BREEDPLAN® Information for Profitable Beef Production

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1. Introduction

BREEDPLAN® is an advanced genetic evaluation system for beef cattle.[1] It uses a multi-trait model which, subject to data availability, produces Estimated Breeding Values (EBVs) or Estimated Progeny Difference (EPDs) for a range of traits.

The data which breeders may collect for BREEDPLAN® analysis includes:

Bull in date	Ultrasound	
Birth date	- (rump)	Fat depth
Birth weight	- (rib)	Fat depth
Calving ease	- fat	Intermuscular
Calf weights from 150 days to 600 days+	Direct carcass measures	
Scrotal size	Net fee intake data	
Docility scores	Conformation scores	
Flight time (from bail head to light beam)	DNA tests	

The BREEDPLAN system allows breeders to input data in any combination of five different systems:

i) Paper records by mail or fax (now used by a small minority of breeders)
ii) Electronically by BREEDPLAN spreadsheets,
iii) Batch submission of files from herd management systems which operate on handheld computers, laptops and desktops
iv) Over the internet by building up a batch interactively and then transmitting the batch on completion of recording (Internet Solutions),
v) Over the internet in real time (ILROnline).

The proportion of records that are submitted by each of these systems varies from breed to breed and is influenced by factors such as herd size, internet speed, the commitment of the breed association to training its members in new technologies and the financial incentives offered for supply of data in electronic form. In the Brahman breed in Australia for example, seedstock breeding herd sizes in the range of 100 to 1500 cows are common place and most breeders have installed herd management systems. Around 90% of data is received as electronic batch files. The Limousin breed has smaller herds than Brahman and its breeders use recording over the internet to a higher degree than Brahman.

Each of the electronic systems provides some form of data validation which ensures that the majority of data goes on file at first submission. In ILROnline all validation is performed in real

time. The electronic systems reduce the cost of data entry and lower the turnaround time which is why they have become so popular.

While most of the trait recording is optional, BREEDPLAN encourages complete recording to underpin the accuracy of EBVs. It has formalised this in two ways:

i) Annual distribution of "Completeness of Performance" reports to each individual BREEDPLAN member
ii) Production of a "Completeness of Performance" star rating for each individual BREEDPLAN member

The "Completeness of Performance" reports provide a summary of the information that the seedstock herd has submitted to BREEDPLAN. A range of statistics is provided within the reports including details of the pedigree, weight, carcass, birth and fertility information that has been recorded.

The star rating for each herd is calculated on a 0-5 scale based on the proportion of calves within the herd born in a fixed 5-year period that have performance recorded for each trait. Herds with a star rating of "5" are considered to be a gold standard in recording "complete" performance information for all traits for which EBVs are available.

The range of traits for which BREEDPLAN® produces EBVs is shown in Table 1.

Table 1:

BREEDPLAN® TRAITS

GROWTH	FERTILITY	CARCASS	OTHER
Birth weight	Scrotal size	Carcass weight	Net feed intake
Growth - Weaning	Days to calving	Fat depth - Rump	Docility
Growth - Yearling	Gestation length	Fat depth - Rib	Flight time
Growth - Final	Calving ease - direct	Retail beef yield	Shear force
Maternal (Milk)	Calving ease - daughter	Intramuscular fat	Conformation
Mature cow weight			

BREEDPLAN® is able to use DNA tests to produce genomic-enhanced breeding values. The analytical software for BREEDPLAN® is developed and maintained by the world renowned Animal Genetics and Breeding Unit (AGBU) at the University of New England (Australia) and is licensed exclusively to the Agricultural Business Research Institute (ABRI) for implementation internationally.

BREEDPLAN® is used by ABRI to undertake genetic evaluations for 34 beef breeds across 14 countries. Many of the breeds serviced are undertaking multi-country genetic evaluations across a majority of the traits shown in Table 1.

Seedstock breeders demand EBVs on a wide range of traits in order to fine tune their breeding programs as part of their quest to breed superior animals. However, while commercial breeders appreciate the security of knowing that the EBVs on a wide range of traits are available for the bulls that they purchase, their primary motivation is to access genetics that ***maximizes the profitability of their beef production enterprise.***

To service this need of the commercial beef industry, AGBU has developed a companion product to BREEDPLAN® called BreedObject. This is a Selection Index tool that weights EBVs by their respective contribution to different production systems and market end points. This paper explains BreedObject, gives an example of genetic progress in BreedObject for a leading breed, shows how it can be used in benchmarking a herd and outlines its use in mate selection to optimize genetic progress. As this paper is part of the Beef & Sheep Industry Day at the ICAR 2012 Conference it is based on actual case studies rather than theoretical proposals.

2. BreedObject – Case Study[2]

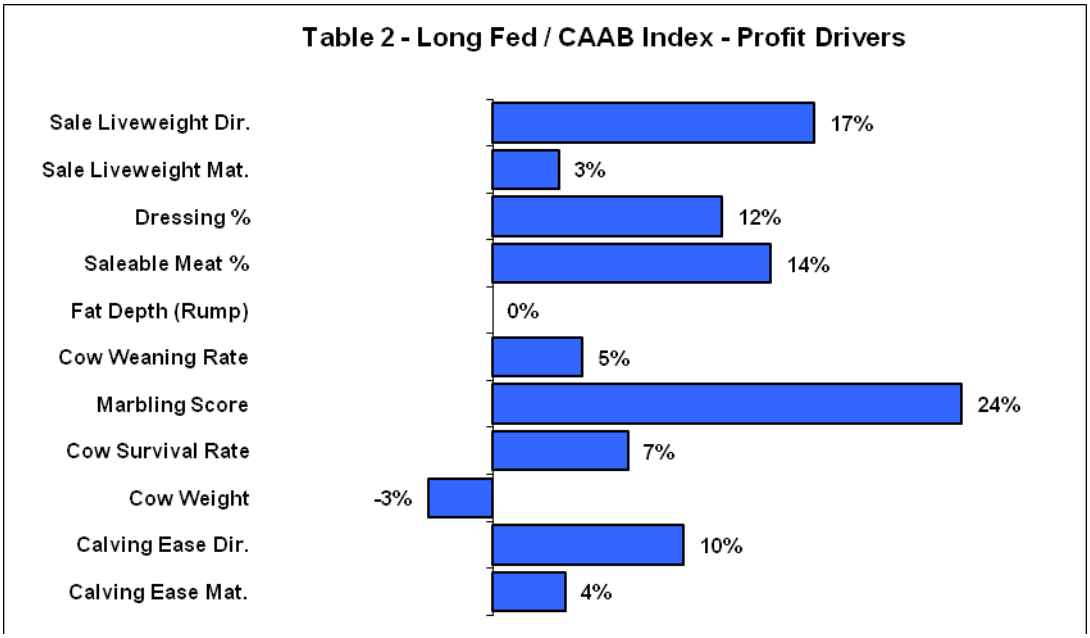
This section gives a case study of progress with the Long fed/CAAB Index calculated for and published by Angus Australia (CAAB is Certified Australian Angus Beef).

The index was developed in consultation with the breed Association and their Technical Committee with industry inputs. The economic characteristics take into consideration the costs and returns of producing commercial cattle for this specific market.

The Angus Long Fed / CAAB Index estimates the genetic differences between animals in net profitability per cow joined for an example high fertility self replacing commercial Angus herd in temperate Australia targeting pasture grown steers with a 270 day feedlot finishing period for the high quality, high marbled Japanese export market. Steers are assumed marketed at 740 kg live weight (420 kg HSCW and 25 mm P8 fat depth) at 26 months of age. Significant emphasis is placed on marbling and 600 day growth.

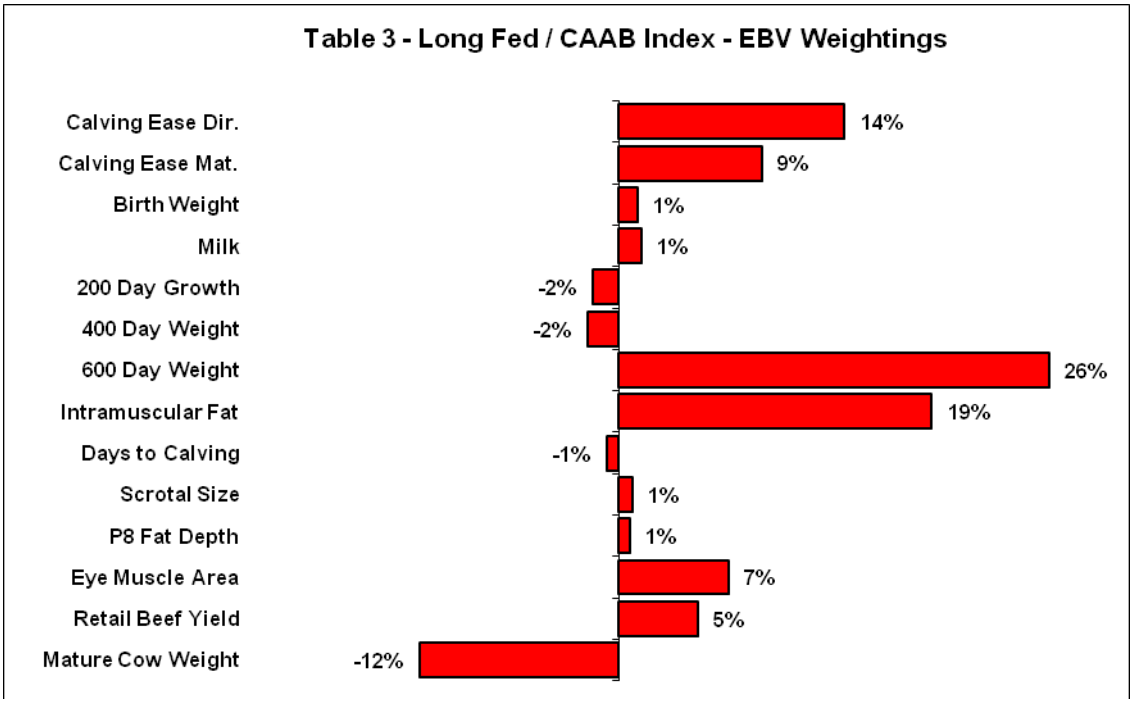
The bar graph in Table 2 shows the key economic traits that are important in this selection index. The different trait emphases reflect the underlying profit drivers in a commercial operation targeting the long fed export market.

Table 2 - Long Fed / CAAB Index - Profit Drivers



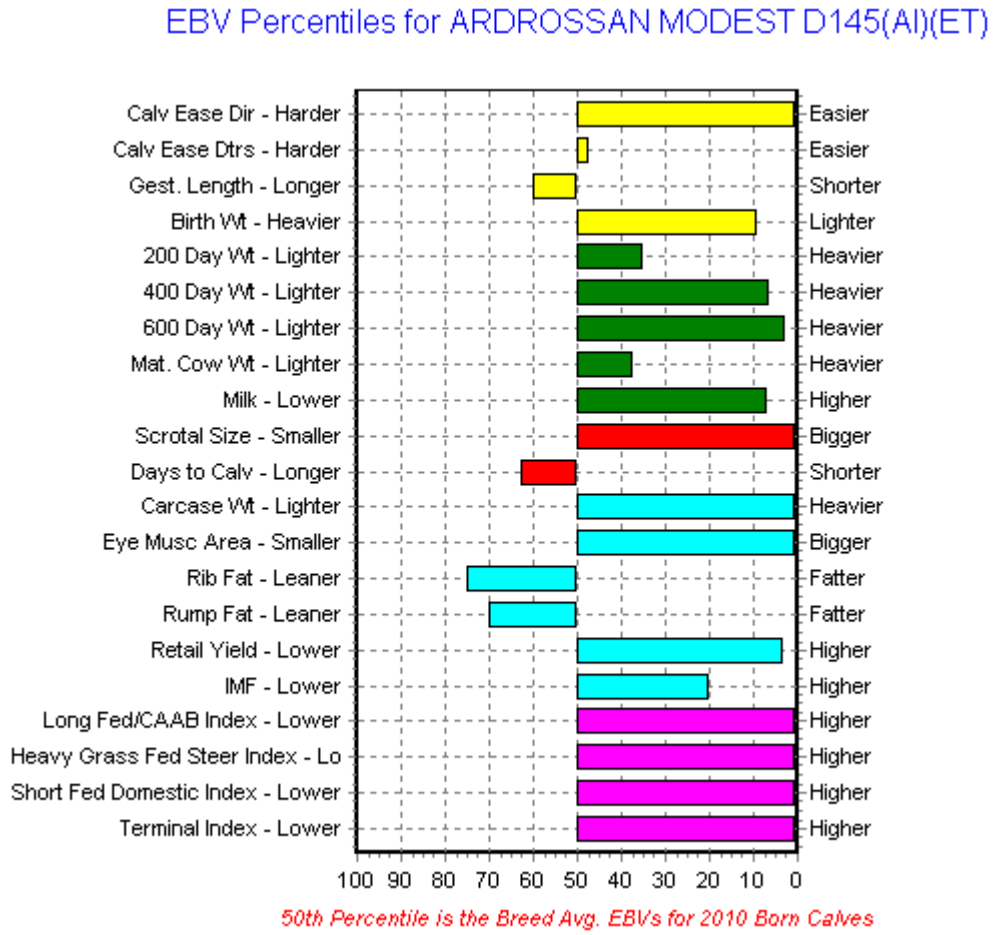
Considering the genetic relationship between the key profit drivers and the EBVs that are available, this transposes to the EBV emphases shown in Table 3. The sign indicates the direction of the emphasis. For example, greater 600 Day Weight EBVs and shorter Days to Calving EBVs are favoured. The EBV weightings are calculated by software developed by AGBU that models each production system/market end point. Not all EBVs are directly

included in the Index as the multi-trait EBV analysis already has correlations across traits included in the calculations.



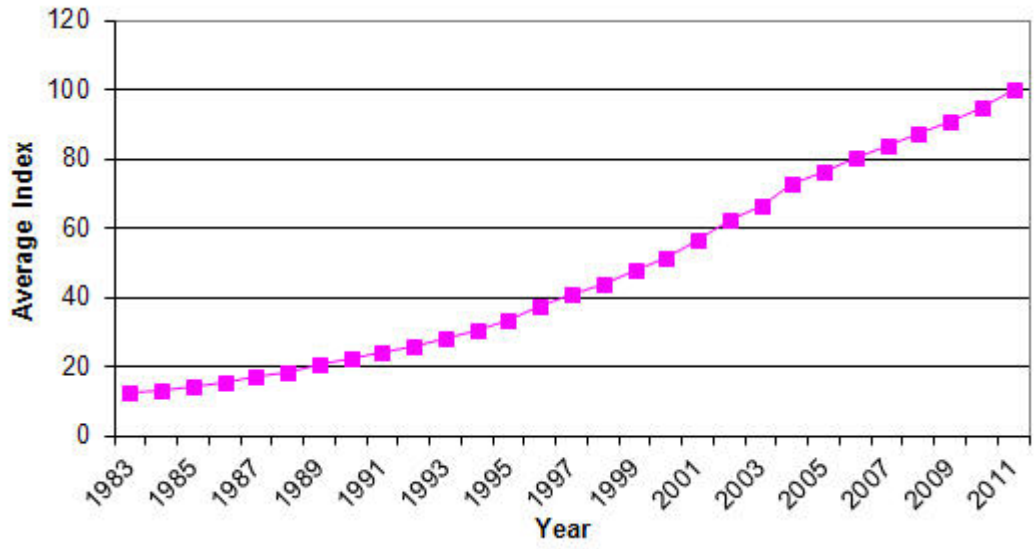
This $ Index is displayed on the Web for each Angus animal along with its EBVs. As well as the actual index value, the information is displayed as percentiles in a bar graph format with the breed average as the common reference point (Figure 1). This gives bull breeders and buyers an immediate reference point to discern where the EBVs and Indices fit within the breed.

Figure 1. EBV and Index percentile bar chart example



The improvement in the Long Fed/ CAAB Index over the last 20 years is shown in Figure 2 for the Angus Australia animals.

Figure 2: Graph of Genetic Trend in
Long Fed/CAAB Index – Angus Australia



The improvement of $75 per cow mated per year in the average Long Fed/CAAB Index in the last 20 years translates into a huge boost in profitability in commercial beef herds using the latest Angus genetics.

Of course, not all commercial cattle producers in a particular country are targeting the same market end point. In the case of Angus Australia, four BreedObject Indexes are produced:

- Long Fed/CAAB Index
- Heavy Grass Fed Steer Index
- Short Fed Domestic Index
- Terminal Index

Many of the breeds which use BREEDPLAN have developed a small number of BreedObject Indexes that are country/breed/market specific.

The BreedObject Website also allows animals with BREEDPLAN EBVs in a country other than Australia to be ranked by the same BreedObject weightings as applied in Australia and vice versa. That is, the EBVs of UK Angus can be weighted by the Angus Australia parameters to assist Australian breeders in their evaluation of overseas genetics and vice versa.

The list of breeds in the UK and their BreedObject indexes is:

Breed	Index 1	Index 2
Angus	Angus Terminal Index	Angus Self Replacing Index
British Blue	British Blue Carcase Yield Index	British Blue Pedigree Breeding Index
Charolais	BCCS Terminal Index	BCCS Self Replacing Index
Hereford	Hereford Terminal Index	Hereford Self Replacing Index
Shorthorn	Shorthorn Terminal Index	Shorthorn Self Replacing Index
Simmental	Simmental Terminal Production Index	Simmental Self Replacing Index
South Devon	South Devon Quality Beef Index	South Devon Suckler Replacement Index

3. Use of Selection Indexes in benchmarking a herd's genetic progress

TakeStock® is a genetic benchmarking tool also developed by AGBU and implemented by ABRI initially in Australia but now in a number of other countries which use BREEDPLAN.

TakeStock®:

i) Evaluates the genetic progress of a herd for each particular Selection Index.

ii) Benchmarks the progress of the herd against the breed.

iii) Identifies Key Performance Indicators (KPIs) that explain significant differences in the rate of genetic progress between herds.

Table 4 gives excerpts of the TakeStock® report for the Wirruna Poll Hereford seedstock herd in southern New South Wales, Australia (http://www.wirruna.com/). Wirruna has been performance recorded since the 1960's and has over 9000 animals recorded on BREEDPLAN. The owner, Mr Ian Locke, has consented to the use of parts of his actual report for the Supermarket Index. This Index relates to a commercial herd targeting the domestic supermarket trade. Steers are either finished on grass or grain (eg. 50-70 days) and are assumed marketed at

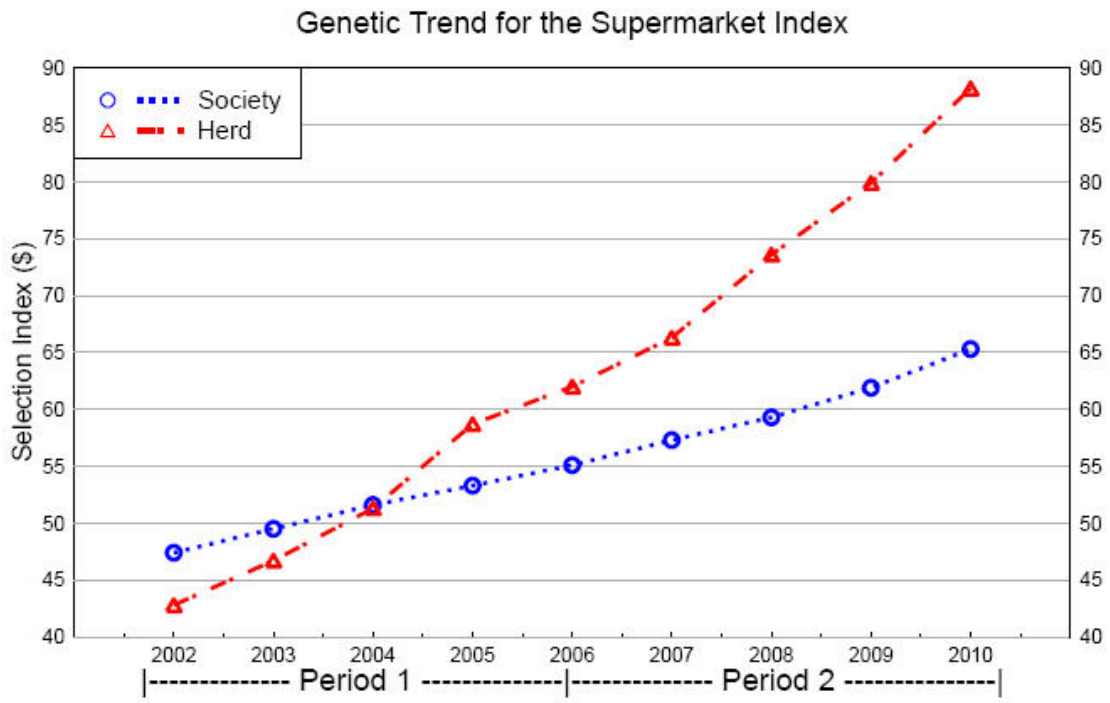
450 kg live weight (250 kg HSCW and 12 mm P8 fat depth) at 17 months of age. Daughters are retained for breeding. In response to industry feedback regarding eating quality and tenderness, a small premium has been placed on marbling.

Table 4: Summary TakeStock® Report - Wirruna
Period 1 – 2002 to 2006 Period 2 – 2006 to 2010

		Herd	Breed Average
Average Index value in Period 2	Males (bulls & steers)	$68.88	$57.95
	Females	$68.15	$57.87
	Steers	$58.40	$46.81
Average Index value of parents in Period 2	Sires	$80.52	$64.68
	Dams	$55.34	$50.59
Average Index value in Period 2		$68.53	$57.90
Average Index value in Period 1		$49.69	$50.13
Average genetic progress in Period 2 (pa)		$5.44	$2.17
Average genetic progress in Period 1 (pa)		$3.68	$1.91
Average number of progeny per year in Period 2		440	94

The genetic trend for the herd and the breed is given in Figure 3.

Figure 3 - Wirruna



Wirruna started the evaluation period in 2002 at below breed average for the Supermarket Index. In period 1 its rate of genetic progress was 93% above breed average. This increases to 150% above breed average in Period 2 so that its $Index in 2012 of $88 was well above the breed average of $65.

Space in this paper does not permit reproduction of all the TakeStock® reports for Wirruna, however Table 5 gives a summary of Key Variables.

Table 5: Key Variables - Wirruna
Period 1 – 2002 to 2006 Period 2 – 2006 to 2010

	Herd	Breed Average	Percentile Band
Average genetic progress in Period 1	$3.68	$1.91	10
Average genetic progress in Period 2	$5.44	$2.17	5
Average Index value in Period 2	$68.53	$57.90	10
Key Performance Indicators			
Selection differential of sires	$27.51	$12.85	5
Selection differential of dams	$2.79	-$1.16	10
Sire:dam mating correlation	0.31	0.03	5
Average age of all sires used (yrs)	4.0	4.6	30

Selection differential of sires is average index of sires used compared to average index of herd sires available
Selection differential of dams is average index of dams used compared to average index of herd dams available
Sire:dam mating correlation is correlation of sire Index to dam Index

The Key Variables show that this genetic progress has been achieved by application of good genetic principles – specifically selecting higher Index parents (applying a high selection differential in sires and dams compared to breed average) and turning over generations quickly (lower average sire age). The high (in the top 5% band) sire:dam mating correlation means that the breeder has mated better sires to better dams (i.e. positive assortative mating).

Having herds like Wirruna that are achieving over double the rate of $ progress of the average of seedstock herds in the breed is good for profitability of the commercial industry.

Following is a simplified approach to quantifying the contribution of Wirruna to the profitability of both Australian and international beef production. The herd sells around 150 bulls per year to seedstock and commercial producers. These bulls are estimated to be used on average for 4 mating cycles and leave 30 calves per cycle. That is they produce around 18000 calves per year. A further 420 calves per year are bred by semen from the herd.

The average value of the $Index for Sale Bulls is around $88 versus $65 as the Hereford Breed average. The progeny benefit by half of this difference. That is, Wirruna adds 18420 x 23/2 = $211,830 pa to the profitability of commercial calves across Australia compared with the use of breed average Hereford sires.

The total contribution of Wirruna to profitability of the commercial beef industry in Australia is higher than this. The author's best estimate is that Hereford females in commercial herds will have a $Index value of around $30. Therefore, the total economic impact can be estimated conservatively at 18420 x 58/2 = $534,180pa. Because Wirruna is now in the top level of the pyramid of Hereford seedstock herds in Australia, some of its sires are used by other Hereford seedstock herds which multiply Wirruna's genetics. This creates an economic benefit that is additional to the $534,180 calculated above.

At an international level, 15000 straws of semen have been collected from Wirruna Daffy, one of the herd's top sires. This has the potential to add 6750 calves x 58/2 = $195,750 to the profitability of beef production outside Australia – based on conservative estimates.

This case study shows that seedstock herds that select for commercially important traits have the capacity to make very substantial increases to the profitability of their commercial clients.

But what if a seedstock breeder wishes to optimize the rate of progress with the BreedObject Index in his/her herd for a particular market. In BREEDPLAN he/she can progress to the use of powerful mate selection tools called Total Genetic Resource Management or MateSel.

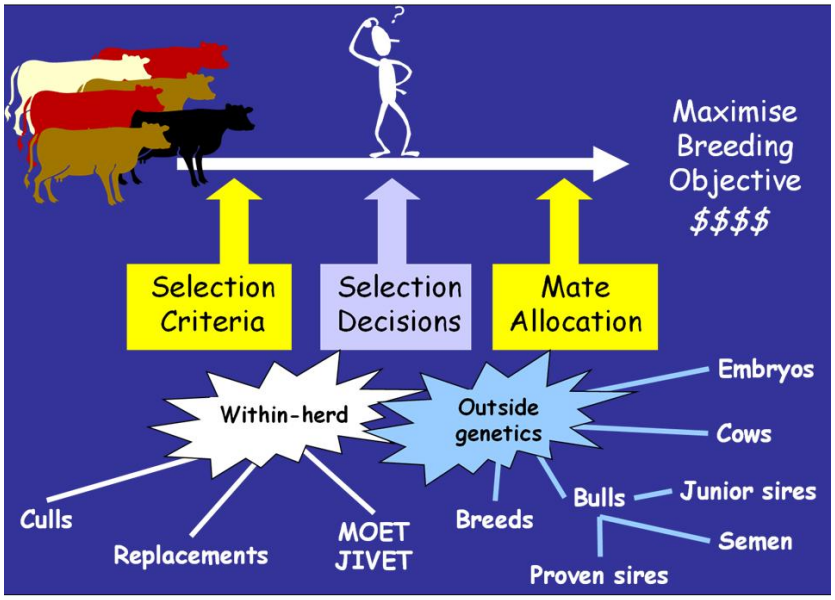
4. Mate Selection Tools

Deciding which sire to mate with each dam, which parents to use in an embryo program, which AI sires to use and how to do this while containing the level of inbreeding involves decisions that determine the future rate of genetic progress.

Total Genetic Resource Management (TGRM) is an example of a package that does this. Developed by a team under Professor Brian Kinghorn at the University of New England this tool has been used on a routine basis in the beef, pig and dairy industries for the last decade.

Figure 3 gives a schematic representation of how TGRM works on the beef industry.

Figure 3 – Schematic of how TGRM works in the beef industry



Beef herds using TGRM engage a consultant to assemble the data, operate the on-line software and assist the breeder in interpreting results. This has been a valuable exercise to develop expertise in the potential for this type of product. Mr Locke has been an enthusiastic user of TGRM for 7 years and believes that it has assisted him in making breeding decisions that have led to such a rapid gain in the BreedObject Indices for the Wirruna herd.

Throughout 2012 ABRI will be rolling out an upgraded mate selection tool called MateSel.

As with TGRM, MateSel integrates complex breeding issues into a single, easy to use, decision making framework. Technical, logistical and economic issues compete for attention in a system that can be guided by the breeder, with the resulting mating list covering decisions on items like semen purchase, bulls used, animal selection/culling, forming mating groups and mate allocation, genetic gain (Indexes), genetic diversity, inbreeding, trait distributions, genetic defect management, logistical constraints and costs. The resulting mating lists optimise the matings for the candidate animals while allowing for all of these variables and constraints.

MateSel has been developed and refined over recent years by Dr. Brian Kinghorn through his work with the Australian beef industry and other national and international livestock improvement sectors. The MateSel technology has been implemented in the US pig industry with fully automated decision-making capabilities and is having a strong impact on sustainable genetic gains and improved profits through genetics. Translated to the beef industry, these developments enable low-cost and routine implementation with full integration into the BREEDPLAN service delivered by breed societies.

The automated service delivery allows breeders considerable flexibility to nominate inputs via easy-to-use web screens. As well as setting parameters and constraints for the MateSel analysis (eg limits on rate of inbreeding), breeders can specify multiple mating list options to suit the variety of requirements within their production systems - including spring and autumn matings, heifers and older cows, etc. Candidate females can be based on inventory lists, age groups, last calving and registration status. Candidate males can be drawn from young and old herd bulls, AI sire lists, semen and sale catalogues and specifically nominated sires. Within these selections, candidate male selections can also be restricted on EBV and Index ranges and accuracies.

Breeders will be able to adjust and save the parameters and submit their run request via the web, getting mating lists back electronically within a short time frame.

An extended service is also available that entails a direct consultation process focused specifically on individual breeding objectives, management constraints, corrective mating, etc. Output is more detailed with custom graphical analyses in real time reviewing key outcomes and constraints applied, while exploring mating strategies. A web-delivered consultation version is also foreshadowed for the future.

Using the multi-tiered delivery option, MateSel is geared towards broad coverage of the industry to maximise the potential benefit of the technology. This means that the seedstock herd, their commercial clients and the industry as a whole all benefit from the use of MateSel. This application is scheduled to be in production in the beef industry in the second half of 2012.

References

1. GRASER H-U, TIER B., JOHNSTON DJ, BARWICK SA (2005). Genetic evaluation for the beef industry in Australia. *Australian Journal of Experimental Agriculture* **45**, 913-921.

2. BREEDPLAN Website, http://breedplan.une.edu.au/ and Angus Australia website, http://angusaustralia.com.au

3. Angus Australia website, www.angusaustralia.com.au