Reflections on the Australian pig breeding industry

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Introduction

At the end of 2005, APL commissioned a review of its research investment plan to support national genetic improvement in the Australian industry. The full Report was issued in July 2006 and this paper summarises some of the data presented and views expressed during the consultation.

Background

There were five main components of the study:

Part One

Review AGBU achievements in pig genetics since 2001 and document likely benefits to the Australian pig industry.

Part Two

Using benefit/cost analysis to quantify the likely return on APL investment made in quantitative pig genetics in the period January 2001 to June 2006.

Part Three

Predict the likely future structure of the pig breeding sector in Australia in 2015.

Part Four

Recommend and justify the role that APL should take in accelerating genetic improvement and adoption of improved genetics to meet the industry goals in APL's Strategic Plan.

Part Five

Using benefit/cost analysis, detail the projects that APL should invest in to accelerate genetic improvement and adoption of improved genetics in the next 5 years.

Methodology

The background information for this study was collated by reviewing documentation supplied by APL and AGBU. A Questionnaire was also circulated to leaders in the Australian pig breeding and processing industry and representatives of the breeders were invited to attend a confidential meeting with the report evaluator or to be interviewed by phone. Six breeders were interviewed in person and five were interviewed on the phone. A twelfth breeder and a major processor submitted written answers to key questions. APL's General Manager, Research and Innovation, attended some of the meetings and was available for other detailed discussions. The staff at AGBU working in pig genetics were also available for discussions.

Report Highlights

Part One

Review AGBU achievements in pig genetics since 2001 and document likely benefits to the Australian pig industry.

AGBU is involved in the development and exploitation of superior genetics in the industry right through from research in quantitative genetics to implementation through genetic evaluation systems and the support of rapid uptake by a large and significant group of Australian breeders.

Since 2001, AGBU achieved the targets recommended at the start of the programme. Three major R and D projects were completed, there has been significant advancement in the PIGBLUP modules, the National Pig Improvement Programme (NPIP) has been enhanced and transferred from the DPI in Queensland and there has been a considerable programme of industry education undertaken by AGBU staff.

There has been significant expansion in the number of Australian sows on PIGBLUP from 5,600 in 2000/01 to 10,800 at present. It was estimated that in 2006 these sows had a direct impact on the genetic improvement of nearly 50% of the Australian herd or some 158,000 sows, producing some 2.5 million slaughter pigs per year (see Part Two).

The main reason for the expansion of PIGBLUP usage in the Australian industry has been due to increasing nucleus herd size. Several breeders when interviewed claimed that there has been a significant increase in demand for their breeding stock both at home and overseas over the past five years. In particular, breeders indicated that there has been a substantial increase in the use of AI in Australia and many commercial producers now require trait EBV's to help them chose boars for their individual requirements. In turn, this means that PIGBLUP is having an increasing influence on the commercial slaughter pig. Another reason for the expansion in numbers is the addition of new breeders who appear convinced that using PIGBLUP will be of benefit to them through making better use of genetics.

As Hermesch (2006a) reports, PIGBLUP herds showed favourable phenotypic trends in all the key production traits over the period analysed. This indicates that the PIGBLUP herds were improving and capturing real economic benefit.

Hermesch (2006a) also reports significant genetic gains in growth, feed conversion, backfat, muscle depth and numbers of piglets born alive. The average economic gain resulting from genetic improvement was $1.06 per slaughter pig per year. In comparison, the top 25% group had an increase of $1.92 each year while the bottom group achieved $0.35.

As well as the expansion in PIGBLUP usage there has also been a significant increase in the number of sows in the NPIP, rising from 2,100 to 3,200 in the past six years.

AGBU staff have undertaken a considerable programme of industry education from 2001 to 2006. As well as the four AGBU Pig Genetics Workshops there were numerous presentations at industry and science meetings. As well as the up-dating of the web pages, there have been several Pig Genetics Sheets produced and reports incorporated in the Pig Tech notes of the DPI of Queensland, the Pig Industry news of Rural Solutions, South Australia and the Pig Tales of the Department of Agriculture of Western Australia. In addition, extension personnel have facilitated presentations by AGBU staff to producer groups. Therefore, information about pig genetics developed at AGBU is spread widely through the industry beyond the direct industry contacts of AGBU staff.

Among the benefits accruing from improved knowledge transfer are a better understanding through the food chain of the value of genetics and a likely increase in the percentage of the national herd that is bred and monitored through a viable genetic programme.

Another important aspect of AGBU is its excellent international reputation. Among its piers, AGBU is regarded as one of the world's centre's of excellence in the field, and is one of very few examples of this for the Australian pig industry.

AGBU also supports PIGBLUP overseas, where there are 12,200 sows using the modules. Overseas licensing generated more than half the fees received over the period 2001-2006, contributing $170,000 to total cash revenues for the program. The reaction from the Australian PIGBLUP users is that the use of PIGBLUP overseas is a major benefit because of the increased flow of ideas from foreign breeding companies and the valuable source of income for AGBU and the PIGBLUP programme. Often overseas users have trained geneticists who interact with AGBU to test new programs and help identify any errors in the computer codes prior to general release.

The majority of Australian breeders are very supportive of AGBU and use most of the resources available. However, two breeders who obtain most of their genetic advice from overseas partners had concerns about using levy funds to support AGBU. However, it is important to note that R and D results are made available to all the industry, that consultancy services are available and that gene introgression into 'closed' breeding company nucleus herds may be sampled from the PIGBLUP/NPIP pyramids.

Part Two

Using benefit/cost analysis, quantify the likely return on APL investment made in quantitative pig genetics in the period January 2001 to June 2006.

APL contributed $1,170,317 or 32.37% to the AGBU budget while other sources of income (PIGBLUP fees, consultancy, direct and in-kind contributions by breeders and AGBU) contributed the remaining 67.63%. Note that for every APL dollar another 2.09 dollars were raised from other sources. Of the total AGBU contribution, 82.24% was used for the support of PIGBLUP and the remainder for R and D. For the purposes of the cost-benefit analysis the total funding of $1,170,317 was used together with two key pieces of information – the size of the Australian pig herd influenced by PIGBLUP users and the amount of genetic progress achieved in the reporting period.

Data were obtained from all of the 15 herds using PIGBLUP to establish the size of their respective breeding pyramids in terms of the number of sows influenced by each breeder and the number of slaughter pigs produced by matings to their male lines by boars and semen. Details of the method of estimation are shown in Appendix One. Unfortunately, because of confidentiality issues, individual data were not available for publication. The estimated total pyramid was 157,945 sows. Based on an average national herd size of 333,333 sows over the reporting period these data suggest that PIGBLUP has an influence on 47.38% of Australian genetics. Of course, a real criticism of this figure is that individual breeders may have quoted inflated herd sizes and/or volumes. However, breeders provided extensive information about semen sales and sales of live animals and cross-referencing between breeders suggested that the individually claimed figures were close to most competitor estimates. This suggests that the data are as accurate as is possible to access without having some independent means to check the individual breeder data.

As the average number of slaughterings per year in the time period was 5,393,400, it was estimated that some 2,555,392 slaughter pigs per year came from breeding pyramids operating PIGBLUP.

Genetic trends from 28 Australian pig populations were obtained through within-herd evaluations using PIGBLUP (see Hermesch, 2006a).

The growth in the influence of PIGBLUP on national slaughterings was used in two models to estimate the gross cost benefit of APL's investment in PIGBLUP and associated R and D. Model One looked at the cost benefit to the industry due to new users. The difference between the annual genetic progress in an average PIGBLUP user and a non-user was $0.61 per pig per year (lower boundary). In comparison, the difference between the annual genetic gain of the top 25% of PIGBLUP users and a non-user was $ 1.47 (upper boundary). The cost benefit of the APL investment for Model One ranged from 2.2 to 1 (lower boundary) to 6.5 to 1 (upper boundary).

Model Two looked at the benefit due to higher genetic gain in existing users. The difference in the financial value of genetic progress between the top 25% of users and the mean was estimated to be $0.86 per pig per year. It was assumed that 40% (lower boundary) and 80% (upper boundary) of this genetic gain resulted from APL funding. The cost benefit of the APL investment for Model Two ranged from 4.5 to 1 (lower boundary) to 9.9 to 1 (upper boundary).

Combining the data from the benefit to the new users (Model One) and the higher genetic gains of existing users (Model Two) gave an overview of cost benefit ranging from 7:1 to 16:1.

Part Three

Predict the likely future structure of the pig breeding sector in Australia in 2015.

The future for the pig breeding sector will depend on many factors. Some of the key components are:

1. Economic success in the pig industry
2. Size of the national sow herd
3. Commercial breeding policy for female replacements
4. Commercial breeding policy for male inputs

Future economic success

The future profitability of the industry will have a significant impact on the number of sows which, in turn, will affect the potential number of herd replacements to be bought from breeders. Experience in other countries also suggests that profitability and confidence help to persuade commercial farms to invest more in genetics, resulting in increased levels of gene introgression. At the same time the home breeding of replacement females declines.

The Australian meat price is forecast to be relatively stable between 2007 and 2014 by the OECD (c) – however, it is highly likely that the cost of production must fall for Australia to be competitive in world markets. Successful cost beneficial R and D and knowledge transfer, as exemplified by AGBU, will help achieve this goal.

Size of the national sow breeding herd

Most breeders questioned believe that sow numbers will remain static or show a small decline by 2015. Their predictions ranged from 230,000 to 350,000 with a mean of 295,000. The variation was due mainly to different predictions for the expansion of export markets and national health status. It was generally felt that numbers would expand if the current Australian high health status was maintained but that a lowering of health status would lead to a major reduction in home production. An increase in meat exports was viewed by some as an important achievable strategy to the future of the industry which would favour a small expansion in the national sow herd.

Whatever the size of the national herd it is predicted that Australia, like most developed pig industries, will see a decline in the number of producers together with an expansion in individual herd size. The reduction in the number of producers will mean that there are fewer customers for the breeders and breeding companies which will result in greater competition between them than at present. At the same time, the customers will be more aware of the importance of cost reduction and efficiency and will demand high levels of service and genetic integrity from their suppliers.

Replacement policy for females

The breeding of commercial female replacements may be divided into three options:

- A GGP (Great Grant Parent or nucleus) programme where all female replacements are bred on the farm.
- A GP (Grand Parent) programme which breeds all the commercial replacements. The herd is closed to importation except for routine GP replacements.
- An 'open' commercial plan where all Parent commercial replacements are bought into the herd on a regular basis.

The first option of total closure with GGP, GP and Parent females all in the same pyramid is typically only successful in very large commercial herds because of the problems of management control with three types of animals (GGP, GP and commercial females), the expense of testing and monitoring and the lack of breeding experience.

With regard to the other two options, the Australian breeders interviewed had very different views on the likely breakdown for the future. For example, the range of projected percentages for bought in commercial females was less than 5% to more than 90%! With regard to the GP system the range was 'very few' to 90%.

Nielsen (2004) published data from a national survey involving 59 pig herds and reported that only approximately 44% of commercial producers brought in any female breeding stock. This appears rather lower than suggested by many of the breeders interviewed and may be due to sampling effects. Indeed in Europe and much of the Americas there has been a huge increase in the number of producers who buy in female breeding animals. However, the typical European experience has been that there is a growing trend away from buying commercial replacements to the GP option. This is sometimes referred to as the 'parent gilt time bomb' because sales of parent gilts are plummeting in many countries as farms switch to GP systems. In some countries this has led to a major re-think by breeding companies on their marketing strategies.

Policy for male inputs

Nielsen (2004) reported that approximately 86.4% of producers brought in boars while 62.7% were using AI. For AI, all eight herds with more than 500 sows were using AI. Also, it was reported that there was a trend over time toward increased AI usage.

All breeders reported an increase in boar and/or AI sales over the last five years, suggesting that the percentage of sows mated with introgressed genes was increasing. They all believed that home breeding of boar replacements was declining rapidly and the level would soon be negligible.

Growth in AI has been significant recently and mirrors the experience of many other countries which have seen boar sales reduced to be replaced by semen sales. It is predicted that the same will happen in Australia. However, AI might reach a plateau at some stage due to problems of logistics over such a huge country. Even having several small centres distributed across the country may be difficult because of the small market that they will be servicing and the resulting high unit cost of semen doses.

Taking all the above features into account, it is likely that the Australia pig breeding sector will see the following changes in the next decade:

- Australia will follow other global pig industries with a decrease in parent gilt sales and an increase in GP closed herd systems. The current growth in AI will continue but may reach a plateau at some stage.
- There will be consolidation with a reduction in the number of seed stock suppliers due to increasing competition to supply fewer buyers. Those that remain will increasingly need specialist genetic and technical advice to 'stay in the game'. For those breeders who do not have an international partnership there will be increasing reliance on the R and D and transfer of information within Australia from AGBU.
- Surviving breeders will tend to become larger because of economies of scale and the fact that successful genetic progress depends, in part, on population size.
- Running a successful breeding programme is expensive and must be covered by the returns – this is often difficult particularly where profits are squeezed by competition. Every attempt must be made to add value to ensure long term survival.
- A few closed and contracted breeding pyramids may flourish. These will be self-contained and have links through to the processor and, possibly, the retailer. They will have a dilemma to decide whether to share their genes with other breeders (such as happens in the NPIP scheme) to ensure maintenance of genetic variation or to remain totally closed.
- Progressive commercial producers will want breeding stock from the best suppliers of advanced genetics.
- The market place will decide on the number of surviving profitable breeders. Some will be totally independent but it is certain that others will require the services of indigenous research, the use of PIGBLUP and the input from AGBU. The main reason for this scenario is that it will give flexibility to the Australian pig industry. There are several examples of programmes in other countries where genetic improvement has been under the control of a very few breeders in such a way that 'problems' have been introduced 'nationally' through the breeding programme. Examples are the concentration of the adverse halothane gene, the genetic relationships that have resulted in the reduction of meat and eating quality and the serious decline in feed intake in some dam lines. There are several examples where breeding companies have gone out of business or lost critical mass because of problems with their breeding decision.

Part Four

Recommend and justify the role that APL should take in accelerating genetic improvement and adoption of improved genetics to meet the industry goals in APL's Strategic Plan.

APL's funding has achieved acceleration of genetic progress and the adoption of improved genetics which are major components of APL's Strategic Plan. In particular, significant cost benefit to the Australia industry at producer level and through to the abattoir is indicated. There has been genetic progress in litter size, growth and feed conversion (improving competitiveness and lowering the cost of production). There has also been a reduction of backfat and an increase in lean meat yield (lowering the cost of production and improving carcase value). Note the reduction in backfat will also aid the industry's planned move to higher slaughter weights.

APL has to ensure that the Australian industry remains competitive, both against international competition and other meats within Australia. This can be achieved by APL providing R and D services plus the adoption of R and D to increase productivity and product quality and knowledge transfer throughout the supply chain.

If the support of APL was withdrawn from AGBU and PIGBLUP then the Australian industry would have to rely fully on overseas technical support. Being a small industry in global terms that is far from major world markets it is likely that Australia would be relatively low priority for large international corporations and thus be disadvantaged.

The recommendation of the Report was that APL continues to fund the very valuable work in pig genetics at AGBU. AGBU's performance and delivery in the past five years has been excellent and it must be encouraged to continue to play a key role in developing further technical achievements for the Australian industry. The justification for APL funding of genetics is based on the following:

- R and D and knowledge transfer are the most effective way of ensuring competitiveness of the Australian pig industry.
- Genetics is the first limiting factor in pig production and is the first component required to ensure future success.
- Genetic improvements are fixed and cumulative.
- The high cost benefit to date of the PIGBLUP and NIPP programmes and steady growth in adoption by breeders should ensure maximum return for investment.
- There is potential for greater genetic progress in the future through the incorporation of extra traits over and above those that are already used in PIGBLUP.
- The benefits likely to flow from the investment will benefit a large proportion of the production industry which will then pass down the chain to the Australian consumer.

Part Five

Using benefit/cost analysis, detail the projects that APL should invest in to accelerate genetic improvement and adoption of improved genetics in the next 5 years.

Introduction

There were many potential projects that were considered. However, in order to limit the options proposed the following 'rules' were followed in the appraisal of projects for future funding by APL:

- The projects must satisfy at least one of the strategies outline in APL's Strategic Plan 2005-10.
- The projects must be applied rather than fundamental research.
- The projects must have potential cost benefit.

Projects

The first projects considered were those that would involve benchmarking against other advanced global industries and the possible importation of genetic material into Australia. With one major exception, breeders were not totally convinced that importation or benchmarking was of the highest priority. However, two breeders specifically mentioned Danish genetics and stated that their published results, particularly for sow traits, in the annual National Committee Yearbooks are outstanding. It may be of interest to quote the last comparative maternal evaluation by the National Pork Producers Council in the US (NPPC, 2000). In total six genotypes were evaluated – three commercial US lines, one experimental line and a Danish line. The rankings for the Danish genotype were disappointing:

	Ranking (Out of 6)
% Showing 1st oestrus	5
% Fertile	4
Born alive	3
Weaned	3
Litters/sow/year	4
Lactation feed intake	3
Lifetime age	5
% Sows reaching parity 4	6

The above shows that objective information often disproves market propaganda and subjective information! Thus, in an attempt to try to get an objective view on the standing of Australian genetics, results from several trials were located that tend to support those people who believe that Australia is not severely disadvantaged.

In the first trial details were accessed on 28/05/06 from the Ausgene website and showed that an Australian genotype was superior to a leading US genotype with advantages in weight, yield and matrix accounting for an additional value of US$5.89 per pig for the Australian genotype:

Sire line Genotype	Number	Weight Pounds	Yield %	Backfat Inches	Matrix %
US	6494	267.1	74.01	0.80	102.69
Australia	6859	275.5	75.27	0.79	103.27

In the second trial, also from Ausgene, Australian genes were superior to Canadian lines and similar to two major American breeding companies in grower/finisher performance:

Sire line	Number	Growth rate Pounds per day	Feed conversion
Canada (Shamrock)	1893	1.61	3.07
US (Monsanto)	10583	1.68	2.84
US (PIC)	10740	1.83	2.85
Ausgene	3423	1.78	2.89

In the third (unpublished) report from the Philippines, Australian and European genotypes were similar in grower/finisher traits:

		Number	Lifetime Growth (Grams per day)	Ultrasonic backfat
Large White	Australian	199	565	14.1
	European	93	564	12.8
Landrace	Australian	16	629	13.2
	European	19	591	15.0
Terminal	Australian	162	579	14.0
	European	141	570	14.1

Finally, a comparison has been made on the performance of two Australian boars that have been used in across-herd national evaluations in the US (see http://www.ansc.purdue.edu/stages/). Both Australian boars were faster growing than the US average and were ranked in the top 50% and top 25% respectively on a terminal sire index. The ranking of these boars was similar in the Australian population which indicates that the genetic merit of these two populations is comparable.

Taking all the above into account it does not appear, at least on these presented data, that Australian genetics are behind some US and European lines. However, it should be stressed that there are no published independent statistical data available.

To put the benchmarking and importation options into perspective, all the breeders were asked to rank a whole range of possible future spending areas in R and D. The 'top 5' were:

1. Flexible trait modelling in PIGBLUP, to include extra carcase traits and genetic markers.
2. Meat and eating quality.
3. Appetite (sow and grower/finisher).
4. Piglet survival.
5. Extra sow traits, including longevity.

Note that international benchmarking and introgression were not on the breeders list. Indeed, the opinion post-farm gate was also not very supportive of benchmarking and the importation of genes. Furthermore, it would appear essential that genes are only brought into the country as long as there was total protection of the high health status of the Australian industry – currently these protocols are not available.

Another area discussed with the people interviewed was whether a national central test should be introduced as operates in several countries such as Germany, Italy, Northern Ireland, Spain and Sweden. However, the schemes tend to be very expensive to operate and have recently come under pressure because of health breakdowns due to the mixing of pigs from different sources. Even the introduction of integration systems using recently weaned piglets has had difficulties with adaptation. In discussions the general view was that the disadvantages of central testing outweigh the possible advantages.

Taking all the above factors into account it was the recommendation of the report that international benchmarking, importation and national benchmarking are low priorities and that there are other more important areas for R and D spend which will give much clearer and effective cost benefit.

Five projects were formulated following the consultation with the Australian breeders and the staff at AGBU which will aim at a whole chain approach to improved performance. These are:

1. Development of flexible trait selection index to include sow and piglet performance, growth and feed efficiency, carcase uniformity and retail value and meat quality. The ratio of the discounted benefit at the end of 20 years to the initial APL investment is forecast to be 18 to 1 and the ratio to the total investment is forecast to be 5 to 1.
2. Accelerating genetic improvement of retail carcase value together with meat and eating quality traits. The ratio of the discounted benefit at the end of 20 years to the initial APL investment is forecast to be 10 to 1 and the ratio to the total investment is forecast to be 4 to 1.
3. Selection strategies for the production of uniform lean growth through to heavier carcase weights. The ratio of the discounted benefit at the end of 20 years to the initial APL investment is forecast to be 4 to 1 and the ratio to the total sum is forecast to be 2 to 1.
4. Promoting better lifetime performance in the sow through the inclusion of feed intake data. The ratio of the discounted benefit at the end of 20 years to the initial APL investment is forecast to be 13 to 1 and the ratio to the total investment is forecast to be 5 to 1.
5. The facilitation of knowledge transfer of genetic technologies to the Australian industry and the provision of fee-based consultancy services. The ratio of the discounted benefit at the end of 20 years to the initial APL investment is forecast to be 13 to 1 and the ratio to the total investment is forecast to be 3 to 1.

The projects are discussed in detail by Hermesch (2006b).

Acknowledgements:

My thanks to all the following for their help in the preparation of the APL Report:

Mark Bauer	Univ. of Queensland	Gatton College, QLD
Colin Bennett	QAF Meat Industries	Corowa, NSW
John Beevers	PIC Australia	Grong Grong, NSW
Jeff Braun	Myora Farm	Mt. Gambier, SA
Kim Bunter	AGBU	Armidale, NSW
Ron Crump	AGBU	Armidale, NSW
Neil Franks	Aztec Farms	Yenda, NSW
Alan Fyfe	Yelmah Holdings	Hamley Bridge, SA
Hans Graser	AGBU	Armidale, NSW
Susanne Hermesch	AGBU	Armidale, NSW
Ian Johnsson	APL	Canberra, ACT
Erik Larsson	Hyfarm	Toowoomba, QLD
Brian Luxford	QAF Meat Industries	Corowa, NSW
Brenden McClelland	Belmont Stud	Bell, QLD
Jason McQuaid	Woolworths	Sydney, NSW
Stuart Neuendorf	Neuendorf Faming	Kalbar, QLD
Paul O'Leary	PIC Australia	Grong Grong, NSW
Rolf Sokolinski	CEFN Stud	Clifton, QLD
Bruce Trout	Caminda Stud	Kingaroy, QLD
Bryan Ward	QLD Pork	Bowen, QLD
Rob Wilson	Wandalup Farms	Mandurah, WA

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Appendix One: Size of the national herd influenced by PIGBLUP

Data were obtained from all of the 15 herds using PIGBLUP to establish the size of their respective breeding pyramids. Individual breeders were asked for the details on their herd size and market penetration. In most cases, breeders supplied the following information:

Number of GGP sows

Number of GP sows

Number of commercial sows

External breeding female sales

Boar sales

Semen sales

These data were used to estimate the size of each breeding pyramid based on:

The 'dam line'

The number of sows under ownership and/or contract combined with the number of third party 'company' sows

The 'sire line'

The number of sows farrowing to 'company' boars and/or semen

The breeders' individual pyramid estimates were based on the average of the numbers from the 'dam line' and the 'sire line'. For example, if a breeder had 3200 sows under its control and 6800 sows were mated by boars/AI the total pyramid was estimated to be 5000 sows.

If detailed data were not available then breeders were asked for the overall number of commercial slaughter animals that they influenced through the 'dam line' and the 'sire line'.