8/5/2025

Final Report: Accelerating breeding herd capacity during periods of climatic variation

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

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RURAL ANALYTICS

Table of Contents

About the author:

Rural Analytics is a private research and consulting company servicing agricultural, government, rural and regional clients in Australia.

Acknowledgements

Rural Analytics gratefully acknowledge the people who contributed their invaluable time, access to resources and knowledge to the conduct of this project. Special thanks to Lu Hogan and Lisa Yorkston from the Armidale Node of the SQNNSW Innovation Hub for all their support in managing the project, preparing Animal Ethics Committee (AEC) reports and building exceptional extension materials. Thanks to Naomi Hobson and Sally Balmain from North West Local Land Services (LLS) for project design, organising field days and providing access to feedback. Thanks to Peter Brown (Bovine Breeders) and Marg Sheddon (Apex Breeding) for Artificial Insemination (AI) management and to Lachlan Ayoub from Zoetis for all the HeiferSELECT results and support. Thanks to Nigel Semmens (ST Genetics) and Chris Mcllroy (Agri-Gene) for assisting with semen identification and purchase. Finally, very special thanks and appreciation to the four herd contributors Richard Puddicombe, Tom Ledingham, Jason and Julie Waters, and Fraser and Pam James who have been a wealth of guidance, continual stimulation and instrumental in driving results and outcomes throughout this whole project.

The Rapid Herd Recovery project was hosted by the Armidale Node of the SQNNSW Innovation Hub, with events and activities supported by NSW Local Land Services and Rural Aid. The SQNNSW Innovation Hub received funding from the Australian Government's Future Drought Fund.

Disclaimer

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Acronyms

Acronym	Full Description	
AEC	Animal Ethics Committee	
AI	Artificial Insemination	
EBVs	Estimated Breeding Values	
FTAI	Fixed time artificial insemination	
IVF	In vitro fertilisation	
LLS	North West Local Land Services	
MOET	Multiple ovulation embryo transfer	
TACE	Trans Tasman Angus Cattle Evaluation	
TSU	Tissue sampling units	
UNE	University of New England	
MLA	Meat and Livestock Australia	
PDS	Producer Demonstration Site	

SNP	Single Nucleotide Polymorphism	
BVDV	Bovine Viral Diarrhoea Virus	

Executive summary and key recommendations

Returning to optimum herd productivity and capacity remains one of the key challenges after drought. When favourable conditions return, producers seek to increase breeder numbers, often at record high prices which can delay restocking and therefore cash flow and business recovery.

Building the capacity of the female breeding nucleus is one of the fundamental elements of drought resilience and recovery. This project examined the potential impact of combining current and emerging technologies to accelerate breeding herd capacity through genomic selection, AI joining of heifers, and increasing the female-to-male ratio of calves. Whilst each of these technologies is commercially available, there is an absence of information that would allow producers to make informed decisions on the cost-benefit of incorporating the technologies into management responses after drought.

The project determined the likely benefit of investment into three compatible technologies (Fixed time artificial insemination (FTAI), Female sexed semen, and Genomic selection), whilst also identifying any barriers to implementation. Combining the anticipated benefits from FTAI, genomic selection, and female sexed semen appears to offer significant benefits (both financial and management) to commercial self-replacing herds. The project provided important knowledge for producers as they attempt to rebuild herd capacity, effective breeding cow numbers, and cash flow after drought. As cash flow and financial recovery are part of effective drought responses, it is critical that producers are aware of the best practices that can lead to the restoration of full herd performance.

Several recommendations have been proposed based on insights from the demonstration trial, observations from the literature review and discussions with project participants. These recommendations are not in priority or rank order. They should be considered in future planning and investment decisions.

1 Background

Returning to optimum herd productivity and capacity remains one of the key challenges after drought. A large proportion of Eastern Australia experienced extremes of climatic variation between 2018 and 2022, with a widespread severe drought to 2020 and above average rainfall in 2021 and 2022. During the drought period beef producers in the region were forced to significantly reduce breeding cow numbers at low prices. When favourable conditions returned, producers sought to increase breeder numbers, often at record high prices which delayed restocking and therefore cash flow and business recovery. It is also notable that this same scenario is repeating in Victoria and South Australia in 2025.

Building the capacity of the female breeding nucleus is one of the fundamental elements of drought resilience and recovery. This project examined the potential impact of combining current and emerging technologies to accelerate breeding herd capacity through effective selection, AI joining of heifers and increasing the female to male ratio of calves. The project was set up to determine the likely benefit of investment into three compatible technologies (Fixed time artificial insemination (FTAI), Female sexed semen and Genomic selection), whilst also identifying any barriers to implementation. Whilst each of these technologies are commercially available, there is an absence of information that would allow producers to make informed decisions on the cost benefit of incorporation of the technologies into management responses after drought.

The decisions made around heifer joining are critical to short-term recovery and long-term resilience of the beef enterprise. Given the generational turnover for the average beef herd is 6.5 years, there is an overwhelming imperative to ensure replacement heifers (either bred or purchased) are selected and joined to obtain the highest level of productivity, whilst minimizing risks associated with low conception rates and dystocia.

Artificial breeding technologies, specifically FTAI has been successfully used to introduce new genetics and to stimulate heifer conception rates at joining. Several Australian and USA studies have been able to demonstrate that despite additional costs associated with semen purchase and AI, profitability per head improves with increased heifer conception rates, reduced heifer and calf mortality, reduced bull costs and in some cases improved weaning weights, due to an earlier calving.

Recently Bergman and Brown (2021) in an MLA PDS project conducted in WA to evaluate FTAI in British bred heifers demonstrated that, despite an additional $35 in costs, there was a $90 per head improvement in profitability associated with increased heifer conception rates (3%), reduced heifer and calf mortality, reduced bull costs and improved weaning weights (due to an earlier calving), although that value varied significantly across herds.

Whilst this trial provides the basis for investment in FTAI, it did not account for the impact of increased rates of genetic gain associated with improved selection intensity and accuracy of the AI sires, nor did it consider the value of new emerging technologies such as genomic selection. The economic benefit in this trial is consistent with USA published data of $87 USD for FTAI in heifers. It must be noted that in June 2022 Dr Phil Holmes indicated that FTAI in heifers did not pay, although final numbers were not forthcoming in that article.

Female sexed semen has been available for several years and is starting to be used in beef seedstock breeding, particularly in IVF and MOET programs. In commercial programs, there is emerging use in the dairy industry (from 2017–2020, sales of unsexed dairy semen declined ~20% in North America) AND the market share of female sexed semen in North America is approaching 30% of all sales. To date there is limited use in beef heifers, particularly as USA data shows that conception rates can be reduced by as much as 30% (10% on average). An additional complexity is that protocols for using female sexed semen are still evolving. In commercial herds, there may be significant benefits in optimising the number of female calves, particularly for self-replacing breeding herds that are emerging from drought conditions, as well as benefits associated with lower birth weights in female calves.

For heifer selection and management, new genomic tools such as HeiferSELECT (Angus Australia[1]) are being used to predict the genetic merit of heifers prior to joining, which allows effective mating to the most appropriate bulls within and between breeds. Miller et al. (2021) showed that the potential economic impact of genomic selection of heifers was $32 per head per year between the highest 25% and lowest 25% of heifers.

Combining the anticipated benefits from FTAI, genomic selection and female sexed semen appear to offer significant benefits (both financial and management) to commercial self-replacing herds. However, current information does not clarify whether these benefits are additive and if accelerated breeding and selection technologies will have a real influence on recovery from drought and long-term beef business profitability.

The project will provide important knowledge for producers as they attempt to rebuild herd capacity, effective breeding cow numbers and cash flow after drought. As cash flow and financial recovery are part of effective drought responses, it is critical that producers are aware of the best practices that can lead to restoration of full herd performance. This project was funded by Future Drought Fund, through the UNE Armidale Node of the SQNNSW Innovation Hub. It has been conducted on commercial beef herds that have been selected for having high quality infrastructure, excellent cattle resources and producers that are interested in exploring new technologies.

The project was supported by Angus Australia, Zoetis, Bovine Breeders, Apex breeding[2], the North West LLS, ST Genetics[3] and Agri-Gene[4].

2 Rationale and technologies investigated

As stated in the background section, producers at the end of a drought face significant decisions with regards to herd rebuilding. Regaining breeding herd numbers and performance after drought (or other

[1] https://www.angusaustralia.com.au/education/breeding-and-genetics/angus-heiferselect
[2] https://www.apexbreeding.com.au/
[3] https://www.stgenetics.com.au/default.aspx?language=english-australia&title=home
[4] https://agrigene.com.au/

significant climatic events) is key to cashflow for all beef producers. There are two options that producers can use to increase breeding herd numbers:

- ❖ Breed and retain more females. This comes at a cost with loss of immediate cash flow (not selling animals) and a potential reduction in genetic selection pressure.
- ❖ Purchase in breeding females. This has inherited risks associated with biosecurity and disease management and the fact that purchased females may not have the desirable genetic profile required for the herd. Furthermore, the value of breeding females appears to be the most volatile during and after drought (300% plus in 2021/22).

Both these recovery options suggest that technologies that could increase the female:male ratio in a cohort, whilst also ensuring that calves born met an optimal genetic profile (requiring some form of genetic evaluation) would be logical to explore as mechanisms to assist with drought recovery and resilience. Additionally, optimising reproduction in yearling heifers offers greater opportunity to breed from the best genetics in the herd and increase rates of genetic gain.

There are a range of technologies currently available including, IVF, ET, FTAI, female sexed semen and genomic profiling tools that are widely used in the dairy industry. For the beef industry a range of genomic profiling tools are available (HeiferSELECT, Inherit Select (Zoetis) and Igenity Beef (Neogen)) which along with female sexed semen and FTAI are rarely considered for commercial herds.

HeiferSELECT is a commercial genomic selection tool developed by Angus Australia in collaboration with Zoetis, and Neogen. The tool is designed to support commercial cow-calf producers in making data-driven heifer replacement decisions.

Key features include:

- Genomic (EBVs) for 14 traits: fertility, growth, feed intake, carcase quality, and resilience
- Three selection indexes:
    - *Cow-Calf Value*
    - *Feedlot-Carcase Value*
    - *Total Breeding Value*
- Star rating system for intuitive interpretation
- Sire assignment and breed composition analysis
- Optional BVDV testing integration
- Delivered via the ANGUS.TECH platform with easy-to-read reports

HeiferSELECT complements phenotypic and pedigree data, offering greater precision in selecting heifers aligned with breeding objectives—especially for traits that are hard to measure directly.

HeiferSELECT is a commercial genomic selection tool developed by Angus Australia with industry partners to help cow–calf producers make more informed replacement-heifer decisions before joining. It provides genomic breeding values across a broad set of traits (including fertility, growth, intake, carcase and resilience) and presents results through multiple selection indexes, a star-rating interpretation, and tools such as sire assignment and breed composition analysis, with optional integration of BVDV testing and reporting via the ANGUS.TECH platform.

Table 1 then synthesises published and anecdotal evidence on the main practices considered in the project—FTAI in heifers, increasing selection intensity/accuracy, genomic selection of heifers, and female sexed semen—by contrasting their typical benefits, implementation risks, and indicative economics. In broad terms, FTAI is associated with reproductive and survival gains (and sometimes profitability improvements) but can add labour, specialist requirements and potential conception-rate penalties; genomic selection aims to lift genetic gain and reduce losses but depends on prediction accuracy; and female sexed semen can improve the female-to-male calf balance and potentially reduce dystocia, but usually comes with higher semen costs and possible reductions in conception rates.

There is a plethora of published and anecdotal reports published on each of the technologies being evaluated within this project. A selected summary of information is contained within Table 1.

Table 1. Summary of advantages, risks and literature estimates for practices that are evaluated within current project

Practice	Advantages	Risks	Benefit:Costs
FTAI in heifers	Increased conception rates Improved return rates of heifers due to earlier joining Reduced dystocia and heifer mortality Increased weaning weights (earlier joining) Reduced bull costs	Increased labour demand Access to trained AI personnel Lower conception rates Higer costs of pregnancy	$90 net benefit per head (Bergman & Brown 2023) Costs $35 per head (Bergman & Brown 2023) $60 net loss per head (Alexopoulos - Angus 2025[5])
Increased selection intensity and accuracy	Higher rates of genetic gain Reduced rates of dystocia		Increased genetic gain (top 10% vs top 50% in Angus; $245 vs $203 Angus Breeding Index or $42 per cow difference) Top 50% vs 75% ($203 vs $178) ~ $25 Angus Australia May 2025
Heifer genomic selection	Increased rate of genetic gain Correct allocation of bull breed and ID Reduced mortality (calf and heifer)	Accuracy of genomic prediction	$33 per year (Miller et al 2021) $41 per heifer (Angus Australia May 2025) $48 per heifer (Neogen)
Female sexed semen	Optimum balance between male and female Joining of heifers to female semen (decreased birth weight) Joining cows to male semen?	Higher semen costs Reduced conception rates	$10-$25+ per straw vs conventional semen costs Total breeding costs higher for herds using female sexed semen via AI at NZD $135-$166 /cow compared with NZD $67-$102 /cow for herds using only natural mating. (Farrell et al 2022) Difference between steer and heifer progeny (at weaning $1/kg for a 300 kg weaner is $300 Auction Plus April 25)

[5] https://www.angusaustralia.com.au/news/jena-alexopoulos-foundation-research-grant-report

2.1 Australian dairy experience

The inclusion of genomic information in dairy industry breeding programs has been transformative. Traditionally bull selection and recruitment for semen sales has been based on large scale progeny test (proof) programs, with young bulls tested within commercial dairy herds and then based on those results, bulls that perform are selected as semen sires. Genomic prediction now allows for accurate selection of young bulls with similar accuracies to progeny tested bulls. As a result, commercial dairy farmers have adopted the use of genomic tested young bulls in their AI programs, reducing the generation interval and increasing the rate of genetic gain. This trend is shown in Figure 1, where essentially genomics has stopped the requirement for progeny tests on young bulls. A similar trend is emerging within Australian beef breeds (particularly Angus), although other breeds and specifically the Bos Indicus based breeds have been slow to adopt.

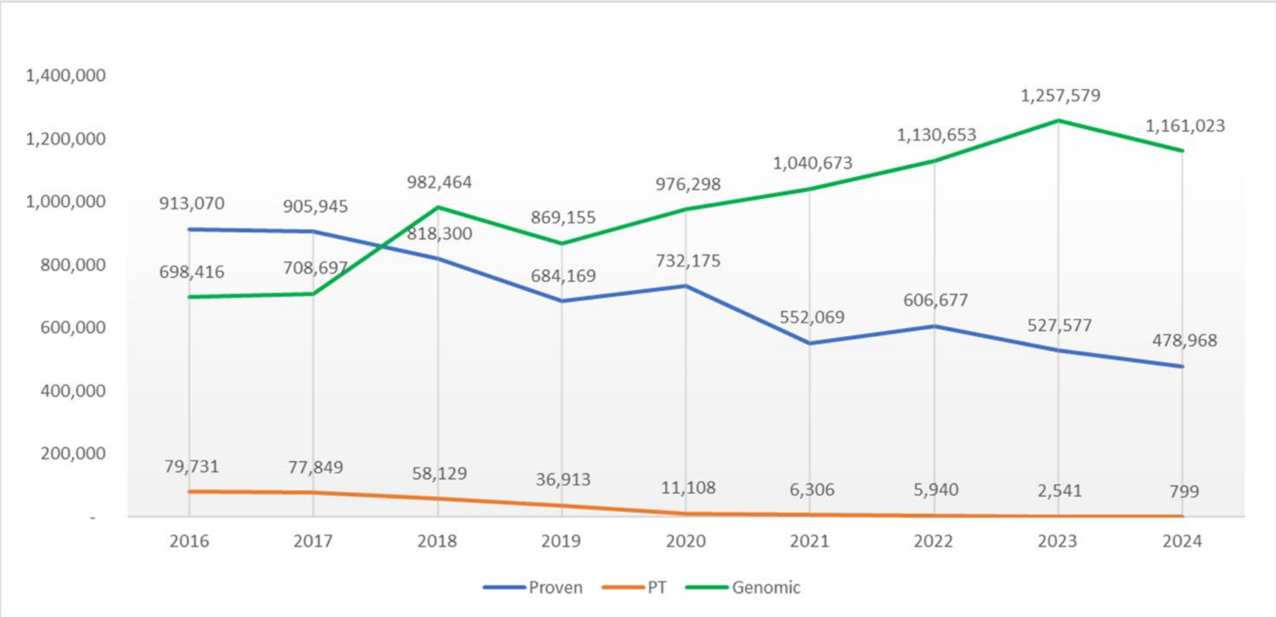

Figure 1. Sales of semen (numbers) in the Australian dairy industry for Proven (sires that have been progeny tested), Progeny Test (PT; young sires that are currently being progeny tested) and bulls with Genomic predictions (G). Source NHIA 2024 Semen Market survey report March 2025[6].

The use of female sexed semen in the Australian dairy industry is shown in Figure 2. The peak of use of sexed dairy semen (35% of total sales) occurred in 2022 and was primarily driven by export demand for dairy heifers. That percentage has declined to 29% in 2024, primarily due to the lack of demand for export dairy heifers but still reflects the objective of breeding female calves from above average cows in the dairy herd.

6 https://www.nhia.org.au/files/2%20Semen%20Market%20Survey%20Calendar%20Year%202024%20GRAPH%20FINAL.pdf

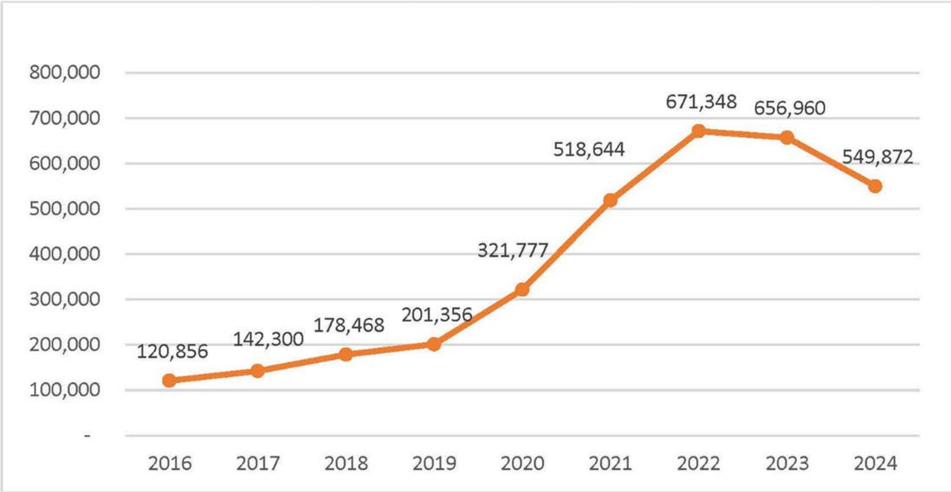

Figure 2. Quantity of sexed dairy semen (female) sold in Australia. Source NHIA 2024 Semen Market survey report March 2025.

In contrast, beef female sexed semen sales have been very minor as shown in Figure 3, with the majority still being imported semen and primarily Angus. The use of domestic female sexed semen is very low, although the opening of new facilities by breeding companies to process female sexed semen may increase both availability and use. There is an important, yet still very small, increase in the use of fresh female sexed semen. The availability of fresh sexed may be a game changer and will be discussed in the implications section. Of note, there is significant use of Beef on Dairy[7] semen (both imported and domestic) which may shift to the use of sexed male semen if current steer to heifer price differences remains.

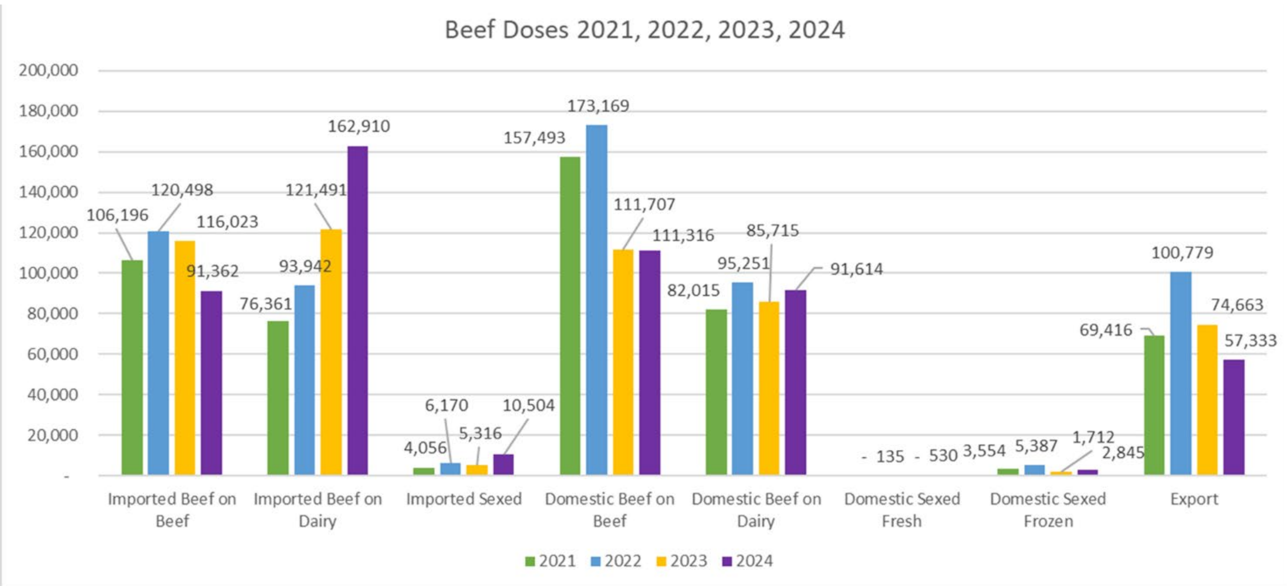

Figure 3. Numbers of beef semen sold, conventional vs sexed, imported vs domestic and beef on dairy. Source NHIA 2024 Semen Market survey report March 2025.

[7] Beef on dairy refers to the practice of using beef genetics in dairy cattle breeding, which have the potential to increase the value of surplus calves that are not required for breeding.

3 Objectives of this project

The aim of this project was to complete a proof-of-concept demonstration, economic and feasibility analysis of combining 3 commercially available technologies to assist rapid beef herd recovery from drought. The technologies trialled included genomic profiling of replacement heifers, FTAI with female sexed semen. Where appropriate a benefit cost analysis has been provided to assist beef producers with tools, knowledge and confidence to apply advanced breeding technologies and genomic selection to accelerate the breeding potential and production capacity of the herd, specifically after periods of drought when cash flow and financial decisions are paramount.

The project design involved four replicates of two factors (FTAI using female sexed semen and natural mating to herd bulls; up to 100 heifers per cell) with genomic selection using the HeiferSELECT DNA test provided by Zoetis and Angus Australia. All heifers mated in the trial and the resulting female calves from the female sexed semen and backup bulls were genotyped for expected progeny breeding values and to ensure sire verification.

4 Project methodology

Prior to the commencement of the project, Animal Ethics approval was sought from UNE. That approval was granted in June 2023. The approval number was ARA23-025, with Lu Hogan from UNE as the principal investigator. The final report was submitted to the AEC in May 2025.

4.1 Selection of cooperating herdsherd

The project was designed to be a producer lead demonstration project with four herdsherds selected, each supplying approximately 200 yearling heifers with a minimum joining age and weight (14 months, 350 kilograms liveweight). An expression of interest was sent to several breeders in the Northern Tablelands and North West regions. Additional invitations were sent by LLS to breeders that had participated in previous projects.

The project team selected four herds in the Northern NSW region that each had a self-replacing Angus herd focused on building herd capacity and with the time and resources to complete this project. Those herdsherds are shown in Figure 4 and contact details are in Table 2. Two of the four herdsherds had previous experience with both FTAI and HeiferSELECT, one property had used FTAI, and one property had no experience with any of the technologies. Female sexed semen was a novel technology for all four herds. Whilst the Angus breed was not an essential criterion for selection, the fact that all four herds had Angus allowed for effective access to female sexed semen (both imported and domestic) and for direct comparison of the genomic evaluation product HeiferSELECT.

Figure 4. Location of the four cooperating herds

Table 2. Contact details and previous experience with technologies

Name	Property Name	Location	Previous FTAI experience	Previous genomic evaluation (HeiferSELECT)	Previous Female sexed semen
Jason and Julie Waters	Glendower	Boorolong Armidale NSW	No	No	No
Tom Ledingham	Bullalla Partnership	Cobbadah NSW	Yes	No	No
Richard Puddicombe	Burindi Station Paraway Pastoral Company Limited	Barraba NSW	Yes	Yes	No
Fraser and Pam James	Guy Fawkes Station	Ebor NSW	Yes	Yes	No

4.2 Initial Genomic evaluation and HeiferSELECT

Cooperating breeders were asked to select 200 heifers from their normal cohort of yearling replacement 2022 T drop heifers for the project. All heifers were required to have a minimum joining weight of 350 kilograms, be structurally sound and where possible representative of the home herd. Two of the four herds had previously conducted genomic evaluations of breeding heifers using

HeiferSELECT and were able to use those results to assist with heifer selection. To ensure that all four herds had a common understanding of their genetic base and also of the variation within the 200 selected heifers, all 800 heifers were genotyped using a tissue sample unit (TSU) supplied by Zoetis and then HeiferSELECT genomic predictions for the 12 core traits and three production indices were produced by Angus Australia. Breed percentage and sire verification (where possible) was also provided by Angus Australia.

4.3 Sire selection and AI processes

Through the extensive networks of Agri-Gene and ST Genetics, the project team was able to identify a range of Australian bred and International (USA) Angus sires that had female sexed semen available. Key criterion for sire selection for all four breeders was genetic merit, specifically high Angus $ index values, favourable calving ease direct (positive) and lower birth weight EBVs. The later were essential given the need to reduce the risk of dystocia, calf and heifer mortality which are important profit drivers in beef production systems. An additional requirement was that one or more bulls would need to be used across herds to provide a genetic link and to also provide some assessment of AI program success.

A total of six AI sires were selected for the project. Those sires are shown in Figure 5. At the time of selection, all bulls ranked in the top 15% for the Angus Breeding Index ($A) and in the most favourable 20% for calving ease and birthweight. Since that time, there has been some changes in EBVs with most bulls retaining high genetic merit.

Angus Australia – Database Search Results – TACE EBVs

	Sire Id Dam Id		CE Dir	CE Dtrs	GL	Bwt	200	400	600	Mwt	MBC	MCH	Milk	SS	DC	Cwt	EMA	Rib	P8	RBY	IMF	NFI-F	Doc	Claw	Angle	Leg	$A	$A-L	$PRO
ALPINE 38 SPECIAL S021 PV	USA18229487		+5.3	+8.9	-8.2	+2.8	+51	+96	+129	+91	+0.31	+8.5	+21	+3.9	-6.0	+62	+7.9	+2.2	+0.6	-0.3	+3.7	+0.21	+21	+0.44	+0.60	+0.84	$238	$399	$195
CGK21S021 M	CGKM003		78%	65%	98%	97%	96%	93%	89%	85%	74%	78%	79%	85%	52%	80%	77%	78%	78%	72%	79%	68%	93%	77%	77%	74%			
12/02/2021		Perc	27	4	7	26	55	41	32	68	41	45	21	7	23	69	32	11	35	83	21	48	47	2	1	8	18	17	14
MURDEDUKE QUARTERBACK	VLYM518		+6.8	+1.9	-9.4	+3.0	+53	+101	+135	+107	+0.20	+10.2	+25	+4.0	-6.7	+77	+5.1	+1.7	+2.9	-1.1	+5.4	+0.60	+21	+0.70	+1.04	+1.06	$243	$413	$204
CSWQ011 M	CSWN026		91%	84%	99%	99%	99%	99%	99%	98%	94%	97%	97%	99%	70%	95%	92%	93%	93%	88%	92%	84%	99%	99%	99%	98%			
10/07/2019		Perc	16	65	3	29	43	29	21	42	71	17	8	6	13	27	66	17	9	98	4	84	47	23	68	62	14	10	9
PATHFINDER JUDD Q194 SV	HKFJ5		+7.8	+8.1	-6.6	+3.2	+52	+97	+126	+107	+0.37	+8.2	+17	+1.7	-5.8	+72	+8.7	+0.9	+2.2	-0.2	+3.9	-0.37	+20	+0.74	+0.84	+0.80	$244	$415	$207
SMPQ194 M	SMPK607		69%	63%	84%	88%	87%	86%	86%	83%	75%	79%	79%	83%	54%	78%	76%	76%	77%	69%	79%	69%	78%	66%	66%	65%			
27/02/2019		Perc	10	7	20	33	47	41	39	42	26	50	48	66	27	40	25	30	15	79	18	6	51	30	21	5	14	10	8
S S BRICKYARD PV	USA17287387		+9.6	+7.4	-2.3	+0.3	+55	+109	+130	+100	+0.40	+5.8	+21	+0.4	-5.9	+84	+8.3	+0.3	+1.4	+0.0	+2.1	+0.33	+24	+0.72	+0.96	+1.12	$251	$421	$201
USA18860371 M	USA18150837		82%	66%	98%	97%	96%	96%	96%	92%	68%	80%	90%	96%	53%	87%	87%	86%	84%	79%	86%	67%	91%	92%	92%	85%			
08/01/2017		Perc	3	11	82	3	35	12	30	53	20	88	21	95	25	13	28	43	24	70	56	61	36	26	49	78	9	7	11
POSS RAWHIDE PV	USA18962396		+6.9	+8.0	-6.7	+3.0	+68	+109	+150	+151	+0.31	+5.3	+17	+1.8	-6.0	+84	+7.9	-1.0	-3.3	+0.1	+2.7	-0.29	+31	+1.34	+1.02	+0.66	$237	$438	$191
USA19416968 M	USA18631711		78%	61%	98%	97%	96%	96%	94%	90%	67%	71%	87%	96%	50%	87%	88%	86%	85%	79%	87%	67%	95%	99%	98%	68%			
11/02/2019		Perc	15	8	19	29	3	12	6	4	41	92	52	62	23	14	32	72	91	64	41	8	15	99	64	1	19	4	16
TE MANIA ROCCO R795 SV	NORH708		-0.4	+1.3	-3.9	+1.8	+41	+90	+118	+113	+0.48	+9.6	+19	+1.6	-4.8	+48	+6.2	+0.7	-2.3	+0.0	+5.6	+0.24	+36	+0.72	+0.88	+1.20	$184	$332	$135
VTMR795 M	VTML1374		82%	70%	99%	98%	98%	97%	97%	92%	85%	83%	86%	96%	60%	91%	91%	90%	90%	83%	90%	83%	97%	97%	97%	96%			
07/08/2020		Perc	75	70	60	12	90	61	55	33	9	24	34	69	49	94	52	34	82	70	3	51	8	26	30	92	74	68	71

Angus Australia acknowledges the funds provided by the Australian Government through the Meat & Livestock Australia Donor Company (MDC). This report was created as a result of a collaboration between Angus Australia and Meat & Livestock Australia Donor Company (MDC) (Project P.PSH.1063).

Figure 5. Angus Australia TACE breeding values for female sexed semen AI sires used in the project (25/07/25).

At each property 100 heifers were part of the artificial breeding program. Two different companies undertook the AI programs, being Bovine Breeders (3) and Apex Breeding (1). Notably all four programs had subtle differences relative to the recommendations from the National Herd Improvement Association for female sexed semen [8]. However, in summary, programs were managed through a 10-day period, and included use of a DIB, 2mls of oestradiol, 2mls of prostaglandin with AI completed on the 10th day. All semen was checked prior to use. One small error occurred at one property where eight conventional doses of semen were used rather than female sexed semen. This

[8] https://www.nhia.org.au/beef-protocols

is probably the source of the three male calves born in that herd to that sire. However, the two male calves born to another sire in that herd were from reportedly female sexed semen.

The other 100 heifers in the cohort at each property were not subject to AI and were mated naturally using backup bulls that had been purchased or bred by the owners of the herds. Some of these bulls were also used as back-up bulls for the AI heifers. In total 92 bulls have been identified from the HeiferSELECT results for the four herds, although some herds have tested more than just heifers' calves.

4.4 Management of heifers and calves

Prior to and after AI, all heifers had similar management within each property. All heifers were vaccinated with Pestigard and either 5in1 or 7in1 prior to joining. Heifers were pregnancy tested between 70-110 days and assigned either to AI or backup based on foetal age. That data is presented in Section 5.

The summer of 2023 had above average rainfall which allowed good pasture reserves to be built going into winter. Most heifers received a mixture of hay, silage, cottonseed and grain supplements prior to calving. The winter period prior to calving was relatively mild, with all heifers calving at moderate to good condition scores on improved pastures with good feed on offer. Given the season, higher than normal calving difficulties were expected, however the results were very good to excellent.

Heifers and calves were managed as per each property's livestock management protocols. Importantly all 2024 drop AI bred, and backup heifer calves were managed in the same cohort allowing comparison of their sires TACE EBVs, HeiferSELECT breeding values and actual 200-day weights.

5 Project performance and findings

A key observation is that the success of this project is largely due to the commitment and enthusiasm provided by the four cooperating herd owners. They provided significant time and resources to collect data and provide that data for analysis by the project. Without that cooperation and in-kind support this project would not have been possible.

5.1 Conception rates from using female sexed semen in FTAI

Although published and anecdotal information indicated that using female sexed semen would result in lower conception rates relative to conventional semen, there was still the expectation of 50% pregnancy in the 2023 mating (2024 V drop calves). The ultrasound scan results, live female calves (genotyped), live bull calves and calf deaths are shown in Table 3. Conception rates were lower than anticipated, with significant variation between the four herds. As different protocols were used, it is difficult to separate property differences from protocol differences. However, linked sire information indicated (same sire used on herds A, B and D) conception rates from 32%, to 54% across the three herds. The other linked sire used in property A and B had conception rates from 32% to 39% between the two herds.

The number of dead calves (either at birth or shortly after) was very low ranging from 5-6%. In the one case (property D), those calves were born in extreme rain and cold and died from mismothering. The number of bull calves born was higher than expected at property A, although that result is questionable as eight doses of conventional semen were used by mistake. Notably the remaining herds all recorded male calves from female sexed semen. There was no sire impact on number of males born. One of the semen companies is now guaranteeing greater than 95% female in female sexed semen.

Table 3. Conception rate, number of heifers genotyped, dead calves (born and died within 1 week) and bull calves. For the 2024 drop female sexed semen fixed time AI.

Property (2024)	Number AI	Ultrasound scanned pregnant (n, %)	Number of heifers genotyped	Dead calves	Bull calves, % of calves born
A	99	51, 51.5%	44	3	5, 9.8%
B	99	43, 43.4%	42	3	6, 10%
C	108	38, 33.3%	27	N/A	2, 5.2%
D	99	48, 47%	36	3	5, 10%

The project was able to obtain data from all four herds for the subsequent 2024 joining (2025 W drop calves). All four herds adopted the use of female sexed semen on commercial terms, as a consequence of participating in this project in the previous year and observing the merits of using female sexed semen. Unfortunately, a different cohort of sires were used by all four herds for the 2024 joining resulting in no direct links across years. However, it was notable that in the 12 months since the project, several semen companies had expanded their offering of bulls that had male and female sexed semen available.

A comparison of the results obtained in 2024 and 2025 are shown in Table 4. The season in 2024/25 was significantly different with well above average rainfall and a spring that promoted significant clover growth. Consensus at the March 2025 field day held Tom Ledingham's property suggested that the reduced conception rates may have been due to excessive protein in pastures. The increase in conception rates for property C was attributed by the manager to a change in AI protocol.

Table 4. Comparison of female sexed semen conception rates for 2024 and 2025 drop (2023 and 2024 joining).

Property	2024 Ultrasound scanned pregnant (%)	2025 Ultrasound scanned pregnant (%)	Difference
A	51.5%	22%	-29.5%
B	43.4%	33%	-10%
C	33.3%	42%	+8%
D	47%	33%	-11%

Although not a formal part of the project, there were useful comparisons with other FTAI programs at three of the herds. In the 2023 joining, property C also used a sexed Wagyu semen and achieved a similar result of 33% pregnant in heifers from the same cohort. In that same year, property B and D used conventional semen in older cows and were able to generate an additional 20% in pregnancy rate compared to the result with heifers and female sexed semen. In 2024, property A, which had a significant decline in pregnancy rates with female sexed semen, used conventional semen in 2-year-old cows and was able to achieve a pregnancy rate of 55%. Although, those cows had conceived to AI as a yearling heifer and had all had a calf born to AI in July 2024. In 2024, Property B completed a second round of AI and was able to pick up an extra 23% of pregnancies on top of the 33% in the heifers.

To demonstrate the impact of sexed semen, a case study was developed for a 400-cow herd that had been reduced by 60% to 240 cows during drought. An analysis shows that if female sexed semen was used in available heifers (100), herd recovery would be achieved in three years compared to four years if using natural mating.

All these results indicate the following:

- There is still a significant difference in pregnancy rates when using conventional and female sexed semen
- Joining older cows resulted in higher conception rates when using FTAI
- The protocols used for FTAI are varied across the AI practitioners and it is important that producers considering AI programs work diligently with their practitioners to achieve the best result
- Seasonal influences on nutritional profiles both prior to AI and after AI do have an impact on success of conception. Managing those profiles is important
- There are significant sire differences in conception rates within and across herds that indicate success is affected by differences in protocols and viability of the semen
- Predicting AI success with female sexed semen is not possible

Recommendation 1. Many factors affect the success rate of female sexed semen in FTAI programs. Working with experienced AI practitioners, using multiple bulls (risk of semen failure), ensuring compliance with chosen protocols and managing nutritional profiles both prior to and after joining are key steps to ensure success.

5.2 Impact on heifer dystocia

One of the potential advantages of using female sexed semen, is that the resultant female calves will be lighter at calving (2-4 kg) resulting in reduced heifer dystocia rates. Three out of the four herds did record calving difficulties in the AI and backup mobs. On property A, three heifers were assisted in the AI cohort, with only one of those heifers having a female calf. Notably the two other assists were bull calves that were meant to be female. Herds B and D recorded no calving difficulties in the AI heifers. Anecdotally all four property owners/managers believed that having heifer calves did reduce dystocia.

These results do suggest that using sexed female semen does result in less cases of dystocia, although this cannot be validated as property A made a deliberate decision to use proven very low birth weight sires as backups, property C and D used Wagyu sires as backup to the AI, which were also very low in birth weight. Property B did have a low percentage of dystocia in the back-up heifers, although no heifers died.

Recommendation 2. The use of sexed female semen has potential for reducing dystocia in beef heifers. That reduction should be considered when evaluating the benefits of female sexed semen.

5.3 The percentage of empty heifers after FTAI

One of the most notable and unexpected results in this project was the proportion of dry heifers after FTAI and a 6–8 week backup period. All four herds consistently recorded empty rates of between 18-24% across the two years of AI. Property B in completing HeiferSELECT, was able to provide sire identification on the majority of the heifers. Sire of the heifer appeared to have a significant impact on conception rate independent of other factors. Some sires' daughters were able to achieve 100% pregnant to AI, whereas others had less than 20% conceive to AI and approximately 60% not pregnant after back-up sires. That data is shown in Figure 6.

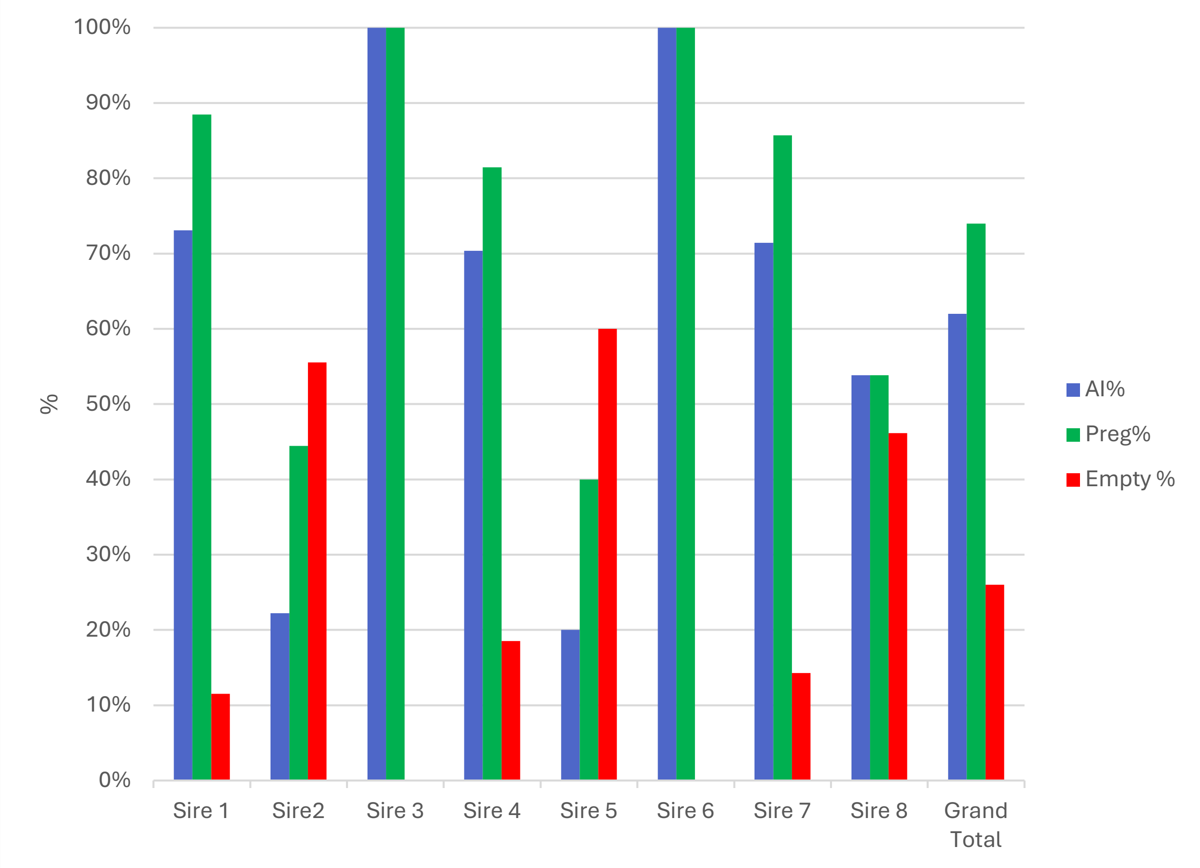

Figure 6. Impact of sire on daughters' conception rate to AI, total pregnancy percent (%) and empty rates in property B in the 2023 joining.

Property D was also able to provide sire of heifer information which again showed that sire has a significant impact (see Figure 7). As shown earlier, there were sires whose daughters achieved 100% conception rate and sires who daughters had up to 37% empty rates.

RURAL ANALYTICS

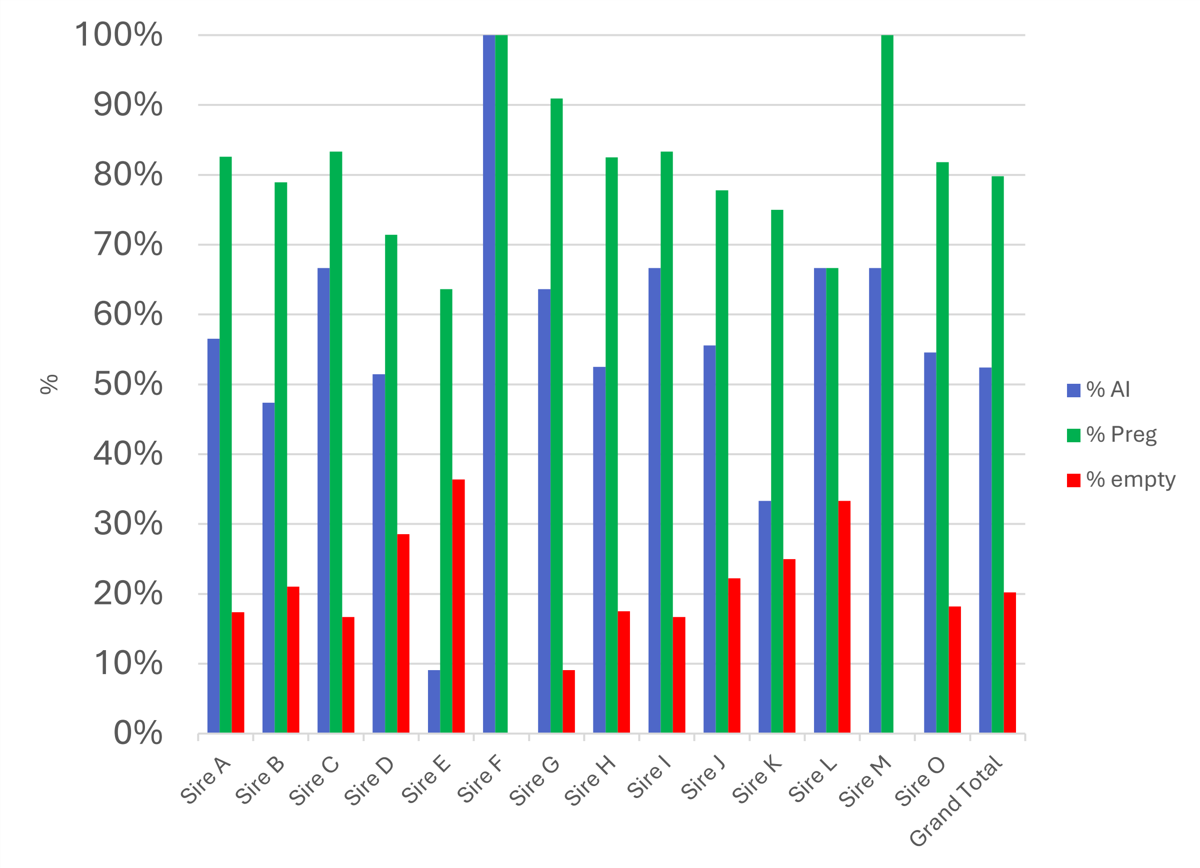

Figure 7. Impact of sire on daughters' conception rate to AI, total pregnancy percent (%) and empty rates in property D in the 2023 joining

Live weight at joining did not appear to have a significant impact on conception rates, although on all four herds heifers were well grown. An example of the relationship between heifer live weight at joining and conception rate for the 2024 joining for property B is shown in Figure 8. Clearly the favourable season had a positive impact on heifer growth rates as all heifers were approximately 400kg and heavier at joining. Within this cohort, there were well bred heifers joined at over 500kg that did not conceive, presenting a significant economic and selection loss to that herd. Empty heifers have a significantly lower value (up to $500 at sale) as well as reducing the number of heifers that become reproductively successful on the property.

It is obvious that a 20% (average across herds and years) empty rate is a major economic impediment for all four herds and is an element that needs to be investigated as it does not appear to be linked to the FTAI program in all cases.

Recommendation 3. That consideration is given to establishing a research project that unpacks the factors that may be leading to an average 20% empty rate in Angus heifers across the four herds.

RURAL ANALYTICS

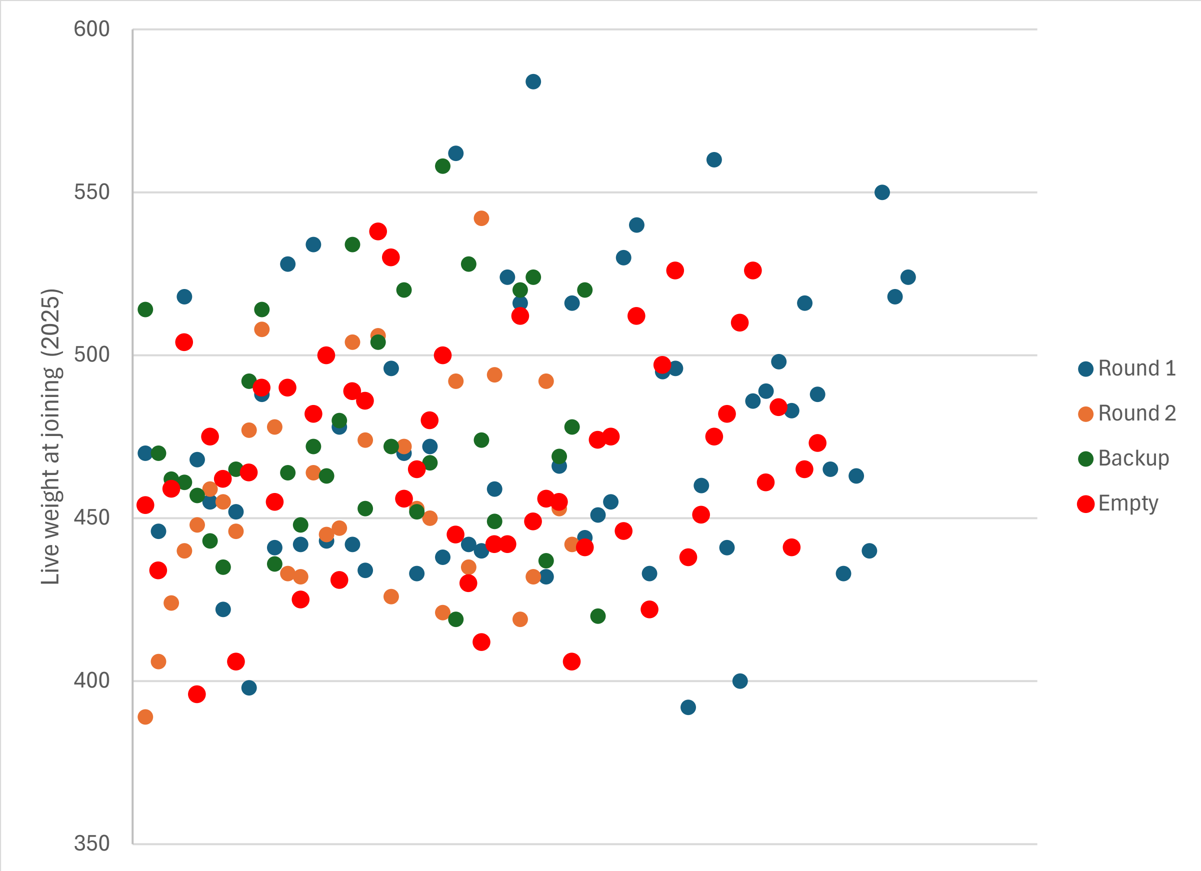

Figure 8. Joining live weight vs conception success for heifers joined in 2024 at Property B.

5.4 Benefit costs analyses of female sexed semen and FTAI

One of the key outputs of this project was to complete a cost benefit analysis for the use of female sexed semen and FTAI. Notably the costs of each AI program varied due to the practitioner, the protocols and the semen used. Table 5 was constructed based on indicative prices for each of the components of the program and then the indicative cost of a female calf on the ground. In this example, the key assumptions that were used include:

- Average costs per straw of semen $60
- Conception rate for AI 45% of heifers joined
- Total conception rate 80% after backups/natural mating
- Backup and natural mated bulls purchase at $12,500 and used for three years
- Naturally mated heifers joined at 1 bull to 30 females
- FTAI reduces bull requirement by 50% for back up mating

The cost of a female AI calf on the ground was $268.89 AUD compared to the cost of a natural mated calf at $173.61. The weighted average of an AI/backup calf is $227.20 compared to the natural mate of $173.61, equating to a $53.59 cost difference. Noting that there is the potential to reduce this difference if back up bull requirements are reduced below the 50% assumption.

The number of heifer calves' available lifts from 40 to 60 per 100 heifers, resulting in a 50% increase in available heifers to facilitate herd rebuilding.

Table 5. Benefit cost analysis of female sexed semen and FTAI

Costs	
AI	$45.00
Semen	$60.00
Labour	$16.00
Total	$121.00
Conception (% joined)	0.45
Cost per live calf	$268.89
Natural Mate (Bulls at $12,500 for three years, joining rate 30:1)	$173.61
Average cost per AI / Backup	$227.20
Cost per heifer FTAI Sexed/Backup (weighted mean)	$227.20
Cost per heifer Natural	$173.61
Difference	$53.59
Genetic gain required to recoup additional cost of FTAI with female sexed semen	Top 5% vs 50% (Angus Australia TACE Index percentiles 2025)
Numbers of heifers available (FTAI)	60
Numbers of heifers available (Natural)	40

Table 6 highlights the sensitivity of this analysis. Reducing the AI conception rates from 45 to 30% increases the cost of live calves by $32.56 or 14%. More importantly it drops the number of available heifers from 60 to 53, which is still above the 40 that would occur if naturally mated. Increasing conception rates to 60% (fresh female sexed semen) reduces costs by $32.55 a calf or 14% and adds an additional seven female calves, taking the number to 67, which is significant if rapid recovery from drought is required.

Recommendation 4. That consideration is given to establishing a demonstration trial to compare the conception rates between fresh and frozen sexed female semen in beef FTAI programs as a mechanism to further improve herd recovery.

The other factor is semen costs. Most AI companies in 2025 are listing semen from between $60-125 for female sexed semen. A figure of $80 is now relatively common and that value would increase the cost of a live calf by $25 or 11%.

Table 6. Sensity analysis of conception rates and semen costs relative to calf costs.

Key change	Cost of AI/Backup	Absolute and % change
AI Conception rates drop to 30%	$259.76	$32.56; 14%
Semen costs increased to $80	$252.20	$25: 11%

AI conception rates lift to 60% (fresh semen)	$194.65	-$32.55; -14%

For comparative purposes, if a female sexed semen AI calf cost $53.59 more to produce, then using AI sires in the top 5%, relative to breed average, would recoup the additional cost through increased production, based on the current differentials for the Angus $ index (July 2025)[9]. If that cost was reduced to a difference of $21.04 by using fresh female sexed semen, the sire differential would only have to be top 25% relative to breed average to recoup the additional costs associated with FTAI and female sexed semen.

Recommendation 5. Commercial breeders should consider the benefits of increasing heifer numbers and selection intensity against increased calf costs associated with FTAI and female sexed semen. If recovery from drought is a key driver of that decision, then female sexed semen is a viable option.

5.5 Genomic Selection and HeiferSELECT

Genomic testing and the resultant production of genomic breeding values offers significant selection benefits for commercial producers, particularly for those traits that are difficult to measure in a commercial environment. Traits such as fertility, eating quality and immunocompetence. In this project HeiferSELECT provides the opportunity to identify the most appropriate heifers to breed from, particularly after drought, therefore allowing herd performance to be optimised. It also potentially provides a tool for screening of purchased heifers/cows to ensure that they are complementary with the herd.

As stated previously, two of the herds had previous experience with genomic selection and using HeiferSELECT over several years (C and D). The other herds (A and B) had no previous experience with genomic selection but had significant experience with purchasing bulls using breeding values.

All four herds completed HeiferSELECT on at least 200 2022 drop heifers. The genotyping results at the time showed that the variation in genetic potential within the herds (despite being high performing herds with a strong focus on bull selection) was still significant. All herds had heifers that ranged in genetic value from the bottom 20% of the population to the top 10% of the population. All four herds used those results to assist with selection of heifers for the FTAI program.

A significant update to HeiferSELECT was completed by Angus Australia in July 2025[10]. This is the first update in 5 years. This update incorporated additional genotypes and phenotypes to the models used to calculate the genomic breeding values. At the same time the selection index was updated to include a significant weighting for the heifer conception (HC) trait.

Whilst the update reportedly increased the accuracy of predictions, it did lead to significant reranking between the HeiferSELECT results obtained in 2023 and 2024 and the new results in 2025. All herds observed significant reranking in animals, with animals at the extreme moving up to 60 points. Unfortunately, this has led to a major reduction in confidence in the use of this product, with further

[9] https://angus.tech/enquiry/animal/ebv-percs
[10] https://www.angusaustralia.com.au/education/breeding-and-genetics/angus-heiferselect

analysis and insights required to restore confidence in what is potentially a very useful and valuable product.

The results presented from this point on are now from the July 2025 analysis. They reflect the current status of the product. Conversations with Angus Australia indicate that further changes are expected in the foreseeable future.

5.5.1 Variation within herds

Given that all four Angus herds are long established and well managed with a strong focus on genetic improvement, the wide variation in performance for all traits and the index in HeiferSELECT was not expected. In all herds, the range in performance generally exceeded 80 units. Furthermore, given the focus on selection for calving ease that all four herds have had, the number of heifers that had calving ease breeding values less than the 50th percentile was surprising. In herds B, C and D which have had a significant focus on marbling, the proportion of heifers that had scores of less than 50 units (the average genetic merit of all heifers tested in HeiferSELECT) was also surprising.

For the two herds that had not conducted HeiferSELECT prior to this project, the variation in performance has prompted some changes in genetic management, with a greater focus on AI and more focus on the selection of replacement bulls. In the other two herds, results have led to a change in bull source. An additional outcome is that HeiferSELECT is being used to select heifers for AI and for replacement in all four herds in 2025, despite the concerns over the reranking of animals

Table 7. Mean, maximum and minimum for key traits of calving ease (CE), yearling weight (YW), marbling (MB) and the total breeding value index (TBV) in four herds

Herd	Year	CE Av	CE Max	CE Min	YW Mean	YW Max	YW min	MB Av	MB Max	MB Min	TBV Av	TBV Max	TBV Min
A	2022	47	89	5	53	98	10	57	92	16	54	85	13
	2024	49	91	4	55	95	12	55	90	16	56	90	4
B	2022	47	94	10	51	90	5	52	87	8	50	92	3
	2024	50	82	10	66	93	24	64	92	15	67	94	20
C	2022	51	95	5	51	95	7	54	95	6	50	94	3
	2024	51	93	7	52	95	6	56	97	8	52	94	7
D	2022	52	94	8	47	95	13	52	91	14	45	94	13
	2024	50	94	7	53	91	13	56	96	10	49	93	12

5.5.2 Performance of female sexed semen AI bulls relative to herd average for 2024 drop

In three of the four herds, HeiferSELECT has been completed on all retained heifers from the 2024 V drop. This allows direct comparison between the female sexed semen sires and the remainder of the herd. In the fourth herd, samples have been submitted but the results are not yet available for some of the backup calves and other female calves born in 2024. Given that the female sexed semen bulls were selected for calving ease, growth and marbling, it is appropriate to compare these three traits. Those comparisons are shown in Table 7.

Table 8. Mean performance of AI bred (female sexed semen (SS)) heifers compared to mean of herd for key performance traits of calving ease (CE), yearling weight (YW), marbling (MB) and total breeding value (TBV).

Herd	CE SS	CE Herd	YW SS	YW Herd	Marb SS	Marb Herd	TBV SS	TBV Herd

A	52	48	56	56	59	54	60	55
C	53	51	53	52	51	55	60	52
D	53	51	64	62	66	55	56	48

Figure 9. HeiferSELECT Genetic effects table (Source Angus Australia July 2025)

Angus HeiferSELECT Genetic Effects Table															
CE (kg)	WW (kg)	YW (kg)	MW (kg)	Milk (kg)	HC (weeks)	ADG (kg/day)	DFI (kg/day)	CW (kg)	EMA (cm2)	RIB (mm)	MBL (score)	OSS (score)	CCV ($)	FCV ($)	TBV ($)
-0.67	3.12	3.73	6.47	1.22	0.54	0.02	0.19	5.22	1.31	0.56	15.24	1.69	30.54	34.07	37.79

In all three herds, performance of female sexed semen sired heifers relative to herd performance was higher for all key traits and the index (except marbling in C). This suggests that not only did each herd achieve the goal of producing more heifers, but they were also genetically better than the herd average and therefore have a higher potential to be retained in the herd. Based on the genetic effects table for HeiferSELECT a difference of 5 units in TBV equates to a difference of $18.90 per year or $151.16 over an 8-year expected breeding lifetime. This project estimates that a female sexed semen FTAI calf cost an additional $53.59, therefore achieving a 2.8:1 return on investment

Recommendation 6. Breeders that are selecting bulls for use in FTAI with female sexed semen, should be aware of their own herds performance to ensure that genetics are complementary and that there is a positive return on that investment

5.5.3 Correlation between HeiferSELECT and TACE breeding values of female sexed semen sires

One of the key questions that all four breeders asked, is whether the selection of sires based on the Trans-Tasman Angus Cattle Evaluation (TACE) that Angus Australia manages translates into differences in HeiferSELECT breeding values given the two are related, but separate analyses. Most of the female sexed semen sires were used across multiple herds and heifers were generally randomly allocated to each sire at AI, which allowed the comparison of sire means (2024 drop heifers analysed) against TACE percentiles of each sire.

To complete the valid comparison, sire percentiles were extracted from the TACE analysis on the 25/7/25 and then transformed to the expected HeiferSELECT value using the following formula:

$$Expected\ HeiferSELECT\ EBV = ((100 - TACE\ percentile) * 0.5) + 25$$

This assumes that 50% of the breeding value is derived from the sire and that 25 is the average merit contribution (0.5 x 50) of females that each sire was joined to in 2022. Table 6 shows that an estimate of 50 is close to(?) the means of 2022 drop for all four herds. Table 10 shows the percentile band and then calculated expected heifer breeding value.

Table 10. TACE percentile bands and expected HeiferSELECT breeding values for female sexed semen sires used in project

ID	CE DIR_perc	400_perc	Cwt_perc	EMA_perc	Rib_perc	IMF_perc	$A_perc
CGK21S021	26	41	70	31	11	19	17
CSWQ011	13	29	29	66	17	4	14
SMPQ194	10	41	41	26	30	18	15
USA18860371	3	12	14	28	45	56	9

USA19416968	15	13	18	35	64	41	22
VTMR795	75	61	94	53	34	3	73

ID	Expected CE	Expected 400	Expected CWT	Expected EMA	Expected RF	Expected IMF	Expected Index
CGK21S021	62	55	40	60	70	66	67
CSWQ011	69	61	61	42	67	73	68
SMPQ194	70	55	55	62	60	66	68
USA18860371	74	69	68	61	53	47	71
USA19416968	68	69	66	58	43	55	64
VTMR795	38	45	28	49	58	74	39

ID	CE	400	CWT	EMA	RF	IMF	Index
Expected CGK21S021	62	55	40	60	70	66	67
Actual Herd A	50	45	42	40	66	47	54
Actual Herd C	58	48	45	37	61	51	57
CSWQ011	69	61	61	42	67	73	68
Herd C	51	56	58	54	61	53	66
SMPQ194	70	55	55	62	60	66	68
Herd C	46	58	37	56	31	50	60
USA18860371	74	69	68	61	53	47	71
Herd A	56	68	54	70	40	61	64
Herd B	60	70	57	63	35	57	67
Herd D	52	74	59	77	41	55	60
USA19416968	68	69	66	58	43	55	64
Herd A	50	59	71	63	40	71	65
Herd B	41	63	53	54	35	77	65
VTMR795	38	45	28	49	58	74	39
Herd D	27	61	50	40	53	69	54

The expectation is that heifer means for all traits based on HeiferSELECT should reflect the percentile ranking based on the TACE analysis for their sires. In addition, whilst the two main indices are very different in structure, they contain similar traits and potential economic weights which should result in a positive correlation. In the majority of examples, the heifer means were within 5 points of the sire percentile which suggests that selection of bulls using TACE will be reflected in daughter genomic values. However, there are notable exceptions, CGK21S021 and SMPQ194 daughters generally recorded lower genomic values relative to expectations for most traits and the index. Where ratings exceed 5 points is where challenges occur in matching sires to herd characteristics. For example, USA18860371 is a bull that was selected for calving ease and growth rate, but with the knowledge that carcase traits would be moderate. His female progeny had lower calving ease, less carcase weight, significantly less rib fat, yet higher muscling and IMF.

It is common across all livestock genetic evaluations that some animal's performance will deviate from expectation, although given these are widely used, highly accurate AI sires within the breed, unexplained deviations do lead to a loss of confidence in the product and the information it provides.

Recommendation 7: That further analysis be conducted with Angus Australia, Zoetis and interested breeders to determine the source of differences in sire progeny performance.

5.5.4 Correlations between HeiferSELECT historical and 2025 analysis

As indicated earlier, one of the most challenging elements occurred at the end of the project. Angus Australia with CSIRO released a full update of HeiferSELECT in June 2025. This update included the addition of several thousand animals with genomic and phenotypic information to the analysis which should have significantly "improved" the accuracy of the genomic information as well as increased the correlations between HeiferSELECT and TACE. In addition, the trait Heifer Conception (HC) was updated and added to the main index with a high weighting. Such changes should be seen as positive for both breeders and industry.

Notably, this is the first change in HeiferSELECT for several years and reranking is unavoidable given the changes that were made. But breeders had used HeiferSELECT to make selection and culling decisions and were then confronted with information suggesting that some of those decisions may not have been useful. An example of the challenges faced is shown in Table 11. A coefficient of 1 indicates that the traits are 100% correlated, value greater than 0.75 are generally seen as high correlations with little reranking. Values between 0.3 and 0.75 are moderate correlations and there is an expectation that there will be reranking. In Herd A, all traits except EMA, had correlations ranging from 0.42 to 0.7 which suggests that reranking has occurred. This reranking has led to recent unfavourable perceptions of the product amongst users.

Table 11. Correlations between historic and current (Trait25) HeiferSELECT breeding values for herd A T drop (2022) females (n=170)

Trait	*CE*	*WW*	*YW*	*CWT*	*EMA*	*MBL*	*TBV*	*Rating*
CE25	0.70							
WW25		0.57						
YW25			0.58					
CWT25				0.64				
EMA25					0.86			
MBL25						0.42		
TBV25							0.46	
Rating25								0.46

Herd A in this project had selected out the top 100 animals for AI in 2023 and then selected several of those animals for AI again in 2024 based on HeiferSELECT. Figure 10 shows the scatterplot of ratings pre and post the analysis changes sorted on the initial ranking. Animals that kept the same ranking appear on the same line as the initial rating (4.5 down to 1). Where the orange dots do not overlap the blue dots, they indicate animals that have deviated from the initial rating. At the extremes, animals that were rated 4.5 have fallen to 2.5 and from 4 to 1.5, whereas animals rated at 1 have risen to 4. From the 100 originally selected heifers, 28 are no longer in the top 100 (28%) and from the bottom 40 that were culled, 15 (37.5%) should have been retained based on their genomic performance. This reranking has led to a significant loss of both genetic and commercial potential for that herd in the short term. Unfortunately, the three other herds had similar outcomes.

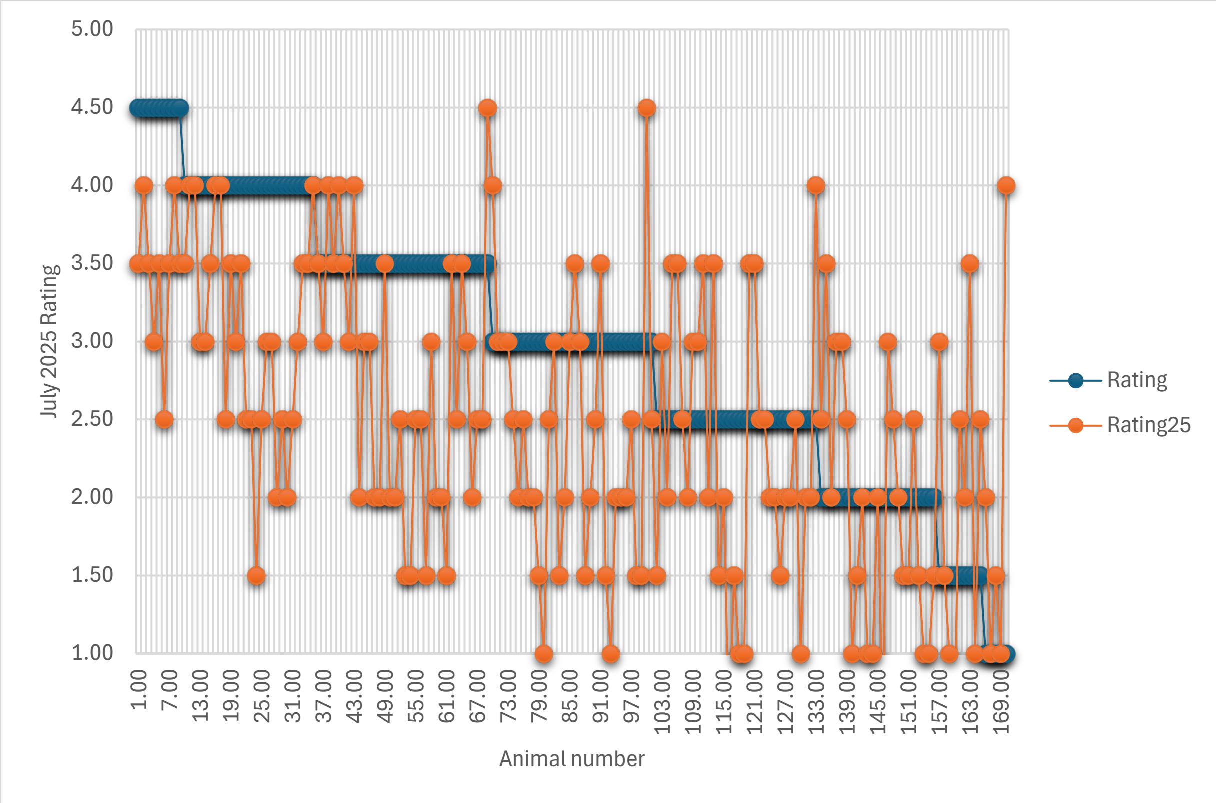

Figure 9. Ratings (1-5) from July 2025 HeiferSELECT test relative to historic HeiferSELECT rating for Herd A in 2022 drop (n=170).

5.5.5 Correlation between HeiferSELECT key traits and observed performance

There are a couple of commercial traits that have been measured by the breeders in this project that can be used to compare against the genomic predictions from HeiferSELECT. Herd A, B and D were able to provide heifer conception for the 2022 drop for AI rounds 1 and 2, backup (3) and empty (4). Herd B results are shown in Figure 10. Unfortunately, there appears to be limited correlation between the Heifer Conception trait prediction and actual pregnancy status in the herd. Herds A and D had similar results. Further work is required to validate this trait in commercial herds.

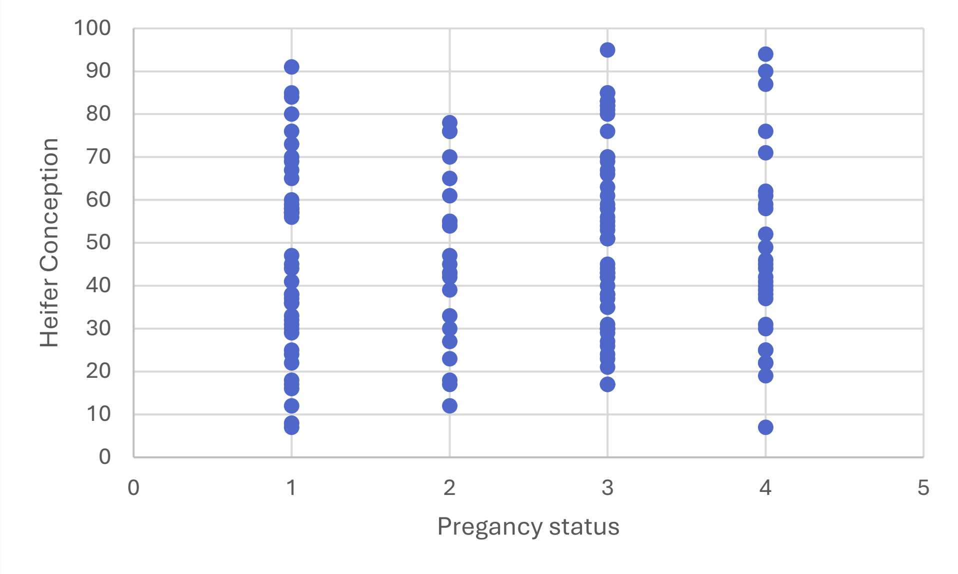

Figure 10. Relationship between July 2025 Heifer Conception (HC) trait value and pregnancy status achieved in 2022 drop.

Herd A weighed all AI and backup heifers at weaning. Those weights were compared against the HeiferSELECT results (July 2025) for weaning weight (WW25) (Fig 11). Based on this sample, there was no correlation between the genomic prediction for WW25 and actual weight. All animals had been run in the same contemporary group and were born within a 6-week window, with the majority being AI (5 days). Whilst cofounding effects such as milk potential and age might have an impact, further analysis of 400-day weights and other traits for these herds is required.

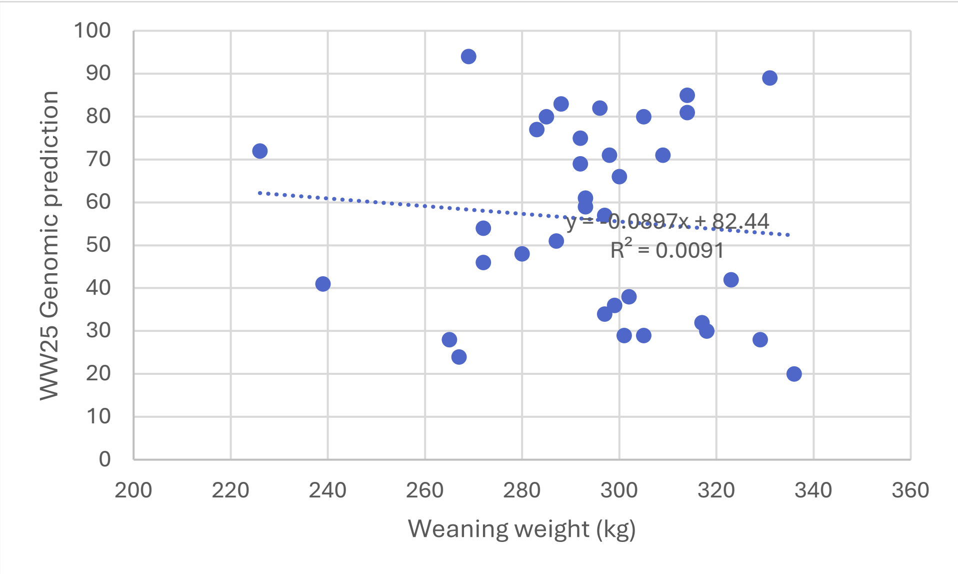

Figure 10. Weaning weight genomic prediction (WW25) vs actual weaning weight (kg) for herd A.

Recommendation 8. That further validation of key traits is completed by the four herds to determine the actual herd impacts from genomic predictions using HeiferSELECT.

6 Project communications, industry reach and broader outcomes

One of the highlights of this project has been the commercial interest, communication and extension reach to a wide range of industry stakeholders. This has been primarily achieved through the excellent guidance and support that has been provided by Lu Hogan and Lisa Yorkton from the Armidale Node of the SQNNSW Innovation Hub. They were able to generate press releases, information packs, webinars and invitations to field days that led to numerous opportunities to promote the project. Naomi Hobbs and Sally Balmain from LLS were also instrumental in the promotion of the project at field days and within the LLS network. Tom Ledingham (and his entire family) was also very generous in providing an opportunity to conduct a field day in March 2025 that attracted over 40 producers. The results of this project were also disseminated by ST Genetics and Apex Breeding, which was very helpful to broaden the reach.

It is estimated that over 600 producers from NSW, Victoria, Queensland, Tasmania and South Australia have had access to results from this project. An example of the excellent resource materials that have been produced is at:

https://www.unisq.edu.au/-/media/usq/research/sqnnsw-hub/events/rhr_2024_factsheet-(1).ashx?rev=5fb57c7e4a084745b1c749fe229e7819&hash=92CE7FA1C57BBB28D31BD22B06F622B4

7 Project in-kind contributions

A key outcome for this project was the significant in-kind contribution that was generated. Semen companies, AI practitioners, Zoetis, Angus Australia, the four cooperators and Rural Analytics all provided in-kind to the project. That in-kind is reported in Table 12.

Table 7: In-kind contributions from project collaborators

In Kind project costs	Provider		Value
Bull Selection advice	ST Genetics and Agri-Gene		$ 5,000
Reduction in semen costs	ST Genetics and Agri-Gene	340 straws @ $25	$ 8,500
Semen Shipping costs	ST genetics and Agri-Gene		$ 1,000
Reduction in semen costs	Te Mania Angus	65 straws @ $15	$ 810
Reduction in AI costs	Bovine Breeders	311 AI @ $10	$ 3,110
Reduction in AI costs	Apex Breeding	100 AI @ $10	$ 1,000
Labour at AI	Four co-operating herds	413 AI * $16	$ 6,608
Labour for Genotyping heifers	Four co-operating herds	800 heifers	$ 12,800
Labour for genotyping progeny	Four co-operating herds	600 calves	$ 9,600
TSUs	Zoetis	TSUs @ $3 per TSU	$ 4,800
Genetic analysis time	Zoetis		$ 5,000

Rural Analytics in kind	Rural Analytics	Additional consultancy time, project administration and communication events	$ 20,000
Angus Australia membership and access costs	Angus Australia		$ 2,500
Total			$ 80,728.00

8 Future project concepts

Whilst this project has been able to achieve all of the objectives that were initially set, it has generated a whole spectrum of new questions. In addition, there is the emergence of new technologies that will be game changing for potential herd recovery. Some of those initiatives include:

8.1 Percentage of dry heifers

In southern beef herds in Australia, it is assumed that heifer conception rates are high and that there is little need for further improvement. This project provides results which suggests this may not be the case, particularly in herds that are using FTAI. Culling up to 20% of heifers based on failing to fall pregnant is a costly both in terms of selection potential and commercial returns. Furthermore, the impact of investing heavily in either high price bulls or semen is less if resulting daughters fail to conceive.

Given there was a unilaterally common empty rate of approximately 20% across all four herds and across the two seasons, further research and development (R&D) should be considered to determine what additional factors (outside of genetic parameters and body weight) may be driving these results. One suggested explanation is the effect of protein and oestrogenic effects associated with high clover content pastures, although that factor would have had limited impact in the 2023 joining as the spring was dry with little clover content. With another round of AI due in September-November 2025 for these herds, additional elements such as ovarian function and cycling behaviour should be considered to help understand the empty rates.

As a result of these observations, one the project supporters (Apex Breeding) have partnered with NSW DPIRD to submit a PDS proposal to MLA to investigate the potential causes of infertility through use of ultrasound scanning of ovaries prior to AI.

8.2 Continual refinement of genomic products

Improving genetic and genomic evaluation systems through combinations of better models, more data, enhanced genomic SNP chips and enhanced computer capacity (including the ability of artificial intelligence to enhance genetic evaluations) is a key catalyst to ensuring that livestock production systems remain competitive. It is expected that genomic selection tools will continue to evolve and with that will come better selection decisions for producers. However as with any innovation, when changes occur, they need to be verified and also communicated effectively to ensure that confidence in the product remains.

This project has identified that genomic selection tools are valuable and useful in assisting with herd recovery and in particular, increasing herd potential. It has also identified that producers need to be fully informed of changes in predictions and that those changes have been fully validated and are better predictors than previous estimates. All four herds in this project, together with other herds that have started to use genomic tools should be seen as a resource for data acquisition to improve models and to be used for validation of future changes.

8.3 Access to world leading FTAI and female sexed semen protocols

Despite best attempts, there was still significant variation in the protocols that were used in the project, both within herds and across years. In Australia, the National Herd Improvement Association of Australia (NHIA) publishes recommended protocols for use in heifers and cows, and for sexed and conventional semen. In addition, most semen companies publish protocols that are consistent with the NHIA or the USA Beef reproduction taskforce recommendations[11]. Those protocols are continuing to evolve as new R&D emerges, particularly with respect to female sexed semen (both fresh and frozen). Commercial breeders that are using or considering the use of female sexed semen should discuss the relative merits of current recommendations and work with AI practitioners to ensure that those protocols deliver the best results.

8.4 Fresh female sexed semen

At the March 2025 Field Day, ST Genetics and Genetics Australia provided updates on female sexed semen technologies. A lot of interest was generated in the emergence of fresh female sexed semen options, where improvements in collection techniques and semen dilutants allows semen to be stored fresh for up to five days. These enhancements make it realistic to collect selected bulls, process the semen to sexed and then ship via overnight transport to commercial breeders to use in FTAI programs. There are already several commercial dairy companies that have used fresh female sexed semen with published and non-published data suggesting that conception rates for fresh female sexed semen could achieve 70%[12].

At 70% conception rates the difference between AI breed and natural calves become negligible, being $172.86 for AI and $173.61 for natural mated. This is a game changer for FTAI as essentially any genetic gain created through selection intensity of using AI bulls is all profit for the breeder. In 2025 it is anticipated that at least one breeder, that participated in this project, will attempt to use fresh female sexed semen. Documenting the experiences and results of using fresh female sexed semen will be invaluable for industry.

8.5 Male sexed semen

The focus of this project has been on herd recovery and the generation of more female offspring. However, with the price differential that exists between heifer calves and steer calves, cash flow can be accelerated if more male (steer calves) can be generated. As fresh sexed male semen is now a reality, this should enable commercial breeders to extract more value from the herd (particularly older

[11] https://beefrepro.org/
[12] FAQ | North East Genetics - Artificial Insemination Service

and genetically inferior cows), by simply producing male claves. Estimates from the dairy industry suggest that a 60:40 split between male and female sexed semen is a viable option for long term herd performance and profitability. As before, it is anticipated that one herd will trial the use of male sexed semen in older cows in 2025. The trial should be evaluated in 2026.

8.6 Application in Northern environments

A fair criticism of the current project is that it has been conducted in well managed southern Angus herds. The application of female sexed semen in Northern environments may require greater management and planning but should still be considered as a viable option for herd recovery after natural disasters (including floods). The establishment of a laboratory in Rockhampton that has the capacity to process female sexed semen provides the opportunity for Northern commercial clients to explore the use of and benefits that may arise through using female sexed semen.

9 Conclusions

Decisions around heifer joining are critical for short-term recovery and long-term resilience. Effective selection and joining of heifers can minimize risks associated with low conception rates and dystocia. The project examined the potential impact of combining Fixed Time Artificial Insemination (FTAI), female sexed semen, and genomic selection to accelerate breeding herd capacity.

FTAI and female sexed semen was successfully used to introduce new genetics and stimulate greater ratios of female calves. Despite additional costs, the benefit cost per head when compared against the genetic merit of the heifers produced, suggest that it is a viable option. While female sexed semen offers benefits, its use in beef heifers is limited when reduced conception rates occur.

Genomic tools like HeiferSELECT were shown to be useful in predicting the genetic merit of heifers prior to joining, allowing effective mating to the most appropriate bulls. The potential economic impact of genomic selection is significant, with differences in profitability between the highest and lowest performing heifers. However, when technologies are updated, and animals re-rank there is an inevitable loss of confidence in the product unless communications are robust and thorough.

The project provided important knowledge for producers attempting to rebuild herd capacity, effective breeding cow numbers, and cash flow after drought. The key bottom line is that commercial producers must way up the benefits of increased heifer numbers and selection intensity against increased calf costs associated with FTAI and female sexed semen.