final report

Project code: L.GEN.1802

Prepared by: Robert Banks
Animal Genetics and Breeding Unit

Date published: 21 June 2019

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 1961
NORTH SYDNEY NSW 2059

Benefit and cost of performance recording in the beef and sheep studs

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

This project aimed to estimate levels of investment and profitability in beef and sheep studs in Australia, and to assess whether these differed between studs using BREEDPLAN or Sheep Genetics and those not. A voluntary survey was developed and invitation to participate widely circulated. The participation rate was low, but participants included a sample of the largest users of BREEDPLAN and Sheep Genetics. Results suggest that BREEDPLAN and Sheep Genetics users have larger businesses in both scale and level of investment, and those businesses are more profitable, than for non-users. Knowledge of operating margins and return on investment is valuable in understanding seedstock sector capacity to increase investment, particularly in hard-to-measure traits and genotyping. On the basis of the results here, such capacity appears likely to be constrained. Obtaining more comprehensive survey results would be valuable, but it is not obvious how to achieve that.

Executive summary

The project aimed at collecting data on the size and level of costs and returns in beef and sheep seedstock businesses in Australia.

Knowledge of these parameters is important for industry for the following reasons:

- Seedstock businesses – businesses that breed and sell bulls and rams – are the source of genetic description and genetic improvement in the beef and sheep industries. This definition is not restricted to breeders who are members of breed societies, or who register animals prior to sale: it simply covers businesses that generate some information on bulls or rams, and who may also make selection decisions leading to genetic improvement.
- Generating genetic information depends on collecting some form of data on animals in seedstock herds or flocks – typically that is performance records, but may also include genotypes. Collecting or obtaining such data require an investment of some form, potentially including investment in equipment and infrastructure, payment to contractors for data collection, payment for genotyping, payment for data analysis to generate EBVs or ASBVs (and other associated genetic information) and owner labour costs.
- It is anticipated that the levels of investment will be larger for businesses using BREEDPLAN or Sheep Genetics, if only because such businesses have to pay herd or flock, and per animal, charges.
- For seedstock businesses to be viable – which means to continue providing the product description and/or genetic improvement services – their returns from sales of genetic material (bulls or rams, cows or ewes, semen or eggs) must be sufficient to cover operating costs and overheads, and generate a contribution to covering the owner-operator allowance.
- Seedstock businesses that use BREEDPLAN or Sheep Genetics on average need to generate higher returns than non-users in order to meet their anticipated additional costs.
- To date, there has been no analysis of the scale, costs, returns and profitability of seedstock businesses, and whether any of those parameters differ between BREEDPLAN or Sheep Genetics users and non-users.

A survey was developed with inputs from ABRI and Sheep Genetics staff, and an invitation to participate in the survey distributed widely through breed societies in sheep and beef cattle, through ABRI outlets, and via Sheep Genetics.

The survey questions covered:

- Scale of business, including number of breeding females and numbers of rams and ewes sold
- Returns from sales, both per unit of genetic material sold and in total
- Operating costs including both variable costs and overheads including plant and equipment
- Participation or not in BREEDPLAN and Sheep Genetics
- Scope for providing information on trait recording

To increase participation rate, direct calls were made to 1450 sheep studs (605 Merino, 539 Dorset and Poll Dorset, 134 Suffolk, 178 Border Leicester) and 1670 cattle studs (197 Hereford, 307 Angus, 143 Simmental, 215 Charolais, 157 Santa Gertrudis, 2633 Brahman, 157 Droughtmaster, 189 Brangus and 52 Braford), and the survey sent directly to over 350 sheep studs and 200 cattle studs.

Response to the survey was not as high as was hoped for. The initial aim was to obtain data from 300 studs in each of beef and sheep, including at least 30 in each species not using BREEDPLAN or Sheep Genetics. Invitations to participate were distributed twice, based on limited response to the first call. In total, 68 responses were received from beef studs, and 81 from sheep studs, including 26 and 51 from non-BREEDPLAN and non-Sheep Genetics users respectively.

The number of respondents not using BREEDPLAN or Sheep Genetics were close to or more than the targets for these groups. Numbers of respondents from BREEDPLAN or Sheep Genetics users were much smaller than the target.

These overall response rates (around 4% of BREEDPLAN and Sheep Genetics users) are lower than the levels quoted as typical for surveys (10-15% for external surveys). This may reflect the amount and/or nature of the questions:

- The survey included up to 82 items of information (sheep) and 42 items of information (beef)
- The survey questions included 18 directly relating to income or costs

Despite the low response rate, the survey results provide a sound basis for estimating investment levels and return on investment for the larger users of BREEDPLAN and Sheep Genetics. This conclusion is based on comparing the herd and flock size distributions among participants with those for all BREEDPLAN and Sheep Genetics users. This outcome was assisted by direct contact to a sample of the largest BREEDPLAN and Sheep Genetics users.

On the basis of this observation, the survey responses can provide indicative information on:

- Any differences in income, costs, overall levels of investment and return on investment between users and non-users of BREEDPLAN and Sheep Genetics
- An estimate of the likely upper range levels of profitability and capacity for increased investment – assessed as margin after operating costs and overheads and estimated owner-operator allowance

The key findings from the survey are:

- Businesses that use BREEDPLAN or Sheep Genetics are larger than those that don't, in scale, value of sales, level of operating and non-owner overhead costs, and estimated return on investment.
- In both species, the distributions of these parameters are all somewhat skewed (they broadly reflect a 70:30 rule), meaning that (for example) average estimated return on investment is markedly higher than median estimated return on investment.
- Businesses that don't use BREEDPLAN or Sheep Genetics are not only smaller, but have lower sales value, lower operating costs and overheads, and lower estimated return on investment. In the beef studs not using BREEDPLAN, average estimated return on investment is negative even before consideration of owner-operator allowance.
- Among both users and non-users, there is wide variation in all aspects of financial performance, with coefficients of variation averaged across parameters of 176% and 154% for Sheep Genetics users and non-users respectively. At the same time, there is a positive relationship between business size and gross margin per female in beef, although there is no clear relationship between these parameters in sheep.

Overall, the survey data and analysis suggests that there is some capacity for increased investment in recording in studs using BREEDPLAN and Sheep Genetics. However, this conclusion should be a cautious one, because we have no way of assessing the level of uncertainty around the value of

future sales – which must be a consideration for stud breeders when considering their level of investment in recording and other items of breeding business expense. In addition, we have no data on the interest costs for any of the businesses, or on the owner allowance they draw from the business. With these caveats in mind, it is likely that capacity of stud breeders to increase investment in recording additional phenotypes, in particular any that are expensive to collect, is limited.

Finally, the question of how to obtain greater volume of detailed information should be considered. If the participation rate achieved here is actually typical or at least a reasonable target, then some more direct method should be considered.

Table of contents

1 Background

The commercial production sector of the beef and sheepmeat industries (and the rest of the value chains in both industries), depend on genetic improvement generated by bull- and ram-breeders respectively. Those breeders have to make investments in performance recording and growing males out to sale ages that are additional to the costs of commercial production enterprises, and which must be covered by returns from sales of rams or bulls.

There is no comprehensive objective data on the levels of investment in these additional costs across the breeding sector, meaning that industry has little or no objective basis for assessing whether the breeding sector has the financial capacity to scale up investments to record more traits – with particular focus on traits which are harder (more costly) to measure and/or which underpin genetic evaluation for high value traits. Accordingly, industry has little or no objective basis for developing a comprehensive strategy for growing the scale and value of genomic technologies, which depend very heavily on large volumes of quality recording for their usefulness. Extending this point, industry actually has very limited information on which to base any expectations about what capacity there is to scale up recording. This point can be extended to there being a lack of information about the adoption costs of BREEDPLAN or Sheep Genetics – in particular of the costs other than direct client charges.

There have been very limited attempts to estimate or assess typical investments in recording in the past (Archer et al, 2004; Sheep Genetics, pers. comm.), and these were some time ago and of limited value now when industry is anticipating increasing adoption of genomic testing.

The intention in this project was to collect objective data, sampling the diversity of breeding enterprises across beef and sheep, across the size range of breeding operations and the regions in which they operate, and across the main breeds and breed groups. The data to be collected would include details of recording costs by trait, including marginal labour costs, to enable analysis of total variable costs. This coupled with data collected on price and volume of ram- and bull-sales, would enable an accurate picture to be developed of both average costs and margins, and the variation around those averages.

This information will assist industry as a whole to be more informed on the likely scale and level of the increases in recording that will be needed to underpin widespread reliable genomic testing in both the breeding and production sectors. The information will also reveal whether there are systematic differences in recording costs and margins between breeds and/or regions, which will be invaluable in helping industry and industry organisations such as breeds, and service providers, formulate strategies for optimising recording.

Reference:

Archer, J. A., Barwick, S. A. and Graser, H.-U. (2004) Economic evaluation of beef cattle breeding schemes incorporating performance testing of young bulls for feed intake. *Australian Journal of Experimental Agriculture* **44** (5): 393-404

2 Project objectives

This project will:

- Survey 300 beef studs and 300 sheep studs to gain information on size of the flock/herd, the average number of bulls/rams sold, average price received, value of annual semen sales and the average number of stud females sold and their average price. Costs collected will include those extra costs associated with operating a stud and costs specific to performance recording.
- The data will be analysed in combination with data on flock or herd genetic merit (statistics available from BREEDPLAN and Sheep Genetics) over time, and datasets of breed-wide and individual herd and flock sales data, to provide a comprehensive picture of the economics of bull- and ram-breeding and any relationships in that data with parameters and measure of flock and herd genetic merit.
- Develop better understanding and benefit cost analysis of performance recording by ram and bull producers.

3 Methodology

The aim was to get a comprehensive understanding of the costs involved in producing stud animals for 300 beef studs and 300 sheep studs. The beef cattle survey aimed to split between northern Australia and southern Australia, with representation in each of these zones consisting of ten respondents for the four most common breeds by scale of operation (large medium and small) identified from BREEDPLAN records. That is, 120 performance-recording beef businesses per zone. The aim for non-BREEDPLAN users was to obtain responses from 30 stud producers who are not performance recording per zone. For the sheep industry a similar process was used except that aim was for the sample population to be split between SA/WA and the eastern southern states.

The survey was developed in consultation with Meat & Livestock Australia (MLA), the beef breed societies and the Agricultural Business Research Institute (ABRI) to ensure compliance with privacy legislation, and was tested with producers and consultants prior to the final version.

An introductory letter was sent to potential participants including a hard copy of the survey. Breeders were also provided with a link to an on-line survey site.

The survey distribution was via:

- Beef breed societies
- SBTS and TBTS Newsletters and websites
- Sheep Genetics newsletters
- Plus a limited number of invitations sent directly to larger BREEDPLAN and Sheep Genetics clients.

Producers were encouraged to complete the survey on line, however to help get accurate data, a series of conference calls conducted by Meridian Agriculture consultants were made each with up to 8 participants at a time, to clarify any questions from producers and to assist with technical issues.

Data collected in the survey included information about the size of the flock/herd, the average number of bulls/rams sold, average price received, value of annual semen sales and the average number of stud

females sold and their average price. Costs collected included those extra costs associated with operating a stud and costs specific to performance recording.

Because of the limited response, the data were not analysed in combination with data on flock or herd genetic merit (statistics available from BREEDPLAN and Sheep Genetics) over time, and datasets of breed-wide and individual herd and flock sales data, to provide a comprehensive picture of the economics of bull- and ram-breeding and any relationships in that data with parameters and measure of flock and herd genetic merit. The analysis include 23 levels:

a) Base level including means and variances of all financial parameters, and analysis of variance to test breed, region and enterprise scale effects.
b) Examination of data on flock/herd merit to explore associations between these and the outcomes of level a) analysis. This analysis level was not performed.
c) Identification of potential market failure – is there any, what form does it take, and what options might be considered to mitigate it.

4 Results

4.1 Survey Response

Despite wide dissemination of the invitation to participate in the survey, and assistance from beef breed societies, ABRI and Sheep Genetics, the overall response was low.

Numbers of beef and sheep breeders responding, together with the total numbers of studs in BREEDPLAN and Sheep Genetics, and the corresponding survey participation rates, are shown in Table 1:

Table 1: Numbers of survey respondents, total Sheep Genetics and BREEDPLAN participants, and survey response rate

Parameter	Sheep		Beef	
	In Sheep Genetics	Not in Sheep Genetics	In BREEDPLAN	Not in BREEDPLAN
Participants in survey	30	51	42	26
Enrolled in Sheep Genetics or BREEDPLAN (Australia)	849		1,190	
Participation rate	3.5%		3.5%	

Target participation numbers were:

- 300 studs in each of sheep and beef
- Including 30 in each species who are not using BREEDPLAN or Sheep Genetics

The second of these targets was achieved in sheep, and almost achieved in beef. However, the numbers of participants in Sheep Genetics or BREEDPLAN are below the targets.

The question that must be considered is how useful the results from the survey can be, given that we are trying to estimate a set of parameters of the population. This can be addressed in two ways:

- Firstly, by examining how representative of the population the sample is, in terms of known parameters.
- Secondly, by examining whether given the data obtained for participants (in Sheep Genetics or BREEDPLAN) and non-participants, the parameter values for the sample sets are significantly different. Strictly, this does not address the representativeness of the samples obtained, merely whether there is a significant difference between the groups.

Taking the first approach, we can compare descriptive statistics for the survey participants and for BREEDPLAN or Sheep Genetics users as a whole (Table2).

Table 2:Herd and flock size distributions amongst survey respondents

Not in BREEDPLAN			In BREEDPLAN		
Herd Size (cows)	*Frequency*		*Herd Size (cows)*	*Frequency*	
Up to 50	22	84.6%	Up to 50	7	16.7%
51-100	2	7.7%	51-100	15	35.7%
101-250	2	7.7%	101-250	9	21.4%
251-500	0	0.0%	251-500	7	16.7%
More than 500	0	0.0%	More than 500	4	9.5%
Mean	40.2		Mean	270	
Median	24.2		Median	100.0	
Standard Deviation	50.9		Standard Deviation	460.3	
Minimum	2.0		Minimum	6.3	
Maximum	236.7		Maximum	1976.3	
Count	26		Count	42	

To gauge the extent to which the survey participants who use BREEDPLAN are representative of all herds using BREEDPLAN, we can compare their characteristics with the total BREEDPLAN users:

- The average number of animals submitted to BREEDPLAN per herd for Australian herds has averaged very close to 100 in recent years. Using an estimated branding rate of 85% and assuming that 90% of calves born in herds using BREEDPLAN are actually entered for evaluation, this would mean an average cow number of 100/(85% x 90%) = 131.
- This is lower than the mean herd size for the In-BREEDPLAN survey participants, and slightly larger than the median herd size of In BREEDPLAN survey respondents (131 v 100).

The representativeness of the BREEDPLAN herds who participated in the survey can be assessed by comparing the distribution of herd sizes with those for whole breeds – using Angus and Hereford (Table 3, over page).

Table 3: Distribution of herd sizes amongst Hereford and Angus seedstock herds

Hereford			Angus		
Herd size	**Herds**		**Herd size**	**Herds**	**% herds**
up to 50	395	67.5%	1 - 100	697	73.6%
51-100	86	14.7%	101 - 200	114	12.0%
101-250	78	13.3%	201 - 300	51	5.4%
251-500	23	3.9%	301-400	30	3.2%
More than 500	3	0.5%	401- 500	10	1.1%
			More than 500	45	4.8%

52% of the survey participants who use BREEDPLAN had herd sizes of up to 100 cows. Among Hereford and Angus members these proportions are 82% and 74% respectively.

The survey participants who use BREEDPLAN not only have larger average herd size than those who do not use BREEDPLAN, but they also have larger average herd size than the averages of all Angus and all Hereford herds.

In sheep, the only comparison we can make is with the overall users of Sheep Genetics. The averages for respondents are:

- Not in Sheep Genetics, average flock size (number of ewes) = 381
- In Sheep Genetics, average flock size (number of ewes) = 559

This can be compared with the flock size distributions in Sheep Genetics (Table 4).

Table 4: Flock size distributions amongst Sheep Genetics users

Maternal					Average = 548.5
<100	101-250	251-500	>500		Total
9	40	44	50		143
6%	28%	31%	35%		
Terminal					Average = 300.8
<100	101-250	251-500	>500		Total
100	159	114	83		456
22%	35%	25%	18%		
Merino					Average = 679.1
<100	101-250	251-500	>500		Total
16	45	64	125		250
6%	18%	26%	50%		

Overall average = 453.9

Together these statistics suggest that the “In Sheep Genetics” survey participants have larger average flock size than the overall average for all Sheep Genetics flocks, and are approximately representative of the top 1/3 to ½ of all Sheep Genetics flocks, depending on breed group.

Considering the comparisons in beef and sheep, it is clear that the survey participants who use Sheep Genetics or BREEDPLAN are on average among the larger users (ie larger herd or flock size) of the industry genetic evaluation systems.

The implications of this for the relevance of the survey findings include:

- The survey participants are likely to represent breeding businesses making larger investments in recording and other aspects of the breeding business.
- The survey participants not in BREEDPLAN or Sheep Genetics have herd or flock sizes and size distributions broadly similar to the overall characteristics of the broader distributions of herd or flock sizes in the seedstock sector.
- Together, these imply that the survey results can give us reasonable estimates of the lower and higher ends of the range of investment in the seedstock sector as a whole. This is useful because it allows us to estimate the upper extent of capacity to invest in more recording – if the overall average herd and flock sizes for BREEDPLAN and Sheep Genetics users are lower than the averages observed here, then the average operating surplus is potentially lower than the values observed here.

4.2 Results

In each section of the results, beef and sheep data are included in that order, with each species then discussed briefly. Results are presented first in terms of means, followed by investigation of variation around the means.

4.2.1 Herd and Flock Size

Table 5a: Beef respondents - average herd size and sale numbers

Parameter	Beef		Ratio - BP/non-BP
	In BREEDPLAN	Not in BREEDPLAN	
Number of studs	42	26	
Average number of cows per stud (across 3 years)	270	40	6.8
Bulls sold per stud per year (average of 3 years)	81.3	10.2	8.0
Bulls sold per cow per year	0.30	0.26	1.2
Cows sold per stud	53	23	2.3

Table 5b: Sheep respondents – average flock size and sale numbers

Parameter	Sheep		Ratio - SG/non-SG
	In Sheep Genetics	Not in Sheep Genetics	
Number of studs	30	51	
Average number of ewes per stud (across 3 years)	559	381	1.5
average weaning rate per stud	126%	140%	
rams sold per stud per year (average over 3 years)	151	63	2.4
rams sold per ewe per year	0.27	0.17	1.6

In both species, the most obvious feature is that businesses that utilise the industry genetic evaluation systems are significantly larger than those that don't:

- In beef, an average 270 cows per herd in BREEDPLAN compared to 40 for non-BREEDPLAN
- In sheep, an average 559 ewes per flock in Sheep Genetics compared to 381 for those not in Sheep Genetics

This in turn translates into higher number sales of bulls or rams:

- In beef, 81 bulls sold per year vs 10 (In BREEDPLAN vs not in BREEDPLAN)
- In sheep, 151 rams sold per year v 63 (In Sheep Genetics vs not in Sheep Genetics)

In both species, these sale rates result in higher sales per breeding female:

- 0.30 bulls sold per year per cow vs 0.26 (In BREEDPLAN vs not in BREEDPLAN)
- 0.27 rams sold per ewe per year vs 0.17 (In Sheep Genetics vs not in Sheep Genetics)

4.2.2 Value of Sales

Table 6a: Beef respondents – value of sales

Parameter	Beef		Ratio - BP/non-BP
	In BREEDPLAN	Not in BREEDPLAN	
Number of studs	42	26	
Average value per bull sold	$5,103	$2,542	2.0
Average value per cow sold	$2,009	$36	55.4
Average value of bull sales per stud	$437,750	$25,903	16.9
Average value of semen sales per stud	$31,818	$0	
Average value of cow sales per stud	$41,465	$10,992	3.8
Average total income from sales per stud	$511,034	$36,896	13.9

Table 6b: Sheep respondents – value of sales

Parameter	Sheep		Ratio - SG/non-SG
	In Sheep Genetics	Not in Sheep Genetics	
Number of studs	30	51	
Average value per ram sold (over 3 years)	$1,089	$729	1.5
Average value of ram sales per stud (over 3 years)	$164,510	$45,840	3.6
Average value of semen sales per stud	$20,955	$5,922	3.5
Average value of ewe sales per stud	$28,727	$8,332	3.4
Average total income from sales per stud	$214,192	$60,094	3.6

In both species, all aspects of herd or flock income are higher for businesses using BREEDPLAN or Sheep Genetics:

- Higher value per animal sold ($5,103 v $2,542 for bulls, $1,089 v $729 for rams; $2,009 v $36 per cow)
- Higher income from semen sales ($31,818 v $0 for beef; $20,955 v $5,922 for sheep)
- Total sales income ($511,034 v $36,896 for beef; $214,192 v $60,094 for sheep)

Variation around the averages are discussed in detail in section 4.2.5 (pp. 18-21).

4.2.3 Operating Costs

Table 7a: Beef respondents – operating costs

Parameter	Beef		Ratio - BP/non-BP
	In BREEDPLAN	Not in BREEDPLAN	
Number of studs	42	26	
Animal health cost per stud	$3,223	$1,990	1.6
Veterinary cost per stud	$14,597	$1,394	10.5
Fodder cost per stud	$41,150	$13,953	2.9
Consultancy cost per stud	$7,237	$865	8.4
Marketing costs per stud	$20,626	$1,096	18.8
Scanning costs per stud	$2,880	$268	10.7
Other measurement costs per stud	$56,197	$1,200	46.8
BREEDPLAN costs per stud	$6,453	-	
Average semen costs per stud	$9,709	$2,274	4.3
Average value (cost) of bulls used per stud	$13,097	$14,755	0.9
additional labour per stud (FTE)	0.9	0.4	2.3
Additional labour per stud ($, assuming $75k per FTE)	$67,500	$30,000	2.3
total costs per stud per year	$242,669	$67,795	3.6

Table 7b: Sheep respondents – operating costs

Parameter	Sheep		Ratio - SG/non-SG
	In Sheep Genetics	Not in Sheep Genetics	
Number of studs	30	51	
Animal health cost per stud	$3,707	$1,708	2.2
Veterinary cost per stud	$9,832	$1,541	6.4
Fodder cost per stud	$7,785	$3,194	2.4
Consultancy cost per stud	$3,163	$249	12.7
Marketing costs per stud	$4,948	$1,217	4.1
Scanning costs per stud	$1,673	$244	6.9
Other measurement costs per stud	$567	$188	3.0
Other costs not specified	$3,946	$272	14.5
Sheep Genetics costs	$2,111	-	
Average semen costs per stud	$5,486	$999	5.5
Average value (cost) of rams used per stud	$9	$9	1.0
additional labour per stud (FTE)	0.77	0.62	1.2
Additional labour per stud ($, assuming $75k per FTE)	$57,750	$46,500	1.2
total costs per stud	$100,977	$56,121	1.8

In both species, all aspects of herd or flock operating costs are higher for businesses using BREEDPLAN or Sheep Genetics (the only exception is cost of bulls used – which is potentially impacted by the breeder assessment of the value of bulls).

Total operating costs are significantly higher for businesses using BREEDPLAN or Sheep Genetics:

- In beef, $242,669 v $67,795 per year
- In sheep, $100,977 v $56,121 per year

The direct investments in recording and genetic evaluation are higher for businesses using BREEDPLAN or Sheep Genetics:

- In beef, the total of scanning costs, other measurement costs, and BREEDPLAN costs is $65,530 per year. This represents 27% of total operating costs, and $243 per cow.
- In sheep, the total of scanning costs, other measurement costs, and Sheep Genetics costs is $4,351 per year. This represents 4% of total operating costs, and $8 per ewe in the flock.

4.2.4 Operating Margins and Enterprise Return on Investment (ROI)

The gross margin is calculated as total income per business – total operating costs.

The return on investment is calculated including infrastructure and equipment costs (both depreciated at 10% per year), and including an estimated capital value of the herd or flock. The capital value has been calculated as:

- The value of each cow or ewe is modelled as 2 times the average sale price of bulls or rams. The value of 2 is used to reflect an average age of breeding females of 3-4, and accordingly an average number of further sales of 2

A salvage value for cull females has been included, with values of $1,000 per head for cows and $350 per head for ewes, and assuming 20% sales of cull females per year.

The ROI estimation does not include any owner allowance (ie what the business pays the owner).

Taking account of herd or flock valuation and salvage value of cull females to calculate the total investment reinforces the comparison of total operating costs between the two groups of participants:

- The total annual investment is very much larger for businesses using BREEDPLAN or Sheep Genetics ($1.28m v $0.15m in beef, $0.47m v $0.15m in sheep)

Comparing gross margins and return on investment, the values are:

- In beef:
    - gross margin per stud of $268,365 for businesses using BREEDPLAN v -$30,899 for those not using BREEDPLAN
    - gross margins per cow of $994 v -$772
    - ROI of 21% for businesses using BREEDPLAN v -20.2% for those not using BREEDPLAN
- In sheep:
    - gross margin per stud of $113,215 for businesses using Sheep Genetics v $3,973 for those not using Sheep Genetics
    - gross margins per ewe of $203 v $10
    - ROI of 24% for businesses using BREEDPLAN v 2.3% for those not using BREEDPLAN

These parameters are listed in Tables 8a and 8b (over page).

Table 8a: Beef respondents – gross margins and estimated ROI

Parameter	Beef		Ratio - BP/non-BP
	In BREEDPLAN	Not in BREEDPLAN	
Number of studs	42	26	
Total operating costs per stud	$242,669	$67,795	3.6
Average total income from sales per stud	$511,034	$36,896	13.9
Average gross margin per stud	$268,365	-$30,899	
Average gross margin per cow	$994	-$772	
Infrastructure costs per stud	$120,543	$18,750	6.4
Plant and equipment per stud	$32,688	$6,850	1.7
Herd valuation	$829,408	$51,857	16.0
Salvage value of cows @ $1,000 per cow	$54,000	$8,000	6.8
Total costs including infrastructure and plant and equipment	$395,900	$93,395	4.2
Total investment including herd valuation and salvage value	$1,279,308	$153,252	8.3
Return on investment = gross margin/total investment	21.0%	-20.2%	

Table 8b: Sheep respondents – gross margins and estimated ROI

	Sheep		Ratio - SG/non-SG
	In Sheep Genetics	Not in Sheep Genetics	
Number of studs	30	51	
Total operating costs per stud	$100,977	$56,121	1.8
Average total income from sales per stud	$214,192	$60,094	3.6
Average gross margin per stud	$113,215	$3,973	28.5
Average gross margin per ewe	$203	$10	19.4
Infrastructure costs per stud	$1,064	$238	4.5
Plant and equipment per stud	$1,293	$327	4.0
Flock valuation	$329,482	$92,106	3.6
Salvage value of ewes @ $350 per ewe	$39,130	$26,670	1.5
Total costs including infrastructure and plant and equipment	$103,334	$56,686	1.8
Total investment including flock valuation and salvage value	$471,946	$175,462	2.7
Return on investment = gross margin/total investment	24.0%	2.3%	

The results presented here do not include any Owner-operator allowance in the costs. This allowance is assumed to be funded out of the gross margin (along with tax, interest etc). The impact of including an Owner-operator allowance on profitability and capacity to increase investment is discussed in section 5.2.

4.2.5 Variation around means

Mean performance in any parameter can mask substantial differences in performance amongst members of a sample – in this case, herds or flocks. The extent of variation in size and financial performance parameters is examined here via standard deviations of individual statistics, and presentation of the median as well as the mean.

Note that some values presented in tables 9a and 9b are different from those presented in previous tables – this reflects editing the data to only include non-zero values for responses.

Table 9a: Beef - means, standard deviations and medians for key physical and financial parameters (studs using BREEDPLAN)

Parameter		Mean	Standard deviation	Median
Income from bull sales	2015	$352,050	$729,770	$73,500
	2016	$460,283	$927,281	$96,500
	2017	$523,482	$1,007,275	$117,500
Income from semen sales	2015	$8,386	$30,676	$0
	2016	$11,885	$39,125	$0
	2017	$17,693	$57,482	$0
Income from sale of cows	2015	$14,902	$38,625	$0
	2016	$10,290	$20,278	$0
	2017	$23,774	$52,866	$0
across-years average total sales value		$474,248	$967,793	$95,833
Total additional cost due to BREEDPLAN participation		$209,585	$392,808	$59,475
Gross margin over total BREEDPLAN participation costs		$264,663		$36,358
Across-year average # cows		285.8	470.4	100.0
Gross margin per cow		$926.14		$363.58
Estimated total investment		$1,005,650		$211,667
ROI		26.3%		17.2%

Table 9b: Sheep - means, standard deviations and medians for key physical and financial parameters (studs using Sheep Genetics)

Parameter		Mean	Standard deviation	Median
Income from ram sales	2015	$130,055	$166,187	$71,000
	2016	$140,756	$174,145	$82,000
	2017	$161,282	$200,208	$97,000
Income from semen sales	2015	$7,562	$20,627	$0
	2016	$7,008	$24,940	$0
	2017	$10,952	$27,094	$0
Income from sale of ewes	2015	$8,705	$15,018	$40
	2016	$9,582	$16,101	$50
	2017	$18,606	$51,695	$0
Across-years average total sales value		$164,836	$232,005	$83,363
Total additional cost due to participation in Sheep Genetics		$92,461	$84,995	$57,400
Gross margin over total Sheep Genetics participation costs		$72,375		$25,963
Across-year average # ewes		594.9	526.9	380.0
Gross margin per ewe		$121.66		$68.32
Estimated total investment		$371,313		$193,327
ROI		19.5%		13.4%

The reason for examining the variation around the means for the respondent herds in BREEDPLAN and flocks in Sheep Genetics is to assess whether the means for the scale and financial parameters are “typical”.

Two aspects of the parameters are apparent:

- The standard deviations of parameters for herds in BREEDPLAN and flocks in Sheep Genetics are very large – in essentially all cases, larger than the means,
- The mean values are much larger than the medians – especially for beef.

Together, these observations mean that the survey respondents in BREEDPLAN or Sheep Genetics include some breeding businesses that are much larger in physical and financial scale than the “typical” such breeder.

This has important implications for the ultimate purpose of this project – to understand the capacity of the breeding sector to increase investment in performance recording. If we examine the means, using gross margins per breeding female as a simple indicator of surplus available for investment, they are $926 per cow and $122 per ewe, suggesting that funds would be available. When we examine the median values however, $364 per cow and $68 per ewe, then it becomes apparent that for the “typical” BREEDPLAN or Sheep Genetics user, funds available after meeting any interest payments and owner allowance may in fact be limited.

The median gross margins reinforce this conclusion: $36,358 for beef studs in BREEDPLAN and $25,963 for sheep studs in Sheep Genetics are clearly not sufficient to support a farm business; rather, they could be described as “useful enterprises in a total farm business mix”.

A second approach to examining the degree to which respondents to the survey are "typical" is to examine the distributions of herd or flock size, and compare them with those for all BREEDPLAN or Sheep Genetics users. Section 4.1 presents statistics on distributions of herd and flock size: here, the same data is presented graphically.

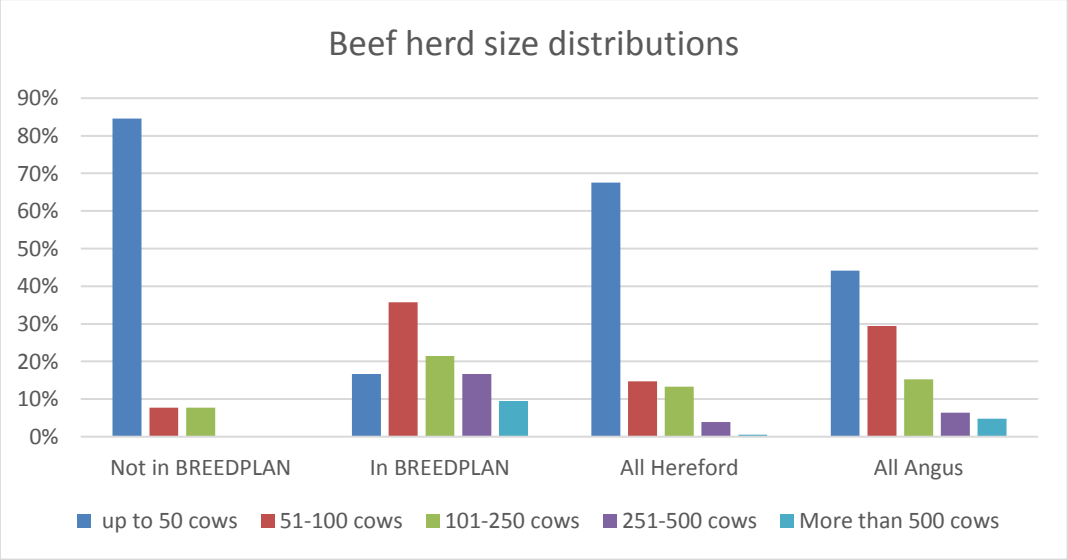

Fig. 1: Beef herd size distributions – respondents not in BREEDPLAN, respondents in BREEDPLAN, All Hereford Australia members, All Angus Australia members

Comparing the pattern of herd sizes for Not in BREEDPLAN with In BREEDPLAN, it is clear that most of the respondents not in BREEDPLAN have herd size up to 50 cows, whereas those In BREEDPLAN are more evenly spread across the herd size categories – which is reflected in the higher mean herd size for In BREEDPLAN.

Comparing the respondent herds' patterns with the overall patterns amongst Hereford and Angus studs, the In BREEDPLAN respondents' have higher proportions at all herd sizes greater than 50 cows, and markedly so at 251-500 and more than 500 cows.

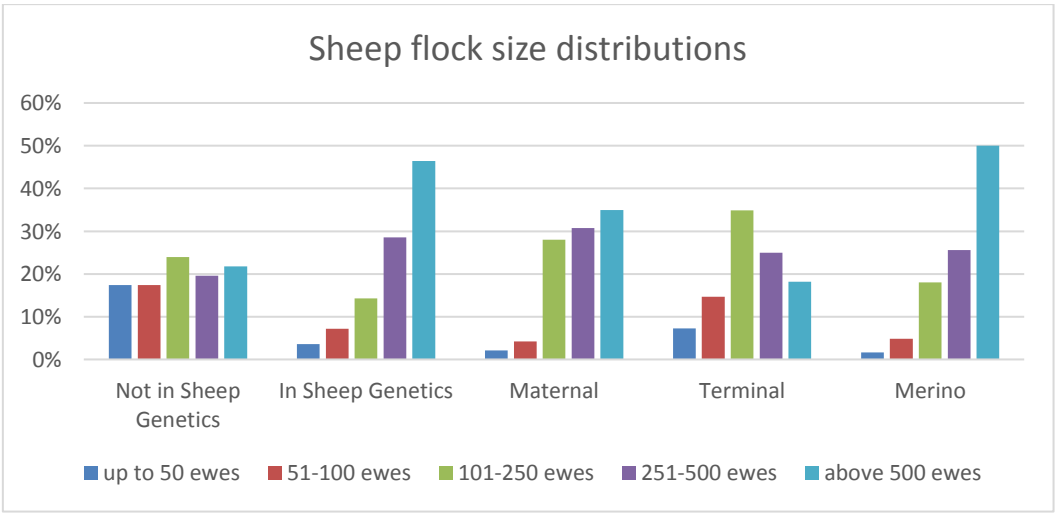

Fig. 2: Sheep flock size distributions – respondents not in Sheep Genetics, respondents in Sheep Genetics, All Sheep Genetics – Maternal, All Sheep Genetics – Terminal, All Sheep Genetics - Merino

Comparing the pattern of flock sizes for Not in Sheep Genetics with In Sheep Genetics, the respondents In Sheep Genetics have a higher proportion of flocks in all the categories larger than 50 ewes.

Comparing the respondent herds' patterns with the overall patterns amongst Sheep Genetics studs, the In Sheep Genetics respondents' pattern is more similar to the patterns for Maternal and Merino flocks in Sheep Genetics.

As noted in section 4.1 (Table 4), the average flock sizes for all categories of Sheep Genetics users are larger than for the Not in Sheep Genetics, and the In Sheep Genetics respondents have larger average flock size than the overall average for all Sheep Genetics flocks, and are approximately representative of the top 1/3 to ½ of all Sheep Genetics flocks, depending on breed group.

4.3 Relationships to herd or flock merit, and consideration of market failure

Due to the limited sample size for herds using BREEDPLAN and flocks using Sheep Genetics, no attempt has been made to examine any relationships between financial parameters of the respondents' businesses and their herd or flock genetic merit.

Previous work (Banks, 2017) has examined the relationship between herd merit and average sale price in Angus cattle in Australia. In that data, there was a positive regression of sale price on herd merit, with a low r-squared. Earlier work (Banks, unpublished) using data from the same breed found a modest positive relationship between herd-size and genetic merit.

On the basis of these observations, we might predict a relationship between herd size, genetic merit, and profitability (or at least herd income), but that the relationship would not be strong. There would be value in re-visiting the study of relationships between herd size, genetic merit and income from bull sales.

The intention behind including consideration of market failure was simply to explore whether the results of this study have any implications re extent or nature of market failure. In this context, the limited sample size means that caution is appropriate, but some observations are possible:

- The data show that the market is discriminating between users of BREEDPLAN or Sheep Genetics, and non-users: total sales value, and average sale prices, are higher in both species for the users of those systems
- The price differentials for bulls and rams between users and non-users can be used to explore the "implicit" premium being paid for genetic merit, as follows (table 10, overpage).

Table 10: Price differences per male sold, and implied premium for genetic merit

Parameter	Beef	Sheep
Difference in average price (BP v non-BP; SG v non-SG)	$2,551	$360
Likely lifetime progeny*	100	150
Difference per progeny	$25.51	$2.40
Approximate equivalent years of genetic trend**	8.5	3.2

*: assumed value

**: using $3.00 per cow joined per year, and $0.75 per ewe joined per year, as genetic trend values for beef and sheep respectively

Based on these simple estimates, bull-buyers are paying a larger premium for BREEDPLAN bulls than ram-buyers are paying for Sheep Genetics rams. If expressed in generation terms, the difference is not so marked: 8.5 years is approximately 2 generations in beef, whereas 3.2 years is approximately 1 generation in sheep.

The volume of data available here does not support more detailed consideration of the implied premiums for buying from BREEDPLAN herds or Sheep Genetics flocks, but if it were possible to obtain more data, exploring why buyers pay what they do for bulls and rams would be a useful study.

A second dimension of the market failure question is whether the premiums that are observed are consistent with the extra value being obtained. Answering this question accurately would depend on knowing the genetic merit of both groups of respondents' animals in beef and sheep (ie BP v non-BP, SG v non-SG), but we do observe that on average, the additional income for BP and SG users more than covers the additional investments they make. In this simple sense, there is no obvious market failure.

Extending this point, the data does not allow us to conclude that the premiums are consistent with the extra value being delivered, and this leaves open the question of whether the potential return on investment is sufficiently clear or positive to encourage increased investment, particularly in recording phenotypes. As is discussed later, when overheads such as owner-allowance and interest payments are taken into account, there may be limited capacity for such increase. Whether this constitutes market failure is not obvious – increased investment in any business usually comes with risk, but a more efficient market reduces this risk. Although not examined directly here, the general pattern of performance recording in both species, where the proportion of animals recorded for harder- or more costly-to-measure traits is lower than for simple traits such as weights, suggests that the majority of breeders view increased investment in recording with considerable caution.

5 Discussion

5.1 Success in meeting objectives

The primary aim of this project was to collect data on costs and returns in seedstock operations, to assist in understanding the potential for increased investment by seedstock breeders in more phenotyping.

In both beef cattle and sheep, the invitation to participate in the survey was widely disseminated, with valuable assistance from breed societies in both species, and ABRI and Sheep Genetics.

Despite this wide dissemination, the final participation rate achieved was low – 3.5% for breeders using BREEDPLAN or Sheep Genetics, and likely lower for non-users (information readily available about total numbers of seedstock breeders in either species is limited to herds or flocks listed in herd or flock books, but these include both active and non-active studs).

Survey participation rates for external surveys generally are quoted as typically around 10-15% (https://www.surveygizmo.com/resources/blog/survey-response-rates/). Among factors affecting response rates, motivation to participate is highlighted. The present survey offered no direct incentive, and the only motivation was to improve industry knowledge in order to assist in planning future R&D.

Given the low participation rate achieved here, it is important to consider the relevance of the results obtained. This can be considered in two ways:

a) The total numbers of females in the participating herds and flocks. In beef, the total for herds using BREEDPLAN is 11,340, which is approximately 11% of the total number of cows in herds using BREEDPLAN in Australia. Similarly, in sheep, the participants using Sheep Genetics total 16,770 ewes, or approximately 4% of the total number of ewes in flocks using Sheep Genetics.

b) The demographics of the participants who are users of BREEDPLAN or Sheep Genetics. For example, the average number of cows for the BREEDPLAN-user participants is 270. By comparison, the average herd sizes of Angus and Hereford seedstock herds are 109 and 50 respectively. Herds with 270 or more cows represent approximately 9% of Angus herds and 7% of Hereford herds, and 54% of Angus cows and 30% of Hereford cows.

   The participant herds, with 11,340 cows, equate to approximately 20-25% of the cow numbers of the larger seedstock herds using BREEDPLAN.

c) Similarly, in sheep, the average number of ewes for Sheep Genetics-user participants is 559. By comparison, the average flock sizes of maternal, terminal and Merino flocks in Sheep Genetics are 549, 301 and 679 respectively. Flocks with 559 or more ewes represent approximately 25-30% of maternal flocks, 15% of terminal flocks, and 30% of Merino flocks in Sheep Genetics, and approximately 45-50% of maternal ewes, 30-33% of terminal ewes, and at least 50% of Merino ewes in Sheep Genetics.

   The participant flocks, with 16,770 ewes, equate to approximately 10% of the ewe numbers of the larger seedstock flocks using Sheep Genetics.

Overall, the survey participants who are users of BREEDPLAN or Sheep Genetics are more representative of the larger users of those systems. This does not mean that they are an unbiased sample of those larger users, but provides some increase in confidence of the value of the survey results. In both species, direct targeting of a sample of the largest users resulted in responses being obtained from those businesses, which means that the results include data from the largest users, who are likely to include those making the largest investments in recording and other costs directly associated with genetic evaluation and improvement.

Accordingly, the results obtained must be treated with some caution, but at the same time it is reasonable to use those results as a guide to the likely upper levels of investment. This does not automatically mean that they are a guide to the likely upper levels of overall return on investment: there may be some studs in both species that achieve very high returns from low investment in recording and genetic evaluation. However, we can be confident that the participants include a more representative sample of the largest investors in use of BREEDPLAN or Sheep Genetics, who are likely to be the source of the majority of performance records and potentially genotypes (at least in seedstock animals) and hence the genomic reference, into the future.

5.2 Key findings

Taking note of the need for caution in extrapolating from the results, there are some clear messages in the results.

Firstly, there are clear differences in the sizes of BREEDPLAN or Sheep Genetics users' businesses compared to the non-users. The beef studs using BREEDPLAN average 270 cows, compared with 40 for the studs not using BREEDPLAN. Similarly, the median herd size of the In BREEDPLAN respondents (100) is larger than the average herd size of the Not in BREEDPLAN respondents, supporting the overall conclusion that users of BREEDPLAN are likely to have larger herds than non-users.

In sheep, the difference in size between the two groups of participants is not so marked and as noted in the Results section, the participant flocks are more typical of the largest users of Sheep Genetics.

Secondly, levels of investment differ markedly, both in terms of operating costs, and overall estimated return on investment taking into account the estimated value of the business. This applies to operating costs, infrastructure and equipment, and estimated value of the herd or flock. The ratios for BREEDPLAN:non-BREEDPLAN and Sheep Genetics:non-Sheep Genetics for these three costs are 3.6, 6 and 14.8 for beef, and 1.8, 4.2 and 3.1 for sheep.

Total investment in beef studs is $1.28m v $0.15m for BREEDPLAN and non-BREEDPLAN, and in sheep studs is $0.47m v $0.18m for Sheep Genetics and non-Sheep Genetics.

Operating costs detailed in the survey include:

- Animal health cost per stud
- Veterinary cost per stud
- Fodder cost per stud
- Consultancy cost per stud
- Marketing costs per stud

- Scanning costs per stud
- Other measurement costs per stud
- BREEDPLAN or Sheep Genetics costs per stud
- Average semen costs per stud

For all these items, average costs per stud are markedly higher for studs in BREEDPLAN or Sheep Genetics than not. Similarly, investments in infrastructure and equipment are higher for BREEDPLAN and Sheep Genetics users, as is the investment in additional labour.

The "direct" costs associated with participation in BREEDPLAN or Sheep Genetics include scanning costs, other measurement costs, and BREEDPLAN or Sheep Genetics costs. These represent 7% v 2% of total operating costs for BREEDPLAN v non, and 4.3% v 1% of total operating costs for Sheep Genetics and non. (NB: Sheep Genetics users also reported a significantly higher annual investment in "Other costs not specified" than non-users: $3,946 v $272 per stud).

Thirdly, returns from sales of sires, of dams, and of semen, differ markedly. Average prices for bulls sold by BREEDPLAN herds are double those for non-BREEDPLAN herds, and in sheep the corresponding ratio is 1.5. Other sources of income – semen sales and sales of cull females – are 3-4 times higher (total) for studs in BREEDPLAN and Sheep Genetics, and overall income from sales is 14 and 3.6 times higher for BREEDPLAN or Sheep Genetics users in beef and sheep respectively.

Fourthly, return on investment differs markedly in both species. The estimation of return on investment here includes valuation of the herd or flock, as well as operating costs, plant and equipment.

Gross margins and return on investment depend on income and cost. Accordingly, it is possible to estimate break-even prices for bulls and rams sold from herds using BREEDPLAN or flocks using Sheep Genetics. These values are $2,084 for bulls and $340 for rams. These equate to 41% and 31% of the averages for BREEDPLAN and Sheep Genetics participants respectively. If we assume 100 lifetime progeny for bulls and 150 for rams, the differences between averages achieved and the break-even values represent an additional $300 per progeny in beef and $5 per progeny in sheep. The break-even value in beef is close the average bull price for non-BREEDPLAN studs, but in sheep is lower than the averages for both Sheep Genetics users and non-users. The values are very different in terms of proportion of typical current progeny values for the two species, and suggest that at least some beef studs using BREEDPLAN have been able to build reputation and market premiums for their bulls. It is possible that such differences may differ between breeds, but this question has not been analysed because of the small sample size.

No account of owner-operator payment has been taken to this point in the calculation of Return on Investment. ROI for beef studs is 21% v -20% for BREEDPLAN and non-BREEDPLAN, and 24% v 2% for Sheep Genetics and non-Sheep Genetics (the median is 17% for BREEDPLAN, and 13% for Sheep Genetics respectively).

If we add an owner-operator payment of $75,000 (simply for illustration), the gross margin per stud and the ROI per stud are as shown in Table 10.

Table 11: Estimated gross margin and return on investment including example owner payment (mean values only)

	Gross Margin w/o Owner payment	Gross Margin incl. Owner payment	ROI w/o Owner payment	ROI incl. Owner payment
Beef				
In BREEDPLAN	$268,365	$193,365	21%	15.1%
Not in BREEDPLAN	-$30,899	-$100,899	-20.2%	-69.1%
Sheep				
In Sheep Genetics	$113,215	$38,215	24%	8.1%
Not in Sheep Genetics	$3,973	-$71,027	-2.3%	-40.5%

The value of $75,000 for owner-operator allowance is indicative only – this discussion is included simply to stress that the owners of studs have to pay themselves. This survey did not collect data on total FTE invested in the business, but it is very likely that the largest operations surveyed utilise more than 1 FTE (after allowing for additional labour), and that conversely the average or median business only require a part-FTE.

Recognising this point, the surplus – the gross margin after including owner-operator, is in principle funds available to pay tax, invest in the property or business, and/or to invest in additional recording and/or genotyping. The surplus available for such purposes is approximately $717 per cow in beef and $68 per ewe in sheep.

The data suggest that there will be relatively small numbers of businesses likely to have the scale to generate substantial data for genomic evaluation – and this probably more marked in cattle than in sheep. For example, if we assume that 270 cows generates a workable return to the business and can generate useful volume of data for genetic evaluation, the maximum number of businesses at that size to generate the current throughput would be 100,000/270 = 400 – not a large number of businesses.

An important perspective which moderates all the findings discussed here is the wide variation in essentially all parameters of physical and financial scale in both species. If median gross margins as an indicator of capacity for increased investment, the “typical” user of BREEDPLAN or Sheep Genetics likely has only quite limited capacity for increased investment, with median gross margins estimated at $36,358 and $25,963 in beef and sheep respectively. On a per female basis, these values are not markedly different from average gross margins for commercial beef or sheep operations.

5.3 Summary points

Inferences and insights from the data relative to previous research:

We are not aware of any previous demographic research on the beef and sheep seedstock sectors. Accordingly, the results, particularly in terms of economics of businesses, comprise new information.

Practical implications for industry:

The main implications for industry are:

a) Seedstock businesses that use BREEDPLAN or Sheep Genetics are larger than the average of all seedstock businesses in the respective species
b) On average, beef seedstock businesses that do not use BREEDPLAN are not profitable, either in terms of operating (or gross margin), or return on investment.
c) On average, sheep seedstock businesses that do not use Sheep Genetics operate at very close to break-even ie operating profit (or gross margin) and return on investment are very close to zero.
d) Investment levels for businesses using BREEDPLAN or Sheep Genetics are markedly higher than for non-users. This is particularly so for beef studs using BREEDPLAN.
e) In both species, "direct" costs associated with genetic evaluation – recording costs and costs of participation in the respective analyses – are a minor component of the overall costs. The remainder include animal health, veterinary, fodder, consultancy and marketing costs.
f) In both species, there is an approximation of the 80:20 rule operating, especially among the businesses using BREEDPLAN or Sheep Genetics. Not only are the herds or flocks for these studs on average larger than for non-users, but a large proportion of the total animals being evaluated through BREEDPLAN or Sheep Genetics are in businesses significantly larger than the average for all users (the median herd or flock size is smaller than the mean). To the extent that business profitability is associated with business size, and there is evidence in beef that this is the case, most of the profitability in beef and sheep seedstock businesses will be generated in larger operations, and accordingly, any capacity for increased investment in recording will be mainly in those larger businesses. This is particularly the case when the need to pay an Owner-operator allowance is factored in.

Taken together, the overall implication is that seedstock businesses that use BREEDPLAN or Sheep Genetics while being on average profitable, may have limited capacity to increase investment in performance recording and/or genotyping. This will be particularly relevant for hard-to-measure traits, which by definition are usually in some way expensive.

Additional research recommended:

The return rate for this survey was disappointing. To assist in forward planning of strategies around ongoing collection of genomic reference data, alternative approaches to obtaining the data should be considered – such as some form of confidential survey automatically included in submission of data for genetic evaluation, possibly incentivized by discounted costs.

Overall strategy for ongoing investment in reference data is a broader question than this project can address. However approaches to treating herds and flocks that are considered to be part of the reference as R&D partners, and so able to share some data under appropriate confidentiality in return for some form of co-investment, should be considered.

Draft extension messages:

The findings of this survey do not immediately lead to extension messages. However, as noted above, they are important background for industry and stakeholder consideration of strategies for ongoing investment in genomic reference data.

What could have been improved in overall project delivery?

The focus of planning any future survey of this sort should be how to increase participation. A simple approach outlined above would be to incorporate some level of financial reporting in routine membership of BREEDPLAN or Sheep Genetics. In beef, this is complicated by the fact that the businesses using BREEDPLAN are not direct clients of the commercialiser, but options to partner with breed societies and others in collecting the information should be explored.

Success in meeting project objectives:

The primary project objective was:

> To understand the costs associated with stud animal production as a means of identifying the ability of breeders to fund performance recording.

To achieve this by:

a) Conducting a survey, via invited participation, of beef cattle and sheep stud breeders (ie breeders who sell bulls or rams) including users and non-users of BREEDPLAN and Sheep Genetics:
    a. The survey to collect data on operating costs and overheads for bull- and ram-breeding enterprises, and on returns
b) Estimating the gross margins and return on investment for breeding enterprises.

The survey was conducted, and the participants included beef breeders who use BREEDPLAN and beef breeders who don't, and sheep breeders who use Sheep Genetics and sheep breeders who don't.

The survey collected data on operating costs and overheads, and returns, from the participants. The data obtained enable estimation of gross margins and return on investment for the participants.

The key questions in relation to success in meeting the project objectives relates to the size and composition of the survey participants:

- The participation rate was small as a proportion of the known numbers of breeders using BREEDPLAN or Sheep Genetics, and the estimated numbers of breeders not using either system
- The participants were on average representative of the larger users of BREEDPLAN and Sheep Genetics. Based on observed patterns in gross margins within the sample groups, this is likely to over-estimate gross margins and return on investment. If this is the case, then average profitability across BREEDPLAN and Sheep Genetics users is likely to be lower than these results indicate, and capacity to increase investment is also likely to be over-estimated.
- It is also possible that the participants who do not use BREEDPLAN or Sheep Genetics also represent a biased sample, although it is not obvious whether the bias would be likely to be towards the more or less profitable studs.

Given that participation in the survey was voluntary and with no incentives, and the usefulness of having improved understanding of levels of investment and profitability amongst stud breeders, consideration should be given to how to obtain larger sample sets. For BREEDPLAN and Sheep

Genetics users, seeking such data could be a component of participation in the schemes. For non-users, contact mechanisms that are completely independent of, or perceived to be completely independent of, industry funding bodies may need to be considered.

Summary

Taking account of the points noted re the success in meeting objectives, the results do provide a useful estimate of levels of investment and profitability for stud breeders.

Breeders using BREEDPLAN or Sheep Genetics are on average larger businesses that make larger investments in the business than those who don't use BREEDPLAN or Sheep Genetics.

Estimated profitability for the BREEDPLAN or Sheep Genetics users, especially for the larger business, suggest some capacity to increase investment in performance recording. However the extent of this would depend on the fixed and variable costs of such recording, and on the impact of increased accuracy of EBVs or ASBVs, and/or increased superiority of genetic merit, on value of sales.

6 Conclusions/recommendations

6.1 Future R&D

It would be valuable to:

a) Consult with key industry stakeholders regarding the main conclusions of the survey, in particular the extent to which the results seem representative of broader industry
b) Consider alternative strategies for obtaining the data collected here, potentially via feedback forms distributed to users of BREEDPLAN and Sheep Genetics as part of ongoing "membership"

6.2 Practical application of the project's insights

The most important application is to use the information on breeders' scale and margins in developing strategies for ongoing investment in genomic reference populations. In particular, numerically smaller breeds (number of studs, animals per stud) are likely to struggle to maintain investment in hard-to-measure traits given their scale and estimated profitability.

6.3 Development and adoption activities

There are no immediate development or activities arising from this project at this point.

7 Key messages

The conclusions from this survey must be treated with caution given the sample size. At the same time comparisons of the enterprise scale data from the survey with those of overall BREEDPLAN and Sheep Genetics participation suggest that the results for "typical" participants (using the median as an indication of typical) are of some use.

Studs participating in BREEDPLAN or Sheep Genetics are on average larger than those not participating. Around the average stud size there is considerable variation, more obviously so in beef than sheep in this survey and in overall participation in BREEDPLAN and Sheep Genetics.

Participation in BREEDPLAN or Sheep Genetics increases the likelihood that a beef or sheep stud will be profitable, but that appears to require substantially increased investment in comparison to studs not using BREEDPLAN or Sheep Genetics. This increased investment is total investment: the overall investment per female in the stud is higher for non-BREEDPLAN, and includes higher investment per female in fodder and additional labour. Investments per female are more similar between Sheep Genetics users and non-users.

While on average profitability is higher for studs using BREEDPLAN or Sheep Genetics than the non-participants in both species, the variation around the averages is such that the "typical" BREEDPLAN or Sheep Genetics participant achieves profitability more similar to non-participants. Median gross margins are approximately $37k and $26k per year for BREEDPLAN and Sheep Genetics participants respectively. These gross margins are before paying owner allowance or interest, suggesting that funds available for additional investment in performance recording or genotyping are likely to be very limited.

The typical BREEDPLAN or Sheep Genetics participant is not running a stand-alone business. Based on the estimated gross margins from this survey, only a proportion of studs in BREEDPLAN or Sheep Genetics could likely be a stand-alone enterprise, or even primary support for the farm business. Depending on the value used to indicate sufficient margin to be stand-alone, the proportion of studs achieving that level is almost certainly less than half of all studs, and likely to be close to 25%.

Achieving the greater profitability requires achieving significant market premiums for sales of genetic material, most obviously bulls or rams.

In targeting the seedstock sectors for adoption of new genetic evaluation or improvement technologies, consideration should be given to the capacity for adoption of different sized enterprises, and likely different breeds.

Strategies for ongoing maintenance of genomic reference populations need to take account of the impact of enterprise scale and current profitability on capacity to increase and sustain investment.

8 Bibliography

Archer, J. A., Barwick, S. A. and Graser, H.-U. (2004) Economic evaluation of beef cattle breeding schemes incorporating performance testing of young bulls for feed intake. *Australian Journal of Experimental Agriculture* **44** (5): 393-404

Banks, R.G. (2017) The distribution of risk and reward in extensive livestock improvement systems, their consequences and possible responses. *Proc. Assoc. Advmt. Anim. Breed. Genet.* **22**:373-376

9 Appendix

9.1 Significance of differences between Sheep Genetics users and non-users

The significance of differences in aspects of financial performance between Sheep Genetics users and non-users was examined via Analysis of Variance for a range of income and cost results.

This analysis was done only for sheep because of the smaller difference in average flock size between the two groups – which sets up the question of whether in fact the two groups are statistically different.

In beef, the herd size difference between the BREEDPLAN users and non-users is so large that testing for the significance of differences is not necessary or informative (particularly if the sample of users is biased towards the upper end of the herd size distribution, as we know it is).

For each parameter, the significance of the difference in mean between the Sheep Genetics users and non-users is shown. A significant result means that the value for Sheep Genetics users is significantly higher or larger than for non-users. Stars indicate levels of significance (Pr<0.05, *; Pr<0.01, **; Pr<0.001, ***, Table 10).

Table 10: Tests of significance of differences between sheep studs using Sheep Genetics and not

Parameter	Probability of F value for treatment difference
Average number of ewes run, over 3 years	NS
Average number of rams sold, over 3 years	**
Average price per ram sold, over 3 years	**
Average value of semen sales, over 3 years	**
Average number of ewes sold, over 3 years	*
Average price per ewe sold, over 3 years	NS
Average total income per year, averaged over 3 years	**
Average income per stud ewe, averaged over 3 years	**
Labour costs per year, over 3 years	NS
Infrastructure costs per year, over 3 years	NS
Equipment costs per year (depreciation), over 3 years	**
Marginal operating profit, per ram sold, over 3 years	*
Marginal operating profit, per stud ewe, over 3 years	NS

9.2 Summary of costs per female in the stud:

a) Beef:

		Not in BREEDPLAN		In BREEDPLAN	
		Mean per cow	Median per cow	Mean per cow	Median per cow
Average annual costs incurred over what would be incurred in a commercial operation.	animal health	$49.62	$41.38	$12.48	$12.75
	vet costs (eg AI, ET)	$34.75	$37.24	$52.78	$39.66
	fodder costs	$347.93	$165.52	$148.78	$62.09
	Stud related consultancy	$21.58	$0.00	$26.17	$0.00
	Promotion/advertising	$27.34	$41.38	$74.58	$45.00
	Scanning	$6.68	$0.02	$10.41	$10.00
	Other costs	$29.93	$37.24	$203.19	$45.00
Stud specific infrastructure		$467.55	$931.03	$435.84	$500.00
Stud specific plant and equipment		$170.81	$248.28	$118.19	$100.00
Labour		$750.00	$131.25	$250.00	$152.78
Total additional cost		$1,906.19	$1,633.34	$1,332.42	$967.28

b) Sheep:

		Not in Sheep Genetics		In Sheep Genetics	
		Mean per ewe	Median per ewe	Mean per ewe	Median per ewe
Average annual costs incurred over what would be incurred in a commercial operation.	animal health	$6.15	$8.33	$7.17	$5.26
	vet costs (eg AI, ET)	$6.00	$8.33	$16.13	$11.65
	Additional shearing	$6.55	$10.63	$8.11	$7.89
	fodder costs	$13.20	$25.00	$15.19	$13.16
	Stud related consultancy	$3.63	$12.50	$7.74	$5.26
	Promotion/advertising	$4.63	$8.33	$8.39	$6.60
	Scanning	$1.66	$4.17	$2.93	$2.89
	Additional measurements (eg fleece testing)	$2.38	$6.67	$2.58	$2.22
	Other costs	$4.52	$16.67	$12.44	$4.61
Stud specific infrastructure		$43.34	$50.00	$61.99	$32.63
Stud specific plant and equipment		$22.16	$62.50	$24.19	$26.32
Annual value of semen used in stud?		$9.70	$22.92	$8.97	$10.18
Total additional cost		$153.93	$251.67	$155.43	$151.05

9.3 Location of data:

Copies of the invitation letter, the survey, and of the responses to the survey, are submitted together with this final report.