetics, to more easily identify and select stock most suited for a given market. The $Index EBV describes how well individual bulls suit a particular purpose, or have the potential to breed cattle for a particular market.

Depending on the level of detail and the specifications for a particular production purpose, an analysis of traits that affect profitability in the commercial herd for the herd production purpose required is first performed. Secondly, Breedobject then assesses what emphasis is justified for the different BREEDPLAN EBVs available on the animals. The different emphasis is reflected in the $Index value calculated for each animal. The $Index is an EBV for profit, combining EBVs into an economically weighted index relating to performance in a commercial herd (Sundstrom, 2003, www).

Summary

BREEDPLAN is the best available tool for assisting cattle breeders and beef producers, as well as beef industries throughout the world, to make meaningful genetic gains to improve productivity and profitability. Based on more than 30 years of research and collection of beef cattle performance data, the Australian-developed BREEDPLAN system measures the genetic merit of animals, and estimates the ability to pass on certain traits to their progeny. Estimates are expressed as EBVs, and are calculated for birth weight and birth-related traits such as gestation length and days to calving, growth, fertility, carcase and maternal traits.

A major benefit of BREEDPLAN is its ability to separate environmental factors from genetics. Animals of the same breed, from herds running under different conditions and with varying levels of nutrition, can be directly compared. This is possible through the use of common sires across herds to form genetic links, and running stock in contemporary groups. A contemporary group consists of animals of the same sex, born within a short time frame, and run together from birth until final data is collected. Animals are only compared with others from the same group, then known performance data from all relatives is added for computing EBVs for various traits.

Sire selection decisions should always include a balance of all traits against the breeding objectives for a particular herd. Too much emphasis on a single trait usually has a negative impact on other traits. Just as importantly, BREEDPLAN should always be used only as a tool to assist subjective eye appraisal. Structural soundness, walking ability and other factors for which individual producers have different preferences and ideals can only be assessed by careful inspection of the animal concerned. A decision whether or not to purchase can then be made in conjunction with information estimating the genetic merit of the animal as provided by the BREEDPLAN analysis.

A feature of the BREEDPLAN is the continuing research and development as further information is demanded by beef industry participants. EBVs for additional traits are added as sufficient data is collected, and it is now possible to compare EBVs across a limited number of breeds. Demand from the commercial production sector will ensure that a full range of multi-breed EBVs will be available in the near future.

Chapter 4.

Application of BREEDPLAN Technology to the Chinese Beef Industry.

Introduction

Introducing BREEDPLAN to the Chinese beef industry would be a major undertaking. The industry is relatively recent in its development, and significant progress has been made with programs to increase productivity. However, these programs are generally based on cross breeding techniques using imported breeds with indigenous, or yellow cattle breeds. Chinese animal husbandry experts are extremely skilful in all aspects of cattle management and development programs, but are not familiar with the application of BREEDPLAN technology or the extent to which BREEDPLAN can quickly lift the genetic level of cattle.

Just as it has in beef industries throughout the world, BREEDPLAN would provide immeasurable benefits to the Chinese beef industry. Yet, to be successfully introduced, the Chinese would need assistance in the form of consultancy services to ensure benefits were maximised. BREEDPLAN is a valuable tool for measuring and evaluating various genetic traits, but an in-depth understanding of the technology is necessary to achieve a balance in breeding objectives and the reaching of goals.

This chapter looks at the mechanics of applying BREEDPLAN to the Chinese beef industry, particularly in relation to the genetic improvement of some of the superior beef-producing breeds of yellow cattle.

Initial Planning

Once a decision was made to introduce BREEDPLAN, the initial step for the Chinese authorities would be to negotiate a contract with ABRI for the supply of the technology and associated services. Aspects to be considered when negotiating the contract would include the number of animals to be enrolled in the program, method of transmitting data, and the degree of control of the data to be retained by either party. The number of animals enrolled has a direct bearing on the overall cost. Details of each animal must be entered manually into the ABRI database, and would include unique identification, birth date, pedigree details if known, and any other information known about the animal. With regard to the transmission of data and degree of control over the data, some alternatives exist. A powerful computer directly linked to ABRI could be installed in a central location in China, with control of the data remaining in China, or an option could be the purchase of a suitable software program such as Herd Magic (see page 91), with data transmitted by electronic mail which would attract a fee for each piece of data processed. Control of the data would remain in Australia. ABRI is a commercial, international business enterprise with costs worked out on an individual basis, and details of the contract remaining confidential to both parties.

Prior to the introduction of BREEDPLAN technology into the Chinese beef industry, it would be of immense benefit if a consultant, or adviser with expertise and practical experience with the application of BREEDPLAN be appointed by the appropriate Chinese authority. This could be at a provincial, or central government level, depending on the level of involvement and degree of dissemination required. Due to the lack of local knowledge about the BREEDPLAN system, a consultant would facilitate the smooth introduction of the technology and provide the necessary expertise for planning and implementation.

Setting Priorities and Goals

The genetic diversity of beef cattle allow changes in various characteristics from one generation to the next relatively easy to achieve. Rapid changes can be made to growth rates, maturity, and meat yield, but it is vital that a good balance is maintained as changes to one trait can often affect other traits. For example, excessive heavy muscling can have an adverse effect on fertility. Therefore, the importance of setting balanced, achievable goals cannot be overstated. Of equal importance is the necessity for achieving these goals under local conditions, or conditions under which the cattle already run and to which they are accustomed.

Initial priorities and goals could include:

1. Increase the percentage meat yield[14]. Because of their history as draught animals, meat yield of Chinese beef cattle is generally very low. If yield

[14] Yield-related EBVs could only be provided if real abattoir or scanning data was available.

can be increased so that fewer animals can still produce a similar amount of meat, gains can be made to profitability, as well as providing scope for increased production.

2. Improve growth rate to yearling stage. Most Chinese cattle are slaughtered at a mature age, however, younger slaughtering age means quicker turnover as animals are fed for shorter periods. The increase in feedlot finishing also sees a demand for cattle to fatten quicker and at a younger age, but without excess fat.
3. Low birth weight. To avoid an increase in dystocia levels, a major cause of reduced productivity, it is essential to maintain low birth weights as growth rates increase.
4. Fertility. Identify and use sires with superior fertility, so stock can begin their breeding cycle at an earlier age for better utilisation of resources and increased profitability.

The goal should be a balanced, gradual genetic progress rather than a dramatic lift in one or more traits. Extremes in one area generally have a strong, adverse effect in other areas. For example, animals with extreme muscling, or double muscling, generally do not have high growth EBVs, and often fertility is reduced. The above traits can all easily be measured by BREEDPLAN, and an estimation of the future breeding values given for individual animals. In setting goals and priorities for genetic improvement, consideration should also be given to nutrition levels, prevalence of disease and management practices.

Pre-planning Prior to Implementation[15]

To gain maximum benefit from using BREEDPLAN in a breed or herd improvement program, a considerable amount of pre-planning is required. Even in Australia, a studmaster must plan carefully so that a sufficiently large enough group of cows calve within a condensed time frame, and that facilities and records are up-to-date. In the Chinese context, breeding is not geared towards the pedigree, or registration system, and cows are allowed to calve at any time of the year, so a large amount of pre-planning would be necessary.

Based on research conducted in Henan Province, larger herds in agricultural areas are maintained in an enclosure as a group, fed a mixture of silage and straw, and concentrates when necessary. Most of the groups observed were generally made up of twenty to thirty head, and they were rarely allowed to leave the enclosure. Thus the situation for suitable contemporary groups is already established. However, as cows calve at irregular times, groups may need to be re-arranged and mating of some cows delayed so that the whole group calve within a period of 2-3 months as recommended for high quality evaluations.

In China, cows in the larger government-controlled herds are usually bred artificially using semen from imported sires or their progeny. Therefore, for an improvement program involving indigenous breeds it would be necessary to select suitable sires for semen collection and processing, for use as links throughout the various female groups. Groups of females would also need to be

[15] Final decisions regarding implementation strategies would only be taken in consultation with industry officials after introduction, to fit existing management practices.

assembled, either by purchasing, or grouping together existing small herds, to form viable contemporary groups. This could involve extensive travel to cattle markets, large and small herds, and farms and villages throughout the agricultural areas to select superior animals, so as to utilise as broad a diversity of genetics as possible. A decision would also need to be made as to which breeds should be targeted. Would it be more economical to target only those breeds which display suitable beef-producing qualities, or should most breeds which have sufficient numbers to form viable groups be included? A further consideration is the degree of purity of individual breeds and herds. Generally, there has been little or no control over the intermingling of breeds in some areas, and a low level of conservation of lesser known individual breeds of indigenous cattle. Semen from the selected sires would need to be distributed and used in as many different breeding groups as possible to provide links between different herds, so as to increase the rate of genetic progress.

For the large herds of imported breeds such as Simmental, Charolais, Limousin and others, the addition of link sires with known BREEDPLAN figures would greatly increase the accuracy, as well as help to quickly identify superior sires from those already imported. Semen from link sires could be sourced from Australia, where BREEDPLAN is widely incorporated into the seedstock sector, and beef cattle are equal to the best in the world. However, the purchase of semen for importation into China should be seen as a matter of urgency due to quarantine requirements and the time lag between purchase and delivery (see Protocols for Transferring Genetic Material, p.92, for discussion on import protocols). Australian genetic material is relatively easy to import into China, but from date of initial purchase to time of delivery can take up to two years (Geng[16], pers. comm. 2002). Herds of imported cattle could initially be evaluated using with-in herd BREEDPLAN until progeny from link sires became available for comparisons.

As part of the pre-planning phase, a consultant could assist with preparation of forms for collecting data such as pedigrees, birth dates, mating details, identification details of individual animals, and any other information required. Also, weighing facilities and yards where the cattle are held would need to be inspected, and upgrading suggested if necessary. Management and staff responsible for the various herds and groups of cattle could be briefed about herd management requirements, and personnel trained for data entry, maintaining data base systems and use of software programs. Identification with a unique tattoo of all animals to be used in the program could also begin.

Identification of Animals

It is of the utmost importance that accurate data is recorded for submission to ABRI for the processing of EBVs. To ensure the accurate recording of pedigrees each animal must have a unique, permanent identification. Most breeding cattle in China seen by the author did not appear to have any permanent identification. The preferred method of identification is an ear tattoo which shows year of birth, sequence of birth, and ownership, or in the Chinese context, the herd or group to which it belongs. A letter of the alphabet is used to indicate year of birth[17], followed by a number beginning at the numeral "1" for the first calf born each

[16] Geng Fan Jun is Director of the Henan Purebred Beef Breeding Centre.
[17] To avoid confusion with numerals, the letters I and O are not used.

year. For example, if the year-letter for 2003 was “A”, the first calf born in that year in a particular herd would be A1, and the first calf born in 2004 would be B1. In addition, letters and symbols, alone or in combination, are used to indicate ownership, and as well provide the unique identification. The full ear tattoo for an animal from one herd could read, ABC A1, whereas for an animal from another herd could be XYZ A1. A registry would need to be maintained by a reputable organisation or government department to avoid duplication, so that all herds had their own unique tattoo identification. Foundation animals for which the birth date was not known could be given a unique year-letter such as “XX”. For easy recognition of animals, an ear tag corresponding to the tattoo could also be inserted, as an ear tattoo is not easy to read unless the animal is quiet and accustomed to being handled, or has its head restrained. All animals to be enrolled in the BREEDPLAN program would need to be individually identified prior to commencement, or as part of the initial stage of implementation.

A minimum of three months to a maximum of six months would be appropriate for the pre-planning stage. This would allow three months for selection of suitable sires and dams of indigenous breeds, and a further three months for collection, processing and distribution of semen. Mating of females would be delayed, so sufficient cows were available to be mated as the first step of the initial stage of implementation.

Initial Stage of Implementation

To begin the initial stage, cows would be mated over a two month period. It is of vital importance to the success of the program that accurate data with regard to the name of the sire and dam, and service date of each mating be recorded. Gestation length for cattle is approximately 280 days, which would allow 10-12 months until the calves were born, and a further six months before the 200 day weight was recorded. This 12-18 month period would allow time for further education and training, fine-tuning of management practises and the re-assessment of breeding objectives.

The initial stage of implementation would provide an opportunity for the consultant to become familiar with the Chinese beef industry at a herd management level, and also at the macro level. Central research question 3.0 addresses not only opportunities for Australians (consultants) to facilitate the application of BREEDPLAN, but also to assist in devising *holistic breeding programs* based on performance. In order to assist in the setting of breeding objectives, a consultant would need to understand government organisational structure and policy, markets and consumer trends, production systems and their location, as well as processing and transportation systems. Each breeding objective would need to be set according to future policy directions and market requirements, within the context of present and on-going management practises.

Field research for this study indicated that some Chinese MoA and AHB officials were aware of, and had a limited understanding of BREEDPLAN technology and its benefits, but had no comprehension of how it could be implemented, or of the benefits to the beef industry as a whole. The initial stage would be an opportune time for the education and training of Chinese officials and those involved with the management of the various herds, about the requirements for implementing the technology and necessary changes to herd management. Regardless of whether BREEDPLAN was implemented at a provincial or national level, the consultant would need to spend considerable time at the various centres where herds were kept. This would allow time for staff training and ensure correct procedures were followed.

Continuing Oversight

The birth of the first calves marks the end of the initial stage of implementation. As calves were born, birth dates and birth weights would need to be recorded, and care exercised to ensure contemporary groups were maintained. Difficult calvings, as well as degree of assistance would also be recorded. As 200 and 400 day weights become available, data would be entered and submitted to ABRI for processing. Emphasis at this stage would be on overseeing the correct input of data, and the segregating of cows to build contemporary groups depending on whether their calves were either male or female.

Carcase EBVs would require animals to be scanned for eye muscle area, and rib and rump fat measurements. Scanning must be done by an operator accredited with ABRI, so a consultant could assist with the contracting of a qualified Australian operator and the scanning of the stock in the field.

Following the return of the BREEDPLAN report and EBVs for animals recorded, preliminary decisions could be made about animals to be culled. The report would include EBVs for sires, dams and individual progeny. It should be remembered that these EBVs would be preliminary estimates with a low accuracy value, but in conjunction with eye appraisal, superior animals could be identified. As noted previously, one of the suggested goals is to improve growth rate to yearling age. The most useful estimation for yearling growth is the 400 day EBV, so the best of the young bulls should be retained for further evaluation, and ultimately replace their sires for breeding. However, to maintain a balanced breeding program, any decisions for selecting best performers would need to consider carcase and fertility traits also. If selected carefully, the foundation herds for the breeding programs should represent the best available of their respective breeds. Culling the lowest performers, even with preliminary figures, would speed up the genetic gain so that elite herds could be established to breed high performing sires for distribution throughout the villages and breeding areas.

Expected Outcomes

Identification of superior animals can be made within two years following the introduction of BREEDPLAN, and measurable genetic gains achieved when progeny of second generation recorded sires become available for evaluation. This is a result of selecting the best performing male progeny of first generation sires for future matings. However, as shown by experiences with the use of BREEDPLAN in Australian beef cattle, major genetic gains can be achieved in ten years (see Genetic Trends, Chapter 3, p. 68). The Chinese beef industry could expect to experience similar, or even greater gains in certain areas such as carcase related traits due to the generally low level of muscling seen in indigenous cattle.

Benefits of Selected Traits to the Chinese Beef Industry

The overall low quality of Chinese indigenous beef cattle would make genetic gain relatively easy and quick to achieve. Longworth, Brown and Waldron (2001, p.48) state, 'In general, the beef production performance of yellow cattle is low compared with that of the specialised beef breeds because of their late maturity and their low meat and milk yields'. As noted previously, some native breeds have the potential to equal the world's best beef-producing breeds. If carcase EBVs, particularly eye muscle area and retail beef yield EBVs, were one of the main selection criteria, the resultant increase in muscling would dramatically lift productivity of Chinese cattle. As higher yielding sires became available throughout the industry, particularly at a village level, the volume of beef produced would increase dramatically.

Turning animals off at a younger age increases both productivity and profitability. Increasing numbers of cattle in China are now fattened in feedlots for domestic consumption, so it is beneficial if stock will fatten easily at a younger age. By selecting for increased growth and weight at 400 days, farmers are able to produce an animal readily sought by the feedlot industry. In agricultural areas, cow-calf production is mainly an activity of unspecialised households, so a major saving in feed costs would be realised as a result of turning progeny off earlier, and an additional cow could be kept resulting in increased income for the farmer.

Emphasis on selecting for fertility is also a major contributor to increased productivity. Heifers calving as two-year olds rather than as three-year olds have far less calving difficulties, and have a longer productive breeding life. Cows in the agricultural areas of China generally calve twice every three years, which means the farmer often feeds a dry cow. This could be because the farmer holds one dry cow for work and calves in alternate years, or the low fertility rate could be a result of the poor nutritional level which means that heifers need to reach maturity before beginning their breeding cycle. Research into the fertility of Chinese beef cattle is beyond the scope of this study, but is an important issue which should be the subject of an in-depth investigation.

Herd Magic

As an aid to quickly, efficiently and accurately recording a full range of information about a breeding herd, Herd Magic[18] is a powerful herd management and marketing tool for both stud and commercial beef cattle breeders. For stud breeders, Herd Magic provides a direct link between on-farm recording and data requirements of breed societies, and is compatible with BREEDPLAN. Herd Magic is a user-friendly software program with easy to use standard operating procedures throughout the program.

Some of the features of Herd Magic that provide assistance with record keeping include:

- A centralised database of all animal records and performance data.

[18] For further information, see Saltbush website:
http://saltbush.une.edu.au/saltbush_website/HERD_MAGIC.HTM

- Four generation pedigree available on all animals.
- Performance data (EBVs) electronically updated from BREEDPLAN.
- Mating history - monitor which males are mated to which females, and resultant progeny.
- Weights - daily weight gain, and weight ratios for contemporary groups calculated as weights entered.
- Allows carcase feedback to be entered.
- Monitors stock movements.

In the Chinese context, Herd Magic would be an extremely useful tool as it would provide a centralised database for monitoring all animals recorded, with direct links to ABRI. The program also produces data entry work-sheets that can be taken to various locations for easy recording of data. The sire selector and EBV index features would also assist with analysing breeding programs to determine which are the most suitable sires, and which young bulls best meet future breeding objectives.

Protocols for Transferring Genetic Material

To avoid the payment of tariffs, most live cattle and genetic material imported into China are usually shipped either directly or indirectly through the China National Animal Breeding Stock Import Export Corporation (CABS). Although import protocols are relatively simple and not too restrictive, AHB officials indicated that quarantine and health certificates issued by Chinese government departments were often difficult to obtain and subject to long delays. All live animals imported are subject to a quarantine period of 45 days in China, and as are donor animals for semen and embryos, inspected in Australia by Chinese veterinary and customs officials. Health requirements and protocols are the same for live animals as for semen and embryos (see Appendix 3 for health requirements for the import of semen and embryos).

Summary

Management practises within the breeding sector of the Chinese beef industry could easily be adapted to utilise BREEDPLAN technology. The Ministry of Agriculture and Animal Husbandry Bureau largely control the breeding sector and beef cattle improvement programs, so it is in their larger herds that the technology could be introduced to measure, and quickly improve the genetics of indigenous breeds, as well as ensuring that imported cattle were the most appropriate and best available.

The challenge of the future for introducing programs to improve the productivity and profitability of Chinese beef cattle is to find the right genetics. Beef producers must know the present level of ability of their animals to produce beef, and decide what will be their requirements in the future, and how they will achieve those requirements. They must identify the present genetic base, and set achievable goals for lifting the base to a desired level. BREEDPLAN can identify the genetic base, and assist in selecting animals with superior genetics that will lift performance to the desired level of productivity. As the productivity of Chinese beef cattle increase through the identification and wider use of superior animals, the profitability of farmers would improve as better quality bulls were made available at village level.

Chapter 5.

Cross-Cultural Marketing Issues and Marketing Opportunities.

Introduction

It is a common perception among Westerners that conducting business with Asians is extremely hazardous, and their markets are difficult to penetrate. Stories abound of failed attempts to negotiate successful contracts, joint ventures that require the input of vast amounts of capital with little or no return, and negotiating tactics that compel many businessmen to return home empty-handed and disillusioned. Numerous company executives see the vastness of China and its population of almost one and a half billion people as a market just waiting to be tapped, and possibly the saviour of a business venture struggling to survive. Despite recognition of the difficulties of conducting business in China, businessmen continue to travel to China looking to negotiate successful contracts, but the vast majority inevitably fail.

A number of factors contribute to the failure of many of these missions. Inadequate market research is a major contributor, as well as ethnocentrism and lack of international marketing skills. However, the most common factor causing negotiations to fail is a lack of understanding of cultural differences. The literature detailing Chinese culture and every aspect of cross-cultural marketing in Asia is encyclopaedic, and recommended reading for anyone considering involvement in China either for business or other reasons as the principles are the same. However, most literature is more relevant to conducting business at a high level involving large delegations, such as investment by multinational companies, or trade discussions by government departments. Theoretical aspects of culture, conceptual frameworks and the historical context of why Chinese negotiators and business persons react in particular ways are beyond the scope of this chapter, which will focus more on practical suggestions and advice in cross-cultural problem areas relevant to the level of business, such as language, “face”, relationships, and initiating contacts. These factors relating to central questions 3.0, 4.2 and 4.3 are relevant to the marketing of genetic material and provision of consultancy services in China and essential elements of the negotiation process which often determine the success or failure of business initiatives.

Cultural Factors

The Chinese are astute, aggressive marketers. In China, one only has to visit a market, a tourist attraction with the inevitable variety of stalls and entrepreneurs selling mass-produced trinkets, or even just walk along a busy city street to experience the skill and persistence of hawkers and beggars. Although a very old civilisation, China has a long history of poverty, internal struggles and domination by foreign powers. As a result, children were taught from an early age to survive by whatever means possible. Poverty is still widespread in rural areas to this day, but the standard of living for the majority of people has now risen to the extent that a large percentage would be considered middle-class, and comparatively well-off. Yet, survival instincts have been deeply ingrained into society for so long they have become part of traditional culture, and these survival instincts are translated into their attitudes about conducting business. This is even more evident when Chinese conduct business with the West.

Western businessmen and others, such as consultants who wish to operate in China, are well advised to make every effort to learn as much as possible about Chinese culture and how Chinese people think and operate.

Language

English is fast becoming the language of international business. Throughout China there is an urgency to learn English, with English language taught from the early years of primary school through to university level. In fact, to receive a degree at university it is mandatory to pass a high-level English proficiency test before graduation. A common sentiment expressed by Chinese people is: "Now we are in the WTO (World Trade Organisation) we must work hard to learn English so we can do business with the West". The level of fluency attained often may be satisfactory for basic communication in a casual or informal situation, but generally is not of a high enough standard for business or technical negotiations.

Australians wanting to market genetic material in China will find that at a provincial level, very few MoA and AHB officials speak English, so it will be necessary to engage the services of an interpreter. Burton Levin, former United States Consul-General in Hong Kong quoted by Chu (1997, p.192) says: 'It's remarkable how simple truths sometimes seem to be overlooked, such as hiring bilingual agents who understand the difference of operating in a Chinese business environment'. Levin advised business people to either become fluent in Mandarin, or hire someone with unquestionable fluency in both Mandarin and English. Even with professional interpreters, misunderstandings and problems will occur. Nuances of meaning, idioms and common slang are virtually impossible to master in a second language, even after living in a country for a considerable length of time.

A further difficulty when doing business in China is the context in which language is used. Communication in Chinese culture is highly contextual, whereas in Australia communication is low to medium context (Li, Tsui and Weldon, 2000, p.195). In high-context cultures, meaning is not conveyed directly by the words. Much of the information is contained in the nonverbal part of the message, such as values, position and background of the sender, which is understood in the context of the society in which it is delivered. In low-context cultures, the actual words spoken are used to convey the main part of the information. What is said is important, and not how it is said or the environment in which it is said. Generally, Western countries are low-context cultures, with some exceptions such as France, Spain and Italy, with Asian, African and Middle Eastern Arab nations regarded as high-context cultures (Onkvisit and Shaw, 1997, pp.208-209). In a negotiation situation, the Chinese will be implicit and indirect; what is not said is often more important than what is actually expressed. Western counterparts see them as evasive, unwilling to disclose information, slow to make decisions and manipulative. In turn, the Chinese see Western negotiators as too legalistic, brash, demanding, unwilling to compromise and reluctant to spend time developing relationships. They are seen as looking for short-term gains rather than a long-term commitment.

To avoid frustration and disappointment, Australian marketers need to look beyond the tactics and discussions around the negotiating table. The Chinese negotiators will most likely not be the decision makers. They will be subject to considerable pressure from outside to negotiate a favourable outcome, without the loss of face (see below). The Australian negotiators should be prepared in advance to give concessions, and to expect a prolonged and difficult negotiation process. Yet most difficulties can be overcome with patience, respect, and a genuine desire for understanding and friendship.

Despite the emphasis on learning English in China, Australians tend to have great difficulty in being understood. The majority of foreign English teachers in China are American, and to a lesser degree, British. Australian teachers of English in China are very much in the minority. Thus, Chinese people are generally attuned to the American style of English. It is commonly expressed by Australians living in China that it takes at least two or three weeks before the locals, even competent English speakers, have any idea about what they say. The broad Australian accent is difficult because of the common use of slang and idioms. An example of the difficulties faced is a low-level, two-day negotiation session attended by the author, by an Australian businessman with a Chinese company in a large city in central China. The Chinese negotiator spoke excellent English, and had spent a number of years travelling and working in the West. However, throughout the two days he continually appealed to the author to translate into "understandable" English what was said by the Australian businessman. It was the first experience by the Australian of conducting business in China, and he seemed unable to alter his style of language to accommodate the cross-cultural difficulties. It is important to remember in any cross-cultural situation to try to avoid all use of slang, and to keep words used as simple and easy to understand as possible.

"Face"

The concept of "face" is common to most societies, but in China it has special significance because it is central to every aspect of social life and business transactions. Li, Tsui and Weldon, (2000, p. 195) state, 'For the Chinese, face concerns one's dignity, respect, status and prestige; thus, social and business transactions should occur without anyone losing face'. It is possible to give face, and also to cause someone to lose face, which should be assiduously avoided regardless or the situation. Chinese hosts will always hold welcoming ceremonies, visits to local attractions, and lavish lunches and dinners. These activities should be considered as part of the negotiation ritual, and are designed to 1) give face to their business counterparts by making them feel welcome and honoured guests, and 2) maintaining the face of the host by being generous and considerate. The ritual is also the beginning of the process of becoming acquainted and the start of hopefully a long and close relationship. Western businessmen should not feel pressured by these activities, or maybe a sense of feeling ungracious so that unreasonable concessions are given to their "generous" hosts, but must be sensitive at all times to avoid causing loss of face.

Concessions are, however, vital to the successful outcome of the discussions when negotiating with the Chinese. Li, Tsui and Weldon, (2000, p. 196) note, 'The Chinese tend to view a negotiation as a search for mutuality in which processes of reciprocation are critical'. Negotiation is a search for common agreement, and favours (concessions) from one side must be met by the other side. Australian marketers should be well prepared and build a degree of flexibility into their market strategy. Reciprocity builds trust, harmony and respect and maintains face for both parties, and creates a personal bond leading to long-term and successful business collaboration.

Initiating Contacts

The first, and often most daunting task for doing business in China is to meet and get to know the right people. Even though Western businessmen are respected, they will find it impossible to meet their appropriate counterparts unless introduced through the correct channels. The Chinese will only have dealings with another person, even their own countrymen, if the person is introduced by a trusted, or common third party (see *Guanxi* below). As a consequence, Chinese people develop networks of associates and contacts from an early age. However, with continuing exposure to Western cultures and a desire to conduct increased business with the West, it is becoming easier to meet Chinese counterparts without third-party introductions.

A number of avenues exist for initiating and developing the right contacts. As part of market research, repeated visits to China over a period of time may result in contacts that can be nurtured until a degree of trust is achieved. However, research in Australia to find someone who already has suitable contacts is likely to prove beneficial. Due to the increased volume of trade between Australia and China in recent years, government departments such as Queensland's

Department of State Development and the Department of Foreign Affairs and Trade in Canberra, and industry organisations such as Meat and Livestock Australia and beef cattle Breed Societies would all provide useful contacts. In China, the Australian Embassy, and in particular, Trade Offices in Beijing and Shanghai already have a wide network of contacts and have shown a willingness to assist.

Building a Relationship

Relationships have far greater significance and meaning in Chinese culture than in Western culture. Unless considerable effort is expended in developing and maintaining a good personal relationship with a Chinese counterpart, the business venture is unlikely to succeed. The Chinese tend to negotiate the establishment of a good relationship, and leave specific contractual details to be worked out based on circumstances as they occur. Legal contracts are seen as a useful agenda and worthwhile as long as they are convenient, but subject to continual adjustment when necessary. The signing of a contract is the beginning of a long and continuous relationship in which the Chinese genuinely believe it is proper to make increasing demands on the other party (Herbig, 1998, p. 63-67). These demands often will extend well beyond the realm of business to include a request such as hosting a child while attending a university in Australia. Thus, Australians contemplating marketing or consultancy in China must be well informed, know their bottom line, prepared for long-term involvement, and willing to accept the inherent cultural obligations.

Guanxi

Relationships, and networks of contacts are integral elements of business management the world over, but *guanxi* as the system of networking is known in China, has special significance. *Guanxi* extends far beyond business contacts, and refers to direct ties between two or more people. These ties begin at an early age and continue throughout life, and relate to relationships to extended family, even a common but unrelated family name, school classmates, people born in, or who have lived in the same village or district, and many other situations where something more than just a superficial relationship or contact has been experienced. In China, *guanxi* is an integral part of everyday life and is used to "get things done", from simple tasks to business, political and personal dealings. In terms of realising an objective in China, *guanxi* resembles the common phrase in Western culture, "It's not what you know, but *who* you know". But *guanxi* is much more. *Guanxi* also is a system of asking for favours, and the repaying of these favours at a later date.

Reciprocity and Obligations

The granting of a favour places an obligation on the recipient to reciprocate with a return favour, usually of higher value, some time in the future. Reciprocal obligations provide a degree of insurance, but more importantly, avoid imposition or opportunistic behaviour. And, the consequences of violating these unspoken, unwritten social norms can be severe, resulting in ostracism and unbearable loss of face. Reciprocity also helps to maintain relationships, as parties always have a type of "credit", or "debit" balance which provides a strong incentive to ensure the relationship continues (Li, Tsui and Weldon, 2000, p. 250).

If Westerners learn to understand and respect the notion of *guanxi*, they can use it to their advantage. In fact, it is the only way to initiate contact with the appropriate people, but many doors and avenues will be opened that may otherwise have been impossible to penetrate.

Cross-cultural Tips

To highlight some of the cultural aspects and hazards of business dealings in China, the following summary, based on the author's experience and the extant literature on the subject, is presented as a quick reference for Australians wishing to become involved in the Chinese beef industry either as a marketer of genetic material or providing a consultancy service.

1. Mandarin is extremely difficult to master as a second language, but any effort to learn a few simple greetings will be well rewarded. A few words spoken in Mandarin demonstrates an interest in Chinese culture and respect for the people, and will ensure a tremendous advantage over competitors.

2. Learn as much as possible about China, the people and their culture, and the industry in which one wishes to become involved before leaving Australia. It may be surprising how much in-depth knowledge the Chinese already have about Australia, the Australian beef industry, and individual business operations.

3. Patience, flexibility and creativity are essential qualities for negotiating successful business ventures in China. Respect and a warm heart towards Chinese counterparts will achieve much more than a cool, businesslike approach

4. The key to successful business dealings with the Chinese is developing and maintaining a close personal relationship.

5. Be prepared for long-term investment rather than short-term profits.

6. Always expect the unexpected - events are unlikely to unfold as one might expect.

7. Avoid anger and aggression, but maintain harmony at all times, even when problems seem insurmountable. The most difficult problems are usually resolved over dinner, or some other social occasion.

8. The Chinese view signed contracts as a basis for further negotiation in the future as circumstances require, rather than as a legal document.

9. Expect, and try to accommodate personal requests which might otherwise be considered unreasonable and not relevant to the business relationship.

10. Know your bottom line, and do not be afraid to remain firm if the line is breached. It is better to walk away rather than agree to a deal that is unacceptable. The promise of future benefits are unlikely to materialise.

Despite the difficulties, it is possible to negotiate successful business ventures with the Chinese, and enjoy a long term, fruitful and profitable relationship. Understanding cross-cultural issues is important, but exhaustive research before entering the market is even more important. It is vital to know the size of the market, competitors, future demand, government policy, and every other aspect of the market before committing to an entry strategy. China is a vast country and perceived as a market of huge potential, but because of fragmentation and regionalisation, markets can be much smaller than expected, difficult to penetrate and often unprofitable.

Marketing Opportunities

The rapid development of the Chinese beef industry in recent years has created a need for increasing the productivity of Chinese cattle, presenting a number of marketing opportunities for Australian interests. In relation to central question 5.0, field research for this paper identified the following areas for marketing opportunities.

1. Genetic Technology. Huge potential exists for the introduction of BREEDPLAN and other associated technology due to the vast size of the industry, but low level of productivity of Chinese beef cattle
2. Consultancy Services. There is an urgent need for the provision of consultancy services by foreign experts within the Chinese beef industry. Areas of opportunity include the application of genetic technology, devising suitable breed improvement programs, stock selection, progeny tests, and training of animal husbandry personnel.
3. Genetic Material. Significant demand exists for genetic material in the form of live animals, semen and embryos, of imported breeds widely established and popular in China such as Charolais, Simmental and Limousin. Australian genetics of these breeds are now sought for use as an outcross, with lessor demand for other breeds to use in cross breeding programs. If

BREEDPLAN is introduced, most demand would be for BREEDPLAN recorded animals with optimum EBVs for growth, yield and fertility. Research was not directed at determining the size of the market for genetic material, but indications were that demand would be substantial, but not unlimited.

Market Competitors

Cattle of many different breeds have been imported into China from a range of countries, including Australia. In pastoral regions, Simmental, Shorthorn and Hereford were commonly used for crossbreeding, but in the Central Plains and North-east agricultural areas, Simmental, Limousin and Charolais have become the most popular. The majority of cattle have been imported from Canada, and that country has become the preferred source of genetic material. Longworth, Brown and Waldron (2001, p.56), believe this is to a large extent, a reflection of the good relations Canadian suppliers have with the relevant departments of the MoA bureaucracy. Canadian cattle continue to be imported. This is evidenced by the author's inspection of a group of recently arrived (June 2002) two-year-old Canadian-bred Red Angus bulls stationed at the Henan Purebred Beef Breeding Centre.

Australians wishing to become involved in the Chinese beef industry, either as consultants or as marketers of genetic material, should use the Canadian experience as an example of how to approach the Chinese market. The Canadians have developed a close relationship, and provided assistance and expertise in breeding techniques for the Chinese over a long period of time, and are regarded as reliable suppliers of quality material. Australian-bred cattle such as South Devon, Angus, Murray Grey, Brahman and Droughtmaster have entered China in the past, but there has been no apparent sustained effort by Australians to assist the development of the Chinese beef industry.

Summary

There are major differences between Australian and Chinese culture, and in a business context they have the potential to cause serious problems leading to antagonism and despair. Westerners often underestimate the cultural implications, thus failing to understand the rationale behind many of the tactics and actions of their Chinese counterparts when initiating appropriate business contacts or negotiating contracts. Yet the difficulties are not insurmountable. An effort to learn as much as possible about Chinese culture is essential so as to be prepared in advance for the demands usually associated with a business relationship, but a genuine attitude of respect and warmth will ensure harmony, and an environment in which difficulties can be successfully overcome.

Opportunities exist for Australians to develop business ventures in China, but for the uninitiated the market is extremely difficult to penetrate. The barrier of language is a major obstacle, but many failures can be traced to inadequate, or nonexistent market research. It is now an opportune time for Australians to pursue marketing opportunities within the Chinese beef industry as the Chinese look to Australia for quality breeding stock. With a genuine respect for cultural differences and the employment of sound marketing and business principles it would be possible to successfully enter the Chinese market. Australian beef producers would gain long-term benefits by having market access to one of the world's largest beef industries, and Australian expertise, technology and genetic material could contribute much to the Chinese industry, thus providing mutual benefits to both industries.

Chapter 6.

Conclusions and Recommendations

Introduction

Conclusions drawn from the research relate directly to the central questions. Each question is discussed separately and summarises the relevant data which is analysed in relation to the Chinese beef industry as a whole, as well as the pertinent area addressed by the question. Recommendations to the Chinese beef industry in relation to the application of BREEDPLAN, and to Australian interests wishing to market genetic material, or provide consultancy services in China are presented, and based on the conclusions.

Issues identified for further research are discussed, and the chapter concludes with a summary of the research and findings from the study.

Conclusions

1.0 *Given the vastly different management practices and farming methods of the Australian and Chinese beef industries, can BREEDPLAN technology be successfully integrated into breeding programs within the Chinese beef industry?*

The present Chinese beef industry, despite being one of the largest in the world in terms of total numbers, remains relatively undeveloped and subject to traditional management practices. Beef production is concentrated in the agricultural areas of the central plains, and the vast majority of cattle are owned by unspecialised households. These farming households keep up to a maximum of three cows for draught work, with the progeny generally sold to specialised households for fattening. The majority of cattle are slaughtered locally and sold through wet markets close to where the animals were fattened, and the quality of the meat is considered very poor by Western standards. Most of the cattle are indigenous yellow cattle, and are usually mated to a local village bull. Except while they are used for working, the cows spend most of their time housed in stalls in the owner's courtyard, or occasionally tethered along roadsides if feed is available. Although specialised households run more head of cattle, most resources are directed towards fattening rather than breeding. However, a number of large herds do exist. At a provincial government level, the Ministry of Agriculture and Animal Husbandry Bureau control a number of sizeable herds of yellow cattle, as well as purebred herds of breeds imported from overseas. These herds are run as separate large groups of up to approximately 30 breeding cows together in suitable enclosures and are fed mainly silage and straw, with some concentrates as necessary.

By contrast, the Australian beef industry is highly developed, with breeding herds generally run on the vast pastoral areas. Many of the herds, including seedstock herds, are relatively large, and it is to the seedstock herds that the commercial sector looks for replacement sires. Thus, it is the seedstock sector that is largely responsible for genetic improvement of Australian beef cattle. BREEDPLAN, the Australian- developed genetic evaluation technology has been widely integrated into the seedstock sector, and has assisted in lifting the level of performance of Australian beef cattle to equal the best in the world. By separating environmental from genetic factors, BREEDPLAN is able to identify superior performing animals by estimating the breeding value of individuals through measurement of growth, muscling, fertility and other traits required by the beef industry.

Research of the Chinese beef industry has shown that the small herds of unspecialised households would not be suitable for the introduction of BREEDPLAN, however, it has been concluded that management strategies of the larger government-run herds would make them eminently suitable for the integration of BREEDPLAN technology. By running approximately 30 cows together in separate enclosures, the requirement for contemporary groups is satisfied, and the intensive management would allow for the accurate collection of data. In addition, provincial governments would have the resources and skilled personnel to ensure that the introduction of the technology was successful.

2.0 *Is the BREEDPLAN system a viable alternative to current programs for beef cattle improvement in China, as an aid for the selection of sires and the prediction of their breeding value and measurement of genetic merit?*

The Chinese beef industry began a period of rapid growth in the early 1980s mainly as a result of economic changes introduced by the government, however, it was the government's strong support for the cattle and beef industry from the early 1990s that encouraged widespread expansion and development of breeding programs for increased performance. Breeding programs generally involve crossing yellow cattle with imported breeds such as Simmental, Charolais and

Limousin, significantly improving the growth, muscling and market acceptability of cattle available for medium and large sized feedlots. BREEDPLAN is not designed to replace existing breed development programs, but is a tool to assist with the identification of superior animals. Therefore it is concluded that the BREEDPLAN system should not be seen as an alternative to current breeding programs, but could be used to select sires with desirable traits to most benefit existing cross-breeding programs.

2.1 *Would the BREEDPLAN system complement existing, and/or new research and development of the Chinese beef industry?*

At a government level, considerable resources are directed towards programs to improve the quality and productivity of Chinese beef cattle. However, these programs generally fail to take a holistic, practical approach, but concentrate on unrelated, technical aspects of animal production. Performance trials and cross-breeding programs have boosted production in the larger pastoral areas and government-run herds, but there is no attempt to evaluate genetic make-up of herds or to collect data for identifying animals with superior, measurable traits. Some indigenous Chinese breeds of cattle have the potential to rival the world's best for yield and meat production, but very little work has been done to conserve and develop local breeds. Successful cross-breeding requires the mixing of two or more pure breeds, so the foundation of all cross-breeding programs in China are cows of various local yellow cattle breeds. If the genetics of purebred yellow cattle were improved through the use of genetic evaluation technology, they would provide a higher quality base for cross breeding programs. Indigenous breeds of yellow cattle also provide adaptability to local conditions and the ability to survive and produce on a low level of nutrition.

BREEDPLAN can separate environmental from genetic factors, and identify superior animals for their future breeding potential. As proven by the application of BREEDPLAN in beef cattle herds throughout the world, the use of BREEDPLAN in herds of Chinese yellow cattle would quickly lift their performance and greatly increase their value in cross breeding programs. New developments of BREEDPLAN technology such as multi-breed EBVs could prove invaluable in the future for the Chinese industry, to assist the fine tuning of cross-breeding programs, and collection of accurate data and genetic information. It is therefore concluded that BREEDPLAN technology would complement existing and/or new breeding programs within the Chinese beef industry, by facilitating the selection of suitable stock, and giving a sense of direction so that goals and objectives can be coordinated and achieved. By providing a system of objective measurement benefits are tangible, and gives confidence that genetic gain is accomplished.

3.0 *Are there opportunities for Australians with experience and expertise in the Australian seedstock sector to facilitate the application of BREEDPLAN technology to the Chinese beef cattle breeding sector, and to assist in devising suitable, holistic breeding programs based on performance, aimed at producing a higher quality and more efficient article under local conditions?*

Although relatively small in terms of numbers, the Australian beef industry is a major global player being the largest volume exporter of beef worldwide. To achieve that position, the industry has historically benefited from many astute studmasters and cattlemen who have developed and bred cattle equal to the best in the world. In recent years, the seedstock sector has embraced the Australian-developed genetic evaluation technology BREEDPLAN, to the extent that the vast majority of sires used in Australia are BREEDPLAN recorded, or the progeny of recorded sires. This has been a major factor in the dramatic increase in performance of Australian beef cattle in the last 20-30 years.

The Australian beef industry encompasses a wide range of geographic and climatic conditions, from the lush improved pastures of southern Australia, to the heat in the north, and arid areas of central Australia. Cattle producers understand the need to breed cattle most suitable for the environmental conditions under which they are run, to achieve maximum productivity and profitability. For example, the introduction of Brahman and Brahman infused cattle have revolutionised the northern beef industry because of their heat tolerance and resistance to parasites.

Despite the difference in management practises between Australian and Chinese beef producers, the general principles of selection, and breeding for increased performance remain the same. BREEDPLAN has been widely accepted throughout the world as one of the best management tools available to assist with the identification of superior stock, and has proven to be equally effective in the embryonic beef industries of developing countries such as Thailand and the Philippines, as the highly developed industries such as the Australian, European and North American beef industries.

Field research in China indicated that the Animal Husbandry Bureau is aware of BREEDPLAN technology and would welcome its introduction. However, officials and managers have no understanding of practical management aspects with regard to the introduction of the technology or how it can be used to maximise benefits to the Chinese beef industry. It is concluded that Australian seedstock producers do have the expertise to facilitate the application of BREEDPLAN technology to the Chinese beef industry, and the practical experience to devise suitable programs to lift the performance of Chinese beef cattle. It is further concluded that many opportunities exist for Australians to become involved; indeed there is an urgent need for Australians to act as consultants to facilitate the application of BREEDPLAN within the Chinese beef industry.

4.0 *Is it feasible for Australian genetic material to be introduced widely into the Chinese industry to lift the level of performance of Chinese beef cattle?*

Prior to European settlement in the late eighteenth century, Australia had no indigenous cattle. As a result, the entire Australian beef herd is built on importations from Europe, South Africa, Canada and the United States. The industry benefited greatly in its early development stages from astute cattlemen whose expertise and knowledge laid the foundation of the industry with sound breeding principles. Having access to the best genetic beef cattle material throughout the world, together with the need to breed cattle that perform in a variety of environments, has meant that Australian cattle have reached a level of genetic excellence to the extent that animals born and bred in Australia have been exported to major beef-producing countries worldwide. Australia's freedom from serious livestock diseases such as Mad Cow disease and Foot and Mouth disease due to its geographic isolation, has been a major factor driving the export of genetic material throughout the world. In addition, the widespread use of BREEDPLAN in seedstock herds to measure and predict the future breeding value of sires, dams and their progeny, and the identification of genetically superior animals, has significantly enhanced productivity and profitability within the Australian beef industry. It is therefore concluded that it is feasible for Australian genetic material to be introduced into the Chinese industry to lift the performance of Chinese beef cattle. An important benefit to flow from the introduction would be the availability of Australian animals with known EBVs to be used to link Chinese herds to the BREEDPLAN system.

4.1 *What is the most appropriate method for introduction of genetic material; live animals, semen, and/or embryos?*

Coinciding with the rapid development of the Chinese beef industry which began in the early 1980s, many live cattle were imported from overseas to improve the performance of local cattle. Purebred herds of imported breeds have been established for the breeding of future sires which are used extensively with artificial insemination. The purebred herds are controlled by the Animal Husbandry Bureau, and employ latest embryo transfer technology to increase numbers as quickly as possible.

The importation of live animals, and the widespread use of AI and ET technology indicates that a number of alternatives exist for the introduction of Australian genetic material. Imported bulls could stand at an AI centre for semen production, to be widely dispersed throughout the industry, or alternatively, semen from Australian bulls or embryos taken from Australian cows could be purchased and imported directly. It is concluded that initially, the most appropriate method for the introduction of genetic material would be the purchase and importation of semen from elite sires with known BREEDPLAN EBVs. Live animals and embryos would tend to restrict the gene pool to a few individuals, whereas semen could be purchased from a wide selection of bulls for use as link sires in the various herds of purebred females. The best of the elite sires are generally not available for export because of their value to the Australian industry. However, semen from these bulls is usually available for purchase both in Australia and overseas.

***4.2** What are the marketing opportunities for Australian genetic material in China?*

Australians wishing to market genetic material in China should first conduct in-depth market research to determine the demand, and size of the market before committing to a marketing program. Extensive cross-breeding programs with imported breeds have been implemented for approximately the last thirty years, with some breeds such as Charolais, Limousin and Simmental used extensively for artificial insemination. All imported stock have come from either Europe or North America, which provides an opportunity for Australian genetics to be used as an outcross. Bull breeding stations, the most likely purchasers of genetics, are currently subject to budget restraints as government enterprises are forced to become self-sufficient and profitable. However, the demand for Australian genetics is considerable. Research has indicated that most demand would be for the three breeds noted above as they are proven and popular in China, with demand for other major breeds limited at present. The researcher found a need for breeds such as Angus, Shorthorn, Murray Grey and Hereford breeds to improve the quality of beef as the Chinese industry looks to export markets, as well as supplying the increasing demand from the large middle-class urban population for premium quality meat.

5.0 *What are the likely benefits to the Chinese beef industry and how can they be measured, if BREEDPLAN, and Australian genetics were introduced?.*

Dramatic changes in the level of performance of beef cattle can be made in less than ten years with the application of BREEDPLAN genetic evaluation technology. Australian cattle have increased weight at 600 days with less fat and more muscle, leading to a higher percentage yield of edible meat product. An indication of the genetic changes possible within the cattle population is the changes of weight, fat and eye muscle area of bulls scanned and weighed at the Glen Innes Hereford bull sales in 1994 and 2001. Liveweight increased by 14%, while fat depth decreased by 22%, and eye muscle area increased by 2.5%. Translated into the Chinese context, changes of this magnitude would have the potential to positively influence management practices at herd level, as well as policy decisions by provincial and central governments.

The objective evaluation and estimation of the breeding value of animals as provided by BREEDPLAN allows for easy assessment of the genetic progress of a herd. As BREEDPLAN reports are returned from data submitted to ABRI, EBVs of progeny can be compared with EBVs of parents and genetic trends observed. Preliminary figures for the Chinese beef industry would be available within 18 months after mating, to allow for gestation and weights recorded at 200 days, with more meaningful figures after 24 months following submission of 400 day weights. For herds of imported breeds mated to BREEDPLAN recorded link sires, the 400 day analysis of the first drop of calves would give a good indication of the genetic level of the herd, with the analysis of subsequent drops indicating genetic trends and the level of improvement.

The benefits to Chinese farmers using sires identified as genetically superior for growth and carcase traits would lead to fewer cattle required to produce the same amount of meat product, within a few generations. Farmers could make more efficient use of available feed resources to either run additional cows, or to diversify into other activities. Producers that became known for marketing heavier and higher yielding cattle would attract premium prices for their stock from fatteners, resulting not only in increased productivity, but also a lift in profitability as well. In turn, feedlots would become more efficient and profitable from feeding cattle that grew and fattened faster with a higher yielding carcase. Increased industry profitability would provide an incentive to both breeders and fatteners to breed and produce a better product to meet the needs of increasingly affluent urban consumers who are demanding higher quality meat slaughtered under controlled, hygienic conditions. As the lift in performance of BREEDPLAN analysed herds became recognised, the sale of breeding stock and semen would attract substantial premiums. This would greatly assist provincial Animal Husbandry Bureaus by giving a financial boost to struggling bull breeding centres at a time when central government policy is to reduce subsidies to state-owned enterprises. In addition, a centrally located computer could be contracted to neighbouring provinces for data processing, recouping some of the initial installation costs. Increased industry profitability would provide immeasurable benefits to the Chinese economy as the government looks to promote beef as an export item, encouraging policy adjustments with regard to infrastructure, transportation and marketing at both provincial and central government level.

Recommendations

Recommendations from the research for this study are based upon the conclusions above, and relate to the introduction of BREEDPLAN in Henan Province. In terms of cattle numbers and total volume of beef produced, Henan is the largest of the beef producing provinces, and is home to a number of indigenous yellow cattle breeds known for their superior beef-producing qualities. Rather than taking a blanket approach with widespread introduction nationally, a controlled step-by-step implementation at provincial level due to unfamiliarity of the technology within the Chinese beef industry is recommended. These recommendations would apply equally to other major beef-producing provinces of the central plains agricultural areas.

Recommendations to the Chinese Beef Industry

In relation to central questions 1.0, 2.0 and 2.1, it is recommended that:

1. BREEDPLAN technology be introduced as a tool for assisting genetic improvement of beef cattle as quickly as possible.
2. A delegation of officials representing the provincial government travel to Australia to negotiate a contract with ABRI, The University of New

England, Armidale, New South Wales, for the supply of the technology and analysing of data.

3. All imported breeds with sufficient numbers of purebred females to form viable contemporary groups be enrolled.
4. Indigenous yellow cattle breeds enrolled initially be restricted to no more than three individual breeds, but as many herds of these breeds as possible.
5. BREEDPLAN be integrated into current and new beef cattle improvement programs.
6. A suitable computer be located in Zhengzhou for the control of data, and direct submission of data to ABRI.
7. Herd Magic software be purchased to assist the management of herds and more efficient recording of data.
8. An Australian consultant with practical experience and expertise be engaged to facilitate the introduction of BREEDPLAN, to oversee every aspect of its application, and to train officials and staff in correct procedures.

Recommendations to Australian Interests

In relation to central questions 3.0, 4.0, 4.1, 4.2, and 4.3, it is recommended that Australians wishing to become involved in marketing genetics or the provision of consulting services in China:

1. Research the market thoroughly before committing to a marketing strategy.

2. Develop as many contacts as possible within the Chinese beef industry, particularly amongst officials of the Ministry of Agriculture and the Animal Husbandry Bureau.
3. Build a good personal relationship with prospective business counterparts by repeated visits to China, which should continue after contracts are finalised.
4. Offer additional services such as advice and supervision of breeding programs. This will enable genetic material to be monitored, and benefits assessed.
5. Expect a contract to be the basis for further negotiation as circumstances change, rather than a binding agreement.
6. Be prepared for the obligations of a business relationship, which may include the receiving and giving of favours, and requests that may be considered unreasonable such as hosting a business partner's child for education in Australia.
7. Learn as much as possible about Chinese culture and history, so as to understand and respect the thought processes, actions and negotiating tactics of business counterparts.
8. Try to become fluent in Mandarin language, or engage a competent interpreter for any discussions and negotiations. Learn to speak a few words and phrases of greeting as an indication of friendship and respect. It will be very much appreciated by the Chinese hosts.
9. Do not have over-inflated expectations of the financial benefits likely to be achieved from any contract negotiated. Plan for a long-term commitment rather than short-term gain.

Issues for Future Research

Following the introduction of BREEDPLAN into the Chinese beef industry, research would need to be on-going to monitor the benefits and suitability of the system within the Chinese context. In addition to evaluating the level of improvement with regard to growth, meat yield and fertility of Chinese cattle, a number of other factors relating to implementation would also need to be considered. An assessment of the long-term economic viability of BREEDPLAN in relation to increased productivity of the beef industry and improved profitability for farmers, and the overall value to the provincial economy should be made after approximately five years.

Two other areas for further research were also identified. Firstly, research found that most Chinese cows only calve twice every three years, as compared to a calf every year in developed countries. Thus, the fertility of Chinese cattle needs to be investigated. Is the low level of fertility due to poor nutrition, or are Chinese indigenous cattle genetically less fertile than other breeds? Another factor could be that farmers in agricultural areas have no financial incentive to breed their working cows regularly. BREEDPLAN would identify the more fertile animals, and assist in evaluating the level of fertility of the Chinese beef herd.

Secondly, in-depth market research needs to be conducted to assess the actual demand for Australian genetic material. A comprehensive review is required of industry breeding programs and the value of continued importations, together with a study of government policy, fiscal restraints, and expected trends in consumption and future marketing directions with regard to exporting beef. This study identified a need for Australian genetic material within the Chinese beef industry, but an assessment of the size of the market was outside the scope of the research.

Summary

Despite now being one of the largest in the world, the Chinese beef industry has only been developed within the last thirty to thirty-five years. Prior to the economic reforms introduced by Deng Xiaoping in 1978, cattle were only used for draught purposes, and except for the minority Muslim Hui people, beef was not considered a consumable food item. Following the reforms and as a direct consequence of their introduction, the beef industry began a period of rapid development in the early 1980s. The dismantling of the commune system, and the spread of the Household Responsibility System, in which land and freedom to make decisions about its use, was assigned to individual farmers, was a major factor in the dramatic rise in cattle numbers. Farmers were able to keep additional cows for work, with progeny available for sale. Another factor was the government's decision to improve prices for livestock products, and provide direct support and encouragement for development of the beef industry.

In the past, the Chinese beef industry was based mainly in the pastoral regions of northern and western China, but since the early 1980s major development has been in the central plains agricultural provinces of Henan, Hebei, Shandong and Anhui. A program known as the "Straw for Ruminants" program was promoted by the government, in which straw from cereal crops was treated with ammonia to produce a nutritional stock feed. The vast amount of straw which previously was considered a waste product and burnt in the fields, provides an unlimited resource for farmers and has become the main ingredient of the diet for beef cattle. The “Straw for Ruminants” program was a major factor in locating beef production in agricultural areas, and away from the overgrazed and drought-ravaged pastoral regions.

The vast majority of cattle, estimated at about 90%, are raised by farmers who do not specialise in beef production. Known as unspecialised households, these farmers, which includes most Chinese farmers, keep one or two cows for draught work. Older cows and progeny not required for replacements are usually sold to specialised beef households for fattening and slaughtering. The meat is then sold in wet markets direct to the consumer. However, increasing numbers of cattle are now fattened in feedlots, providing a better quality product for sale in supermarkets. Generally, the quality of domestic beef is low when compared to meat available in Australia. Traditional Chinese cooking methods in which the meat is sliced into thin strips does not require high quality product, but the fact that cattle in China have always been used for draught work is another reason for the lack of quality and poor yield of edible beef.

In an effort to improve indigenous cattle, extensive importations from North America and Europe of well-muscled breeds such as Charolais, Limousin and Simmental have been made for cross-breeding purposes. Extensive use of artificial insemination and embryo transfer technology occurred. However, breeding programs have been indiscriminate with no effort to evaluate and lift the genetic value of indigenous or imported cattle. With appropriate genetic selection technology, some local breeds have the potential to equal the world's best as beef producers, yet little is being done to develop and conserve Chinese breeds.

By contrast, the Australian beef industry is highly developed and incorporates world's best practice. Although comparatively small in terms of numbers, Australia is the largest volume exporter of beef worldwide and the industry is a major contributor to the national economy. To maintain its position as a world leader, the industry invests heavily in research and development of the latest technology, in particular the genetic evaluation technology BREEDPLAN, to improve the productivity and profitability of Australian beef cattle.

Performance recording began in Australia in the early 1970s and was known as the National Beef Recording Scheme. By 1985, the scheme evolved to become known as BREEDPLAN, and became one of the most popular genetic evaluation systems in the world. Developed by the Animal Genetics and Breeding Unit, BREEDPLAN uses best linear unbiased prediction (BLUP) techniques which is accepted worldwide as the best method for genetic evaluation. BREEDPLAN is able to separate environmental effects from actual genetics, and identifies superior animals by estimating breeding values by evaluating various traits considered important and relevant to the industry. Traits evaluated by all major breeds in Australia relate to growth, fertility and meat yield, and continuing development of BREEDPLAN now offers evaluation of traits relating to temperament, and the efficient utilisation of available feed resources. BREEDPLAN technology has been exported to all major beef-producing countries throughout the world, and has been a major factor in ensuring Australian cattle realise maximum productivity and profitability.

Because of the relatively undeveloped state of the Chinese beef industry, BREEDPLAN has the potential to revolutionise beef production in China. Superior animals could be readily identified and quickly diffused throughout the production sector replacing the poor quality bulls commonly used at the village level. Also, individual indigenous breeds which have acclimatised to local conditions, and proven to be able to produce efficiently on a low level of nutrition, could be selected and developed with the assistance of BREEDPLAN technology.

There is a demand for the marketing of Australian beef genetic material in China. Chinese officials are looking to Australia to purchase semen, live animals and embryos because of the value when used for out-crossing with animals previously imported. In addition, Australia's disease-free status and relative ease in which animals and genetic material can be imported into China is an added incentive. Also of major importance is that Australian cattle with known performance as evaluated by BREEDPLAN can be used to link Chinese cattle to the BREEDPLAN system. This would mean that genetic improvement of Chinese cattle would be hastened and easier to achieve.

A need also exists for consultants with practical beef production experience and expertise in the application of BREEDPLAN to assist with the introduction and operation of the technology in China. BREEDPLAN is recognised in China, but the Chinese have no understanding of its operation, and how breeding programs can be greatly enhanced to benefit the industry as a whole. Breeding programs have tended to be indiscriminate and not focused on improving performance through the evaluation, identification and diffusion of superior genetics.

Australians wishing to become involved in the Chinese beef industry, either in the marketing of genetic material or the provision of consultancy services, should be aware of the need for prior in-depth market research, and of the cultural differences when conducting business in China. Although English is accepted as the language of international business, and many Chinese learn to speak in English, their level of proficiency is not sufficient for technical and business discussions. When conducting business, the Chinese look to long-term relationships rather than short-term gain. It is therefore essential to develop a good personal relationship with the Chinese counterpart, as contracts are continually re-negotiated as circumstances change. Australian marketers and consultants must understand the cultural environment, and should not compromise simply to enter the market. The Chinese are astute marketers and negotiators, and the market is difficult to penetrate. However, the Chinese people are extremely hospitable and welcome close personal friendships with Westerners, and any involvement in the beef industry will be very rewarding.

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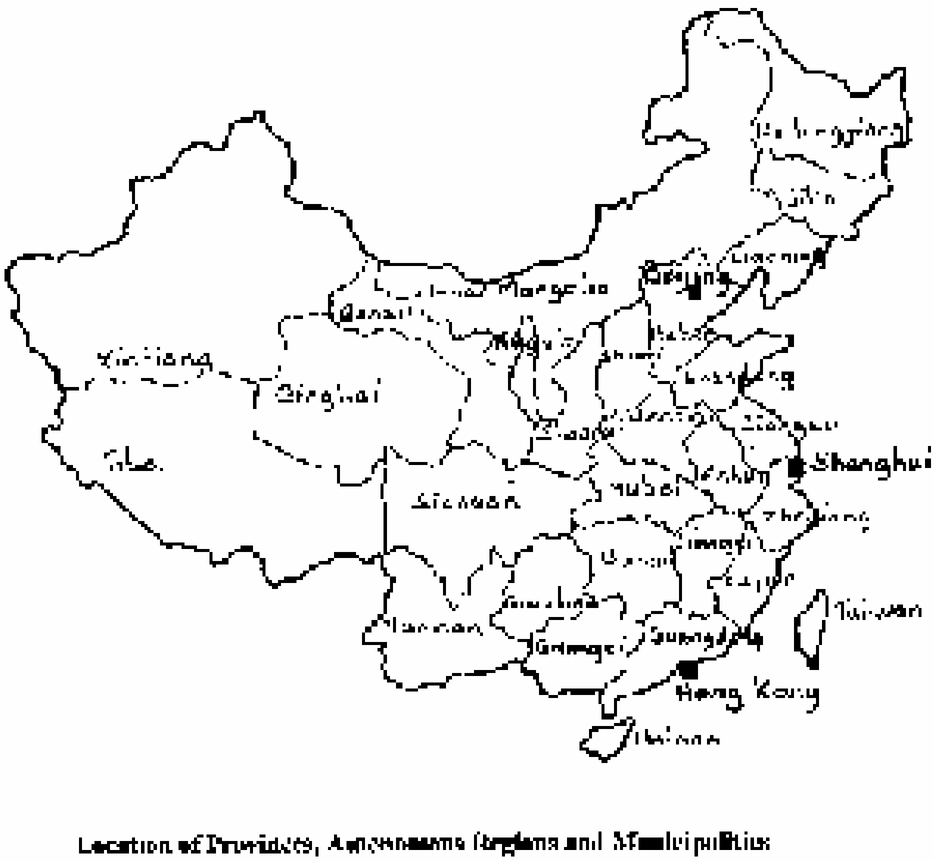
Appendix E.

Map of China



Location of Provinces, Autonomous Regions and Municipalities

Appendix 2

AQIS HOME ANIMEX

ANIMEX home | ANIMEX search | ANIMEX contacts | What's changed | ANIMEX help

Country name:	CHINA, PEOPLES REPUBLIC OF
Species name:	CATTLE SEMEN
Permit required:	Permit is required - Permit details
Permit accompany shipment:	Permit must accompany shipment.
Transport requirement:	Transport requirements do not exist.
Updated:	25 Mar 2004
Effective from:	APRIL 1991

Special Conditions	Disease Free Certification	Isolation / Vac / Treatment	Product Processing	Trans Details	Exam Insp	Health Certificate

Disclaimer
The information provided in this database is intended for use as guidance only and should not be taken as definitive or exhaustive. The Commonwealth endeavours to keep this database current and accurate, however, it may be subject to change without notice, and exporters should make their own inquiries in relation to import requirements. The Commonwealth will not accept liability for any loss resulting from reliance on information contained in this database.
~~~~~~

Special conditions:

```
Please contact AQIS for confirmation as Health Certificate is yet to
be ratified but conditions have been negotiated and agreed upon by
both parties.
```

Permit details:

```
Obtainable from:

    State General Administration of the People's Republic of China
    For Quality Supervision, Inspection and Quarantine (AQSIQ)
    9 Madiandonglu
    Haidian District
    Beijing 100088 CHINA
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TOP
~~~~~~

Disease free certification:

1. Australia is free from:

   - foot and mouth disease
   - rinderpest
   - contagious bovine pleuropneumonia
   - lumpy skin disease
   - bovine spongiform encephalopathy (BSE)
   - vesicular stomatitis
   - bovine brucellosis.

2. The AI centre for the export of semen was located in a bluetongue free zone where a surveillance and monitoring program has demonstrated that:

   2.1 there has been no clinical evidence of bluetongue in any ruminant;
   2.2 no bluetongue virus has been isolated from any ruminant, and
   2.3 no bluetongue seroconversion has occurred in any ruminant that has remained in this zone for at least the previous 14 days.

3. The AI centres for the export of semen were free from bovine tuberculosis and bluetongue, and from clinical signs of other contagious and infectious diseases at the time of semen collection. The centres meet the standards in the SCARM 64 report (Bovine Semen Collection Centres); are registered by DAFF; and are under the regular supervision of an Australian official veterinarian.

4. Donor bulls have been at the AI centres for more than 6 months and have not been used for natural mating since entering the centres. During the period of semen collection and for 30 days thereafter, Australia has been free from the diseases listed under Paragraph 1, and the AI centres have been free from clinical signs of infectious and contagious diseases.

5. Donor bulls do not exhibit any genetic defects and there is no record of genetic defects in their predecessors or offspring. After due enquiry and examination of available information, an Australian official veterinarian has considered that the donor bull/s have not produced any progeny exhibiting recessive lethal genes or possible signs of carrying such genes.

▲ TOP

Isolation/vaccination/treatments:

1. The donor bulls and teasers in the AI centre for the export of semen must be tested at intervals of not more than 12 months for the following diseases with negative results:

   a) Tuberculosis: intradermal test using bovine (PPD) in the caudal fold with reaction of no more than 2mm at the site of injection.

b) IBR: serum ELISA or serum neutralisation test. Any positive bulls were subjected to virus isolation test on serum with negative result.

c) Enzootic bovine leucosis: serum ELISA or AGID (antigens p24 gp - used in Australian Standard Diagnostic Technique for AGID).

d) Campylobacter foetus: immunofluorescent antibody test or culture of preputial washings.

e) Trichomonas foetus: culture of preputial washings.

f) Leptospirosis:

- serum microagglutination test for L.interrogans serovars pomona and hardjo or no increase in titre following 2 tests at least 30 days apart, or
- vaccination.

g) Paratuberculosis:

- absorbed ELISA, or
- faecal culture if ELISA positive.

2. Within the 30 days prior to semen collection each donor bull must be subjected to a clinical examination and tested for the following diseases with negative results:

a) IBR: serum neutralisation test at 1:2 dilution, and at the time of collection, virus isolation test on three samples of semen per donor.

b) BVD: using either an antigen capture ELISA on peripheral blood lymphocytes or a virus isolation test on whole blood using two passages in tissue cultures. Cultures were checked for virus by an immunofluorescence test or immunoperoxidase test; and at the time of collection, virus isolation test on three samples of semen per donor.

c) Akabane: serum neutralisation test at 1:4 dilution.

d) Epizootic haemorrhagic disease of deer: serum AGID test.

e) Bluetongue: serum ELISA or AGID test.

8. Between 21 and 60 days after the final semen collection, all donors must be tested for bluetongue by ELISA or AGID test with negative results.

TOP

Product processing:

Each batch of semen in this consignment was packed and sealed under the supervision of an Australian official veterinarian.

TOP

Transportation details:

TOP

Examination/Inspection:

TOP

Health certificate:

MODEL HEALTH CERTIFICATE FOR BOVINE SEMEN TO BE IMPORTED INTO THE PEOPLE 扴
REPUBLIC OF CHINA FROM AUSTRALIA

1. Australia is free from foot-and-mouth disease, rinderpest, contagious bovine pleuropneumonia, lumpy skin disease, bovine spongiform encephalopathy (BSE), vesicular stomatitis and bovine brucellosis.

2. The AI centre for the export of semen was located in a bluetongue free zone where a surveillance and monitoring program has demonstrated that:

    2.1 there has been no clinical evidence of bluetongue in any ruminant;
    2.2 no bluetongue virus has been isolated from any ruminant, and
    2.3 no bluetongue seroconversion has occurred in any ruminant that has remained in this zone for at least the previous 14 days.

3. The AI centres for the export of semen were free from bovine tuberculosis and bluetongue, and from clinical signs of other contagious and infectious diseases at the time of semen collection.
   The centres meet the standards in the SCARM 64 report (Bovine Semen Collection Centres); are registered by DAFF; and are under the regular supervision of an Australian official veterinarian.

4. Donor bulls have been at the AI centres for more than 6 months and have not been used for natural mating since entering the centres. During the period of semen collection and for 30 days thereafter, Australia has been free from the diseases listed under Paragraph 1, and the AI centres have been free from clinical signs of infectious and contagious diseases.

5. Donor bulls do not exhibit any genetic defects and there is no record of genetic defects in their predecessors or offspring. After due enquiry and examination of available information, an Australian official veterinarian has considered that the donor bull/s have not produced any progeny exhibiting recessive lethal genes or possible signs of carrying such genes.

6. The donor bulls and teasers in the AI centre for the export of semen were tested at intervals of not more than 12 months for the following diseases with negative results:

   6.1 Tuberculosis: intradermal test using bovine (PPD) in the caudal fold with reaction of no more than 2mm at the site of injection.
   6.2 IBR: serum ELISA or serum neutralisation test. Any positive bulls were subjected to virus isolation test on serum with negative result.
   6.3 Enzootic bovine leucosis: serum ELISA or AGID (p24 gp).
   6.4 Campylobacter foetus: immunofluorescent antibody test or culture of preputial washings.
   6.5 Trichomonas foetus: culture of preputial washings.
   6.6 Leptospirosis:

      6.6.1 serum microagglutination test for L.interrogans serovars pomona and hardjo or no increase in titre following 2 tests at least 30 days apart, or
      6.6.2 vaccination.

   6.7 Paratuberculosis:

      6.7.1 absorbed ELISA, or
      6.7.2 faecal culture if ELISA positive.

7. Within the 30 days prior to semen collection each donor bull was subjected to a clinical examination and tested for the following diseases with negative results:

   7.1 IBR: serum neutralisation test at 1:2 dilution, and at the time of collection, virus isolation test on three samples of semen per donor.

   7.2 BVD: using either an antigen capture ELISA on peripheral blood lymphocytes or a virus isolation test on whole blood using two passages in tissue cultures. Cultures were checked for virus by an immunofluorescence test or immunoperoxidase test; and at the time of collection, virus isolation test on three samples of semen per donor.
   7.3 Akabane: serum neutralisation test at 1:4 dilution.
   7.4 Epizootic haemorrhagic disease of deer: serum AGID test.
   7.5 Bluetongue: serum ELISA or AGID test.

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8.  Between 21 and 60 days after the final semen collection, all
donors
    were tested for bluetongue by ELISA or AGID test with negative
results.

9.  Each batch of semen in this consignment was packed and sealed
under
    the supervision of an Australian official veterinarian.
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For more information contact an ANIMEX representative
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