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Development of a New/Revised Commercialisation Strategy and Delivery Plan for BREEDPLAN

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Abstract

The value chain that delivers BREEDPLAN products and services to Australian beef cattle seed-stock and commercial producers has been operating for over three decades. This value chain has achieved reasonably high levels of market penetration, particularly in some of the major breeds. However, in recent years, key stakeholders in BREEDPLAN have raised concerns that penetration of BREEDPLAN across the industry is plateauing or even declining in some key breeds, is not being used with adequate rigour by many users, is becoming increasingly expensive, service quality is decreasing and new product innovation is too slow. The net result of this being that a less than optimal rate of genetic gain is being achieved across the Australian beef cattle production sector.

While these concerns are by no means held universally, they are considered to be of adequate importance for the owners of the core BREEDPLAN intellectual property to instigate a review of the framework though which that intellectual property has been commercialised and the value chain that delivers BREEDPLAN to market. This review has considered previous reviews and market research pertaining to BREEDPLAN and the markets it serves, market penetration data and data pertaining to BREEDPLAN usage at an individual breed sector level, various perceptions toward aspects of BREEDPLAN that are held by different stakeholders, the alignment of participants in the BREEDPLAN value chain, and has modelled the economics of the BREEDPLAN value chain.

This review recommends the adoption of a more strategic approach to managing the existing BREEDPLAN value chain based on a series of collaborative initiatives designed to re-invigorate the BREEDPLAN value chain, ensuring that optimal rates of market penetration of BREEDPLAN are achieved and that it is used by the industry such that the rate of genetic gain across commercially important traits is maximised.

Executive summary

Background

The beef cattle industry is a very important component of the wider Australian agricultural industry. Approximately 60 percent of all Australian farming enterprises run some cattle and in 2015-16 the gross value of Australian cattle and calf production was $14.3 billion, accounting for approximately 50 percent of the total value of Australian livestock industries. The Australian cattle herd can be broadly segmented according to a northern (or tropical) sector that is based primarily on a range of tropical breeds and composites, and a southern sector which is based primarily on British and European breeds, with the national herd split approximately equally across these sectors.

The shift in consumer diets in emerging economies toward animal produce is expected to drive growth in demand for Australian beef from regional emerging economies, particularly the People's Republic of China (PRC) for the foreseeable future. The Australian beef industry's ability to remain competitive in these markets is entirely a function of continued productivity improvement in the form of decreased operating costs and improved product quality attributes that are valued by customers.

The average cost of production in the Australian beef industry is lower than that of European and Asian producers, comparable to CIS and African producers, but significantly higher than North, Central and South American producers. The Australian beef industry's major cost disadvantage is labour, which accounts for approximately twice the portion of total beef production costs as the global average. Labour costs are unlikely to substantially decline in Australia. Therefore, productivity gains must be achieved through other means such that the beef industry's multifactor productivity outweighs, or at least mitigates, any productivity penalty associated with Australia's high labour costs. To this end, industry has made a number of investments, primarily through MLA, in initiatives designed to improve productivity, product quality and supply chain effectiveness, as well as to promote Australian beef in key global markets.

Among these initiatives is BREEDPLAN, a beef cattle genetics database, quantitative genetics model and on-farm decision support tool that has and continues to make a significant contribution to informing and de-risking breeding decisions made by seed-stock and commercial producers in the Australian beef cattle industry

Purpose of this review

BREEDPLAN has been available to the Australian beef cattle industry for over three decades. It is widely used and has made a significant contribution to genetic improvement across the Australian beef cattle industry. However, in recent times stakeholders have raised concerns with respect escalating costs, declining quality of service and slow and selective innovation projects, collectively contributing to slowing rates of adoption and less rigorous use of BREEDPLAN by current users of the service. Combined with a view that there is a growing unregistered sector that under the current value chain that delivers BREEDPLAN to market faces challenges with respect to accessing BREEDPLAN, has led to concern among the owners of the BREEDPLAN core analytical software, that BREEDPLAN is not delivering an optimal rate of growth in genetic gain across the Australian beef cattle industry.

The purpose of this project is to prepare a revised or new commercialisation plan for BREEDPLAN that ensures that it is a sustainable enterprise, continues to facilitate an optimal rate of genetic gain by

adequately meeting the service expectations of the industry it serves and is compliant with Meat and Livestock Australia's (MLA) statutory and contractual responsibilities with respect to the use of Commonwealth Government and levy-payer funds.

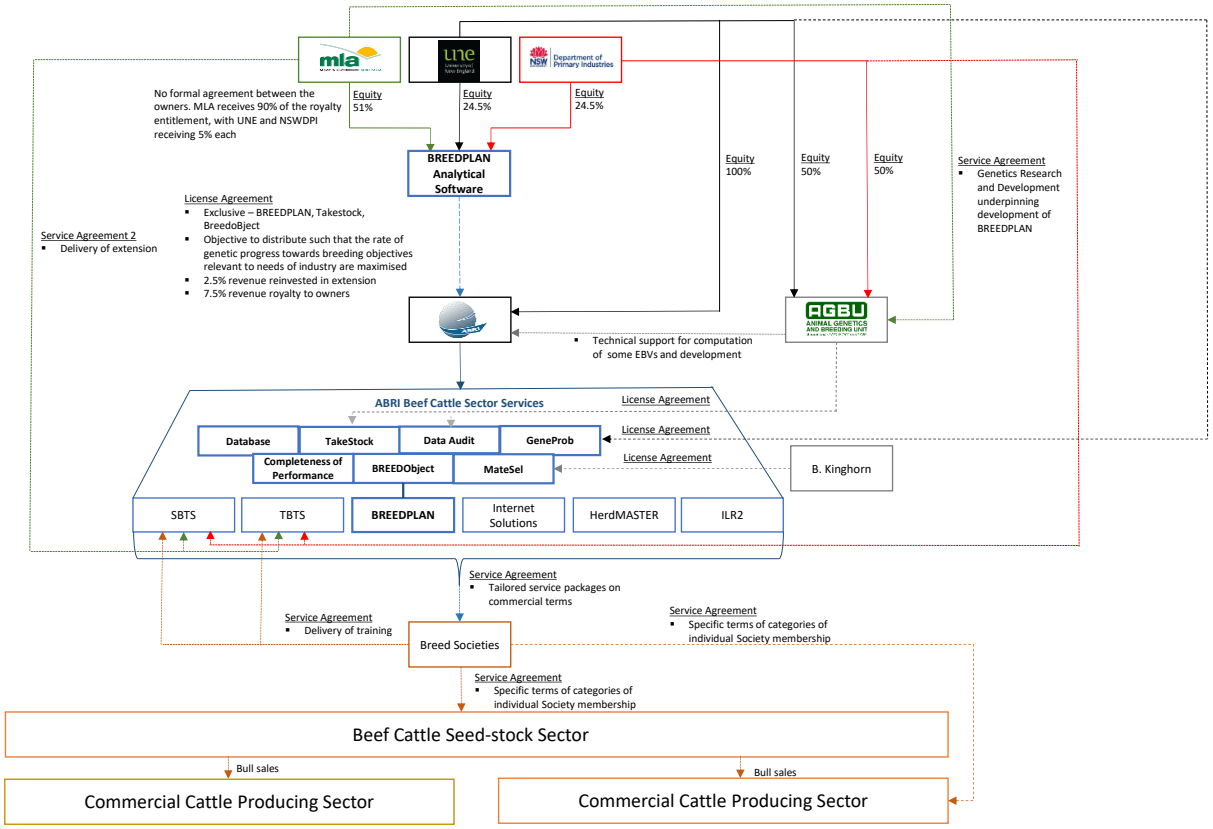
BREEDPLAN and the BREEDPLAN value chain

BREEDPLAN uses a statistical model known as Best Linear Unbiased Prediction (BLUP) to generate a statistical estimate of genetic value of individual animals in the form of Estimated Breeding Values (EBVs) or production goal oriented indices that represent a collection of EBVs.

Primarily, BREEDPLAN allows producers to compare animals within their own herd or across animals from other herds that are registered with the breed association to which they are a member. There is also some limited data on which unregistered animals can be assessed. Also EBVs are only available if sufficient data is available for each particular breed and even where adequate data exists, the accuracy of the EBV will be affected by the volume and range of information that is available to calculate the EBV. As a statistical measure, EBVs have variable confidence intervals and as such an accuracy measure is provided with each EBV, which is a function of the amount of data on which an EBV has been determined. The net effect of this is that BREEDPLAN evaluations pertaining to breeds, that by virtue of having a larger number of animals submitting data to BREEDPLAN (typically the larger breeds that are more extensive users of BREEDPLAN), tend to produce more stable EBVs. While differences in datasets are to some extent handled by accuracy thresholds for publication of EBVs, different breeds do not automatically get the same set of trait EBVs.

The core BREEDPLAN analytical software is owned by Meat and Livestock Australia (MLA) (51 percent), University of New England (UNE) (24.5 percent) and New South Wales Department of Primary Industry (NSWDPI) (24.5 percent). The world-wide exclusive rights to commercialise this software have been granted to the Agricultural Business Research Institute (ABRI), a company limited by guarantee and 100 percent owned by UNE. One of the prescribed objectives of the licensing agreement between the owners of BREEDPLAN and ABRI is to commercialise and distribute the BREEDPLAN software for the purpose of maximising the rate of genetic progress toward breeding objectives that are relevant to industry.

ABRI then delivers BREEDPLAN (and a suite of associated and complementary products and support and training services) to the Australian beef cattle seed-stock and commercial producer market primarily through distribution arrangements with individual breed associations. The relationship between the participants in the BREEDPLAN value-chain are defined by a relatively complex set of equity, intellectual property and licensing arrangements. This value chain is illustrated in the following figure.



In this value chain, each breed association and, therefore their members, access BREEDPLAN under terms agreed between ABRI and each individual breed association, resulting in seed-stock and commercial producers across the Australian beef cattle industry having different levels of access and paying different prices for that access.

While the participants in this value chain may seem operationally aligned with respect to delivering BREEDPLAN to the market, the degree to which they are aligned from a strategic priorities/intent and fiduciary obligation perspective is less clear, possibly compromising the objective of optimising genetic gain across the Australian beef cattle industry.

Key trends in the Australian beef cattle seed-stock sector

There is some evidence that the structure of the industry, as far as that structure is relevant to the operations of BREEDPLAN, is evolving along three dimensions. Firstly, there is increasing concentration of the sector into several key breeds. As illustrated in the following table, three breeds account for 60 percent of registered calves, seven breeds for 80 percent of registered calves and 10 breeds for 90 percent of registered calves currently. This implies that considerable improvement in the rate of genetic gain could be achieved by focusing on initiatives designed to improve BREEDPLAN adoption and usage among these limited number of breeds.

60 percent of new registered calves	80 percent of new registered calves	90 percent of new registered calves	95 percent of new registered calves
Angus (33.0%) Brahman (13.4%) Hereford (11.7%)	Angus (33.0%) Brahman (13.4%) Hereford (11.7%) Santa Gertrudis (7.5%) Droughtmaster (6.0%) Wagyu (4.2%) Charolais (4.1%)	Angus (33.0%) Brahman (13.4%) Hereford (11.7%) Santa Gertrudis (7.5%) Droughtmaster (6.0%) Wagyu (4.2%) Charolais (4.1%) Limousin (3.3%) Shorthorn (3.1%) Simmental (2.8%)	Angus (33.0%) Brahman (13.4%) Hereford (11.7%) Santa Gertrudis (7.5%) Droughtmaster (6.0%) Wagyu (4.2%) Charolais (4.1%) Limousin (3.3%) Shorthorn (3.1%) Simmental (2.8%) Brangus (2.3%) Murray Grey (2.2%) Red Angus (1.5%)

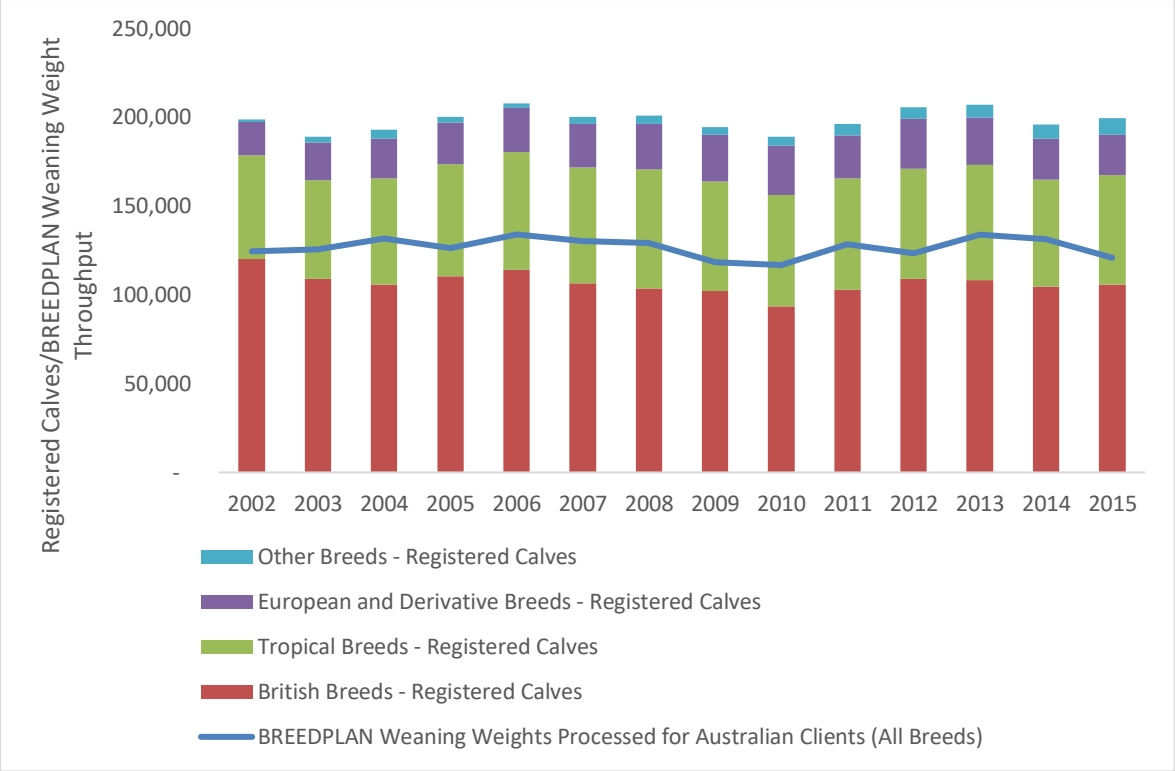
Secondly, while there is an absence of empirical data to support the notion, there is some anecdotal information that suggests that there is a growing unregistered Australian beef cattle seed-stock sector. This implies that if there is a trend toward a larger unregistered sector, the ability of BREEDPLAN to positively impact the rate of genetic gain will be limited by virtue of the fact that under commercial arrangements across the current value chain, accessing an effective BREEDPLAN product (i.e. a BREEDPLAN evaluation beyond a within herd evaluation) for producers who are not members of a breed association is limited by the fact that breed associations have proprietary rights to breed datasets.

Thirdly, there is also some anecdotal evidence that, while the industry is still dominated by pure-bred animals, there is an increasing prevalence of cross-bred and composite animals, particularly in the northern sector. If there is growth in composite and cross-bred animals, the ability of BREEDPLAN to positively impact the rate of genetic gain will be limited because only a few breed associations currently facilitate membership of cross-bred and composite animals.

Market penetration of BREEDPLAN

Using weaning weight[1] records submitted to BREEDPLAN as a proxy for adoption of BREEDPLAN, it is estimated that an average of approximately 65 percent of registered calves submit weaning weight data to BREEDPLAN, and that this level of penetration across the industry has been reasonably consistent for the past 15 years. This is illustrated in the following figure.

[1] Weaning weight measurements refer to any weight measurement of an animal prior to weaning that is recorded with BREEDPLAN (e.g. Birth Weight, 200 day weight, weaning weight etc).



However, this level of adoption has not been consistent across all breeds, with the penetration of BREEDPLAN being much higher in some breed sectors and trends in penetration increasing in some, while decreasing in others. Most notably, penetration in the northern (tropical) sector is generally lower than the southern sector.

Growth in the number of weaning weight measurements recorded with BREEDPLAN is positive in five breeds only that collectively accounted for just under 55 percent of registered calves in 2015. In the other eight breed sectors analysed, that collectively accounted for approximately 41 percent of registered calves in 2015, the longer and shorter term trends have demonstrated declining registrations and/or declining weaning weight records. The market penetration and penetration trends across the breeds analysed for the purpose of this review are summarised in the following table.

Breed	Percentage of Total Registered New Calves (2015)	Percentage of Full and Commercial Members Using BREEDPLAN[2]	BREEDPLAN Weaning Weight Records as Percentage of Registered Calves (2015)	CAGR New Calf Registrations (2002 to 2015)	CAGR New Calf Registrations (2010 to 2015)	CAGR BREEDPLAN Weaning Weight Records (2002 to 2015)	CAGR BREEDPLAN Weaning Weight Records (2010 to 2015)
Growth BREEDPLAN breed sectors							
Angus	33.0%	21.4%	92.5	⇧1.4%	⇧7.7%	⇧1.8%	⇧2.1%
Brahman	13.4%	~10.0%	42.8	⇧1.5%	⇧4.3%	⇧0.2%	⇧7.5%
Wagyu	4.2%	12.2%	43.6	⇧18.5%	⇧13.5%	⇧32.3%	⇧0.4%
Brangus	2.3%	n.a.	36.1	⇧2.9%	⇧3.0%	⇧4.4%	⇧24.2%
Red Angus	1.5%	12.2%	46.3	⇧2.2%	⇧5.1%	⇧4.8%	⇧0.7%
Total	54.4%						
Declining BREEDPLAN breed sectors							
Simmental	2.8%	31.6%	51.9%	⇧2.8%	⇧1.2%	⇧1.8%	⇩5.4%
Hereford	11.7%	30.9%	73.5%	⇩3.8%	⇩3.7%	⇩3.6%	⇩3.8%
Santa Gertrudis	7.5%	6.3%	45.1%	⇧0.2%	⇩2.2%	⇩4.8%	⇧1.3%
Droughtmaster	6.0%	4.7%	20.3%	⇧0.9%	⇩5.8%	⇩1.9%	⇩5.5%
Charolais	4.1%	22.4%	53.1%	⇧2.0%	⇩6.6%	⇧2.7%	⇩0.9%
Limousin	3.3%	n.a.	49.5%	0.0%	⇩2.8%	0.0%	⇩4.1%
Shorthorn	3.1%	17.5%	79.6%	⇩3.2%	⇩2.7%	⇩3.5%	⇩5.5%
Murray Grey	2.2%	n.a.	61.5%	⇩6.0%	⇩6.4%	⇩5.6%	⇩6.5%
Total	40.7%						

Extent to which BREEDPLAN is used rigorously

For BREEDPLAN to make an optimal contribution to enhancing the rate of genetic gain in the Australian beef cattle industry it must not only be used by a maximum number of seed-stock and commercial producers, but must also be used rigorously with respect to performance recording and animal selection.

As an indication of how rigorously performance recording (i.e. the number, timing and accuracy of performance recording) for BREEDPLAN is undertaken across the breed sectors, the review also discusses longer (2002 to 2015) and shorter (2010 to 2015) term trends in scanning records submitted to BREEDPLAN. Over the longer-term, scanning records submitted to BREEDPLAN ranged from an average of 60 percent of the volume of weaning weight records in the case of Angus, to 12 percent in the case of Brahman, suggesting that in most breeds, BREEDPLAN is not being used rigorously by many users.

However, the volume of scanning records submitted to BREEDPLAN has been increasing over the longer term in all of the breeds analysed with the exception of Murray Grey and in most cases, the growth in scanning records submitted to BREEDPLAN has been substantially greater than the growth in weaning weight records submitted. Furthermore, in all breeds with the exception of Wagyu, the volume of scanning records as a portion of weaning weight records is greater in 2015 than it was in 2002. This suggests that while BREEDPLAN does not seem to be used as rigorously, and therefore effectively, as it could be, there is a minor trend toward improvement in this regard which might be the result of increasing confidence in the merits of using BREEDPLAN and appreciation of its value as

[2] Note that in some breed associations only Full Members can register animals with BREEDPLAN and as such, the penetration of BREEDPLAN among the seed-stock sector (Full Members) may be understated in some breeds according to this analysis.

a breeding decision support tool among its users. The following table summarises trends in scanning records.

Breed	Scan Records as a Portion of Weaning Weight Records (2002)	Scan Records as a Portion of Weaning Weight Records (2015)		CAGR BREEDPLAN Scanning Records (2002 to 2015)
Growth BREEDPLAN Breed Sectors				
Angus	53.6%	60.4%		⇧2.7%
Brahman	5.6%	24.4%		⇧12.3%
Wagyu	27.1%	19.1%		⇧28.7%
Brangus	1.7%	78.4%		⇧39.9%
Red Angus	22.2%	39.4%		⇧9.6%
Declining BREEDPLAN Breed Sectors				
Simmental	20.6%	32.6%		⇧5.5%
Hereford	31.0%	58.2%		⇧1.2%
Santa Gertrudis	23.3%	53.6%		⇧1.4%
Droughtmaster	0.8%	29.2%		⇧29.1%
Charolais	13.7%	40.0%		⇧11.4%
Limousin	5.4%	28.3%		⇧13.5%
Shorthorn	29.8%	51.5%		⇧0.6%
Murray Grey	33.1%	41.9%		⇩3.9%

BREEDPLAN value chain surplus

The ability of entities to continue to participate in a value chain does not only requires an adequate degree of alignment in operations, strategic priorities/intent and fiduciary obligation. Participation in that value chain must also deliver on a financial return model that is acceptable to each of those participants, which depending on the nature of the participant and their rationale for participating in the value chain, can range from financial loss minimisation, to cost recovery, to a minimum rate of financial return.

The economic modelling undertaken for this analysis has a number of limitations that are the result of not having access to the full business models for participants in the BREEDPLAN value chain. Nevertheless, the modelling is indicative and provides some useful insights.

Seed-stock and commercial producers

Because it is difficult to determine the extent to which any premium or increased production is a result of using BREEDPLAN, challenging to determine the costs associated with taking and recording performance measurements, and there is a lack of transparency with respect to which BREEDPLAN costs are direct or absorbed in breed association membership (and costs vary across seed-stock and commercial producers depending on the terms agreed between ABRI and their specific breed association), it is very difficult for seed-stock and commercial producers to determine, with accuracy, any surplus that is attributable to using BREEDPLAN.

Breed associations

Independent modelling undertaken by this review based on incomplete data provided under conditions of confidentiality validates that the average BREEDPLAN price per weaning weight submitted across the industry in 2015 of $9.23 as reported by ABRI is reasonable and most likely accurate. The modelling also indicates that the average price per registered calf for ABRI database usage is in the order to $2.00.

The modelling also indicates that because different breed associations have different commercial arrangements with ABRI, offer BREEDPLAN to their members on different terms, and face different economies of scale with respect to the delivery of BREEDPLAN, individual breed associations (and therefore their members) face quite different economics with respect to BREEDPLAN and ABRI database access. Furthermore, in most cases the delivery of BREEDPLAN to members absorbs breed association staff time (in some case a 100 percent FTE) which has not been costed in this analysis. Similarly, some breed associations invest in R&D pertaining to BREEDPLAN such as genotyping and BIN which has also not been costed into this analysis.

Agriculture Business Research Institute (ABRI)

Based on an estimate of the cost of delivering BREEDPLAN which has been derived from the estimated full cost of delivering the BREEDPLAN equivalent in the sheep industry, Sheep Genetics, as well as indicative cost provided by ABRI with respect to delivering the ABRI pedigree database service, an estimate of the gross and net margin appropriated by ABRI for delivering these products was determined. The net margin reported by ABRI's BREEDPLAN and database division of 12.8 percent in 2015 and 4.2 percent in 2016, is within the range determined by this modelling.

Animal Genetics and Breeding Unit (AGBU)

This analysis has not been made privy to the cost structure AGBU faces with respect to undertaking research that supports the ongoing development of BREEDPLAN. However, AGBU receives grants from MLA equivalent to approximately $800,000 per annum to undertake research and development that supports the ongoing delivery and development of BREEDPLAN. All AGBU beef genetics research and development must be commercialised via ABRI.

The Owners (MLA, UNE and NSWDPI)

Total royalty income payable to the owners of the core BREEDPLAN analytical software has grown from just under $80,000 per annum in 2003 to approximately $120,000 per annum currently. Up until 2010, the royalty income was divided among the owners pro rata according to their equity. Since 2010, the owners agreed that MLA will receive 90 percent of the royalty entitlement in recognition of its significant ongoing investment in research and development and training and extension, with the balance of the royalty stream shared equally among UNE and NSWDPI.

UNE and NSWDPI incur some cost associated with the ongoing operations of BREEDPLAN by virtue of in-kind support for AGBU. UNE does not provide any substantive financial or in-kind operational support to ABRI. In addition to the research grants provided to AGBU, the MLA donor company also invests approximately $1.0 million per annum to support the operations of TBTS and SBTS.

Key Issues

There is a wide range of issues that are currently affecting the ability of BREEDPLAN to optimally contribute toward maximising the rate of genetic gain in the Australian beef cattle industry.

Nature of Demand for BREEDPLAN

One of the main challenges with respect to driving greater adoption and usage of BREEDPLAN is the relatively complex nature of the demand profile for BREEDPLAN. Theoretically, demand for BREEDPLAN should be driven by a seed-stock and commercial producer felt need to use BREEDPLAN as a basis for making better and more certain breeding decisions that lead to better production outcomes. There is most certainly a component of the BREEDPLAN demand profile that is based on

precisely this notion. However there are other factors that impact the demand profile for BREEDPLAN. These are summarised in the following table.

Demand Issue	Description
Challenge of identifying how BREEDPLAN addresses a felt need	It is almost impossible for a seed-stock producer to assign the portion of any premium received for a bull that might be the result of having used BREEDPLAN. Furthermore, assigning specific costs to the use of BREEDPLAN is challenged by the difficulties in determining the costs associated with taking and recording performance measurements. This means that determining the portion of a margin that is attributable to the use of BREEDPLAN is problematic. Furthermore, these dynamics, combined with the fact that, as a result of facing different costs that are a function of the specific commercial arrangements between ABRI and individual breed associations, differences in the extent to which BREEDPLAN usage costs are subsidised by different breed associations, and that performance measurement costs vary with production environment, it is very difficult for promoters of BREEDPLAN to establish metrics to demonstrate how BREEDPLAN addresses a felt need that is universally relevant.
Demand for BREEDPLAN driven by market conditions for Australian beef	Demand for BREEDPLAN and the extent to which it is used rigorously by many of its customers in the seed-stock and commercial sectors is at least in part a function of prevailing market conditions for Australian beef. Generally speaking, when demand for Australian beef is high, producers tend to be motivated to produce and turn-off as many market ready cattle as is sustainably possible. In such an environment demand for bulls is also generally high, and seed-stock producers tend to get higher prices for bulls irrespective of whether or not an animal has BREEDPLAN records. This can translate to lower demand for BREEDPLAN from the seed-stock sector. Conversely, when demand for Australian beef is soft, and particularly if the industry is passing through a phase where producers are endeavouring to rebuild herds to sustainable levels, producers tend to have a greater focus on their breeding objectives and demonstrate greater discretion with respect to bull purchases. This results in more producers requiring bulls with BREEDPLAN records and as a result, greater demand for BREEDPLAN from the seed-stock sector. The inconsistent use of BREEDPLAN over-time that is associated with this source of demand is counter-productive with respect to the intention of optimising the rate of genetic gain.
Demand for BREEDPLAN that is derived from a nominal customer request	There appears to be significant, sometimes intermittent, demand for BREEDPLAN that is derived from the fact that some commercial producer customers that want the bulls they buy to have BREEDPLAN EBVs on a nominal basis, either simply to identify a trait is present or as an almost quality assurance on the animal. These customers are not necessarily using BREEDPLAN to inform or de-risk breeding decisions.
The demand pull dilemma	It is reasonable to assume that a primary motivation for using BREEDPLAN for most seed-stock producers is that through one or more of the mechanisms discussed in this table they receive premiums for BREEDPLAN bulls because they have BREEDPLAN records, are perceived as better performing bulls by customers or because they can deliver a greater degree of certainty to a breeding or production program. There is a risk that if premiums associated with BREEDPLAN bulls become significant, they will be purchased by a smaller number of commercial producers. However, it is the interest of accelerating the rate of genetic gains to have as many bulls that can deliver higher guarantees of progeny performance with respect to valued traits operating in the seed-stock and production environment.

Product Issues that Impact on Demand for BREEDPLAN

In addition to the complex nature of the demand profile for BREEDPLAN, there are also a number of characteristics that are inherent to the nature of the BREEDPLAN product that present challenges to higher rates of adoption and more rigorous usage.

The following table summarises the key product issues that impact on demand for BREEDPLAN.

Product Issue	**Description**
Quantifying the value of BREEDPLAN at the seed-stock producer level is problematic	Perhaps the single most significant challenge facing accelerated adoption of BREEDPLAN is the challenge that the primary customer, the seed-stock producer, faces with assigning the level of profitability that is directly attributable to the use of BREEDPLAN. This difficulty exists because it is very difficult, if not impossible, to assign the portion of any premium received for a bull that is directly attributable to BREEDPLAN, difficult to measure the costs associated with performance recording and in cases where BREEDPLAN costs are totally or partially absorbed by a breed association, determine the portion of breed association membership fees that are attributable to having access to BREEDPLAN. Furthermore, only animals with EBVs for desirable traits that are higher than the average would be expected to attract a premium.
Rigour in performance measurement is restricted by practicalities and cost	The extent and rigour to which seed-stock producers undertake performance measurements is function of the different breeding philosophies and associated practices that exist across the Australian beef seed-stock sector, as well as the cost and practicality of taking various measurements, which is also variable across enterprises.
Instability of EBVs in smaller breeds	In the smaller breeds, smaller datasets can result in significant changes to an animal's EBVs year on year, undermining its usefulness as both a decision-support and marketing tool.
Validation of assumptions used in calculating EBVs	There is some scepticism over the assumptions used in the calculation of some EBVs, particularly with respect to how accurately they reflect the production environment. This undermines the credibility of BREEDPLAN.
Measurement of the counterfactual	There is some scepticism as to how well the counter-factual is accounted for in estimates of the contribution that BREEDPLAN makes to genetic gain, a criticism that applies to quantitative genetics programs across livestock industries.
BREEDPLAN treatment of sub-breeds	The fact that separate BREEDPLAN databases are maintained for individual breeds is problematic with respect to facilitating an across-breed evaluation similar to the evaluation that is undertaken for the sheep industry in Sheep Genetics and ensuring stability of EBVs across the industry. However, the segregation and in some cases aggregation of breed databases, also causes problems when breeds on which breed associations are based are very similar.
ABRI product integration	The practical and economic realities that require most breed associations to use the ABRI database application in order to use BREEDPLAN and the fact that a number of smaller breed association acquire a wide range of services from ABRI has implications for adoptability Firstly, there is a view that this results in high costs associated with using BREEDPLAN, simply because it is necessary to incur the cost of using the ABRI database when using BREEDPLAN , albeit many breed association clients were using ABRI database services prior to using BREEDPLAN and are not compelled to do so. Secondly, there is a view that as a quasi-commercial entity, ABRI places more service and product development focus on the customers that deliver it the greater portion of revenue, which is a function of the terms on which they acquire BREEDPLAN and the ABRI database, as well as the portfolio of other ABRI products and services that they acquire.
BREEDPLAN is a complex product	It is perceived by some that critiques of the extent of adoption of BREEDPLAN often overlook that fact that it is relatively complex product to understand. While selecting animals on the basis of EBVs and indices is reasonably easily understood, understanding how BREEDPLAN works at even a rudimentary level requires at least a senior secondary school level of understanding of principles of genetic science and statistical mathematics.

Product Issue	Description
Expectations of genomics	The introduction of genomics to BREEDPLAN brings with it the benefits of improving the accuracy of EBVs by validating the statistical assessment on which they are based, creating a perception that pedigree identification will be totally de-risked and that labour involved in assessing an animal will be substantially reduced. However, this risks demotivating producers to undertake labour intensive performance measurements, ultimately diluting the performance measurement database and undermining the effectiveness of BREEDPLAN.
Limitations of SBTS and TBTS	Because SBTS and TBTS programs are designed to be delivered across multiple breeds, differentiating programs only the basis of the different production environments and BREEDPLAN needs of the southern and northern industry, the programs do not seem to take into account the unique needs of individual breeds. SBTS and TBTS also suffer from the usual criticism of agricultural extension programs that they are delivered primarily by technical staff who do not understand the practical realities of farming and therefore much of the program content is not realistically implementable. At the very least, programs are not tailored to an individual producer's needs. These possible deficiencies with SBTS and TBTS may be rendering it an ineffective mechanism for promoting BREEDPLAN and its rigorous use.

Structural Issues that Impact on Demand for BREEDPLAN

In addition to the complex nature of the demand profile for BREEDPLAN and inherent product characteristics, there are a number of structural issues that impact on how extensively and rigorously BREEDPLAN is used.

The following table summarises the key structural issues that impact on demand for BREEDPLAN.

Structural Issue	Description
Long and complex product feedback loop	The Australian beef supply chain that services both the domestic and international market, is long and complex. This lengthy and complex supply chain means that while seed-stock producers bear the entire cost of using BREEDPLAN, either through direct payments and/or through the cost of their breed association membership, any benefit in terms of increased value of the animal and its produce is shared along this supply chain. The length and complexity of the supply-chain also means that it is difficult for seed-stock producers to assess the impact of the breeding decisions they are making using BREEDPLAN on end-customer perceptions, as this information is typically not adequately measured or delivered back to the seed-stock producer.
BREEDPLAN promotion fatigue and possible market saturation	A number of factors indicate that given BREEDPLAN has been promoted to industry for over three decades and adoption seems to be plateauing, it may have achieved market saturation. In any event, the market is likely suffering from promotion fatigue with respect to BREEDPLAN. This implies efforts should be more targeted to drive more rigorous use by existing BREEDPLAN users and growth of adoption in key breed sectors that demonstrate opportunity to drive higher levels of adoption.
Relevance of across breed analysis	There have been some calls for BREEDPLAN to transition to an across-breed analysis, similar to that which is conducted under Sheep Genetics. The would potentially provide seed-stock producers and their customers with information on an animal that is relative to all other animals, leading to arguably more informed animal selection and joining decisions. If animal selection and joining decisions were consistent with this information, the rate of genetic gain across the Australian beef industry would likely increase. It would reduce the current instability of EBVs in the smaller breeds that is the result of inadequate performance records to underpin accuracy in the EBVs. There is significant resistance to a BREEDPLAN cross breed analysis based on the fact that commercial producers, particularly in the southern beef sector, tend to seek-out pure-bred animals that they then use to produce pure-bred commercial product or in their own cross breeding programs. There would also need to be a considerable investment in research and development to create the cross-breed linkages in BREEDPLAN and most would consider there to be other research and development priorities.
Breed associations remain an important channel to market	Most certainly, it would appear that the BREEDPLAN delivery model must evolve over time to cater for the unregistered sector. However, for so long as market remain purebred oriented, breed associations will remain an important channel to market for BREEDPLAN and could potentially play a greater role in promotion and delivery of training for BREEDPLAN.

Issues Associated with the BREEDPLAN Value Chain

Because the value chain that delivers BREEDPLAN to market is substantially different to that which delivers Sheep Genetics, there is a tendency to associate perceptions of high cost and suboptimal product development and market penetration with this distinguishing feature. While the structure of the value chain that delivers BREEDPLAN to market has the ability to determine and influence some issues associated with the demand profile, product characteristics and structural nature of the industry and market, it is clearly not the sole determinant of challenges faced by BREEDPLAN with respect to optimising the rate of genetic gain across the industry.

The following table summarises the key issues associated with the BREEDPLAN value chain.

Issue	Description
Has BREEDPLAN really been commercialised?	The transaction that delivers BREEDPLAN to market might better be described as an outsourcing arrangement between public, quasi-public and not-for profit organisations, rather than commercialisation. While there are some elements of commercial behaviour along the value-chain that delivers BREEDPLAN, the key distinguishing factor is that the value-chain is not designed to produce financial investment style returns for the shareholders or members of the organisations that are participating in that value-chain. Rather, it is expected that any surplus generated is modest and is invested in improvements to BREEDPLAN and its delivery, or in BREEDPLAN price reduction for the seed-stock sector. The extent to which significant surpluses might be generated questions the extent to which there is a market failure. Similarly, the fact that BREEDPLAN has not been genuinely commercialised but rather delivered through a series of government, quasi-government and not-for-profit organisations defines the extent to which any surplus should exist and how that surplus should be invested to ensure that the objective of commercialising BREEDPLAN (i.e. maximise the rate of genetic gain) is being optimally achieved.
How well are BREEEDPLAN value chain partners aligned?	*Prima facie*, the participants in the BREEDPLAN value chain would seem to be strongly operationally aligned with respect to the purpose of delivering an information technology product to the Australian beef cattle seed-stock sector. However with respect to the objective of optimising genetic gain across the Australian beef cattle industry, their strategic and fiduciary obligation alignment with this objective is less so simply because the different participants demonstrate quite different strategic intent and fiduciary obligations.
Absence of a joint venture or shareholder agreement among the owners	There does not appear to be a formal agreement in place between MLA, UNE and NSWDPI that transfers the equity holdings to each of the parties and governs their relationship. The fact that taxpayer and levy funds have underpinned the development of the BREEDPLAN analytical software and therefore the value that underpins the equity that they hold, that all owners are public or quasi-public organisations, that MLA receives a royalty stream that is in excess of its *pro rata* equity entitlement, and most importantly, the owners each have material equity and contractual interest in other participants in the value chain necessitates this from a governance and commercial risk management perspective.
Are UNE's interests along the value chain dysfunctional?	Of all the owners of the BREEDPLAN core analytical software, it is UNE's equity interests in the value chain, particularly its 100 percent ownership of the BREEDPLAN core analytical software licensee, ABRI, that has the potential to create the more problematic conflict of interest, particularly with respect to decisions pertaining to that license.
Are the exclusive arrangements resulting in monopoly powers?	Several relationships along the value chain that delivers BREEDPLAN prescribe or manifest themselves in exclusive commercial arrangements. This exclusivity along the value chain has created perception among some that the extensive exclusivity is resulting in a lack of competition in the development and delivery of BREEDPLAN, leading to monopoly-style pricing. The counter-view to this is that the market is too small to support multiple providers and that exclusivity is necessary to adequately commercially motivate participation in the value chain. Furthermore, without the exclusivity that applies to the BREEDPLAN core analytical software license between the owners and ABRI, multiple providers of EBVs could emerge, resulting in multiple, non-comparable analyses that is not in the interests of optimising genetic gain across the industry.

Issue	Description
Inconsistent terms of use for end users	Individual specific arrangements pertaining to access to BREEDPLAN vary across breed associations, meaning that different breed associations face different financial dynamics with respect to the delivery of BREEDPLAN in terms of both quantum of cost and ratio of fixed to variable costs. Additionally, the breed associations themselves deliver BREEDPLAN to their members under different terms, ranging from full cost-recovery to almost full subsidisation. The net result of this is that, seed-stock and commercial producers across the Australian beef industry pay different rates for BREEDPLAN depending on which breed they are producing (and therefore which breed association they belong to). Obviously higher levels of adoption and greater rigour of use is more likely in the breeds that face lower BREEDPLAN costs.
Concentration of value chain surplus	It is difficult for seed-stock and commercial producers to quantify any surplus that is directly attributable to using BREEDPLAN. It would seem that few if any breed associations generate a surplus from offering BREEDPLAN to their customers and the royalty stream generated from the licensing agreement pertaining to the core analytical software is concentrated with MLA and does not remotely cover the investment MLA makes in research and development and support of TBTS and SBTS. This analysis indicates that all of the value chain surplus is concentrated with ABRI and that in a tax free and partly subsidised environment (BREEDPLAN research and development and promotion is subsidised by MLA) this surplus is commensurate with those achieved by commercial entities operating in similar industries. If this holds true, it raises questions as to how that surplus should be reinvested, whether it should be distributed along the value chain or if it should be used to provide price relief to the end customer.

Options Analysis

The issues identified in this review can be wholly or partly addressed through two principle mechanisms.

- The current value chain that delivers BREEDPLAN to market could be collapsed by the Owners using the triggers in the BREEDPLAN Core Analytical Software license to cancel that license, effectively removing ABRI's ability to continue to offer BREEDPLAN. The Owners could then seek to either commercialise BREEDPLAN through another party, or internalise the delivery of BREEDPLAN in MLA under a model similar to which Sheep Genetics is delivered to market.

- The participants in the existing BREEDPLAN value chain can work collaboratively to adopt a more strategic rather than transactional approach to delivering BREEDPLAN that better aligns the value chain participants' interests and addresses most of the issues that have been identified.

Terminating the Current Licensing Arrangement

The mechanism for terminating the existing BREEDPLAN core analytical software license is prescribed in Clause 12 of the Licensing Agreement that provides the Owners with the power to terminate if they cannot reach an agreement of the annual operating plan pertaining to the delivery and development of BREEDPLAN as prepared by ABRI.

This option is not advisable for a number of reasons. Firstly, as discussed in the previous section, not all of the obstacles to BREEDPLAN optimally driving the rate of genetic improvement in the Australian beef cattle industry are associated with the structure of the value chain.

Secondly, collapsing the existing value chain is not without legal obstacles. UNE is an Owner of BREEDPLAN and the owner of the licensee, ABRI. Clause 22 of the Licensing Agreement requires termination of the Licensing Agreement to be by consent of all three owners. Obviously, UNE has a significant conflict of interest in this decision, but could substantially frustrate, if not prevent termination if it so desired.

Thirdly, for the following reasons, collapsing the existing value chain that delivers BREEDPLAN to market would be expensive and represent a significant risk of service disruption, if not catastrophic service failure:

- The existing value chain has been operating for three decades. As a result there are established product and service delivery systems and protocols that the market is accustomed to and transitioning these systems and protocols to a new structure, or transitioning the market to adopt new systems and protocols under a new delivery mechanism would take considerable time, require considerable investment and present significant continuity of service risk.

- The equity and licensing arrangements that exist along the value chain are complex and their reconfiguring to accommodate a new delivery model would absorb both financial and time resource and in some cases may not be achievable, potentially resulting in a compromised product.

- Data ownership along the value-chain is complex and its use outside of the value-chain would require the consent of the different owners, which in some case is unlikely to be forthcoming.

- AGBU, ABRI and many of the breed associations have invested significantly in developing and promoting BREEDPLAN over the course of three decades. As a result, these organisations justifiably have a sense of equity in BREEDPLAN and would likely react adversely to the value-chain being totally dismantled. This would cause further problems for BREEDPLAN's credibility in the market-place.

Finally, despite some of the perceived deficiencies associated with the current value chain and a perception that adoption and usage of BREEDPLAN is not optimal, the fact is that the current value chain has delivered BREEDPLAN to market and has achieved reasonable market penetration.

If the owners did terminate the license agreement with ABRI, they would then have the option of seeking to commercialise BREEDPLAN through a third party, or internalise the delivery of BREEDPLAN in MLA under a model similar to which Sheep Genetics is delivered to market.

Commercialisation

The natural acquirer of the BREEDPLAN business is a company operating in the livestock genetics industry.

The macro industry and market trends in the global commercial livestock genetics industry appear *prima facie* to be favourable to the genuine commercialisation of BREEDPLAN. However, much of the focus of these firms is the development of proprietary lines of breeding animals or genetic testing

services. BREEDPLAN is a service provider to proprietary lines of breeding animals and a user of genetic testing services. As such, while BREEDPLAN is part of the 'ecosystem' of an attractive segment of the livestock genetics industry, it is not operating in the space where the most attractive returns are being generated.

Furthermore, while in the current not-for-profit operating environment BREEDPLAN seems to deliver an attractive rate of return, a taxable operating environment would see those returns substantially diminished and the Australian seed-stock cattle producers market is likely too small to generate quantum of return that is adequately attractive to a large company.

The other main limitation to this option is that by commercialising BREEDPLAN, the Owners' control over how and to who BREEDPLAN is offered will almost certainly be limited and its ongoing delivery will face uncertainty associated with potential failure of the enterprise delivering BREEDPLAN or a decision by that enterprise to not invest in the ongoing development and delivery of BREEDPLAN. Any conditioning around these issues would likely substantially detract from the value of BREEDPLAN to a potential acquirer.

As such commercialising BREEDPLAN would not be aligned with the objective of achieving optimal genetic gain.

Internalise Delivery within MLA

If the current Licensing Agreement was to be terminated, BREEDPLAN could theoretically be delivered by MLA under an arrangement similar to which Sheep Genetics is delivered. At the most basic level, this would involve MLA operating the service delivery component of BREEDPLAN as an internal business unit and outsourcing the core processing to AGBU.

Some would see this as an attractive option, primarily, because it would:

- Pave the way for BREEDPLAN to be accessed by any commercial or seed-stock producer, allowing penetration in the unregistered sector;
- Give MLA control over the innovation and product development agenda, potentially resulting in more timely innovation and product development that is better aligned with the objective of accelerating the rate of genetic gain across the industry; and
- Potentially result in a cheaper BREEDPLAN product for the seed-stock and commercial producer end-users.

However, for the reasons cited in the introduction of this section, transitioning the delivery of BREEDPLAN to this model would be complex and consume considerable resource. It would also likely cause resentment among the existing value-chain participants and possibly many customers whose primary customer loyalty and trust resides with their breed association.

BREEDPLAN Value Chain Reinvigoration Program

There is adequate evidence that the current value chain is not delivering optimally with respect to maximising the rate of genetic gain. Furthermore, while the structure of the existing value chain is not the cause of all of the factors that limit BREEDPLAN's ability to optimise the rate of genetic gain, it contributes to some and can be modified to address others.

As such it is recommended that a BREEDPLAN value chain reinvigoration program be put into effect that is designed around the initiatives described in the following table.

Initiative	Description
Strategic approach to managing the value chain	The BREEDPLAN value-chain currently operates primarily on a transactional basis. A strategic approach would involve all the participants agreeing to the strategic intent of the value chain and aligning their interests with that strategic intent. Transactional agreements between value-chain participants then articulate terms, including performance criteria and incentives that reinforce that alignment.
Owner's agreement	If the BREEDPLAN Core Analytical Software intellectual property was to be vested in a company in which MLA, UNE and NSWDPI were issued shares according to their current equity interests, this agreement would take the form of a shareholder's agreement. If the interests of the Owners were to remain as they are, a joint venture agreement would be the most appropriate instrument. This agreement would seek to better align the owner's interests in BREEDPLAN, prescribe classes of equity among the owners, prescribe systems for decision making and managing conflicts of interest, as well terms and conditions that are common to such agreements such as those that pertain to disposal of interests.
Financial transparency along the value chain	The current confidential, transactional approach to managing the value chain has resulted in a concentration of the value-chain surplus with a single value-chain participant, significant distrust and along the value-chain and terms of BREEDPLAN usage that are inconsistent across the industry and not in the best interest of optimising the rate of genetic gain across the industry. A more strategic approach to managing the BREEDPLAN value-chain would see a higher degree of financial transparency along the value chain. This would likely involve a set of standardised financial reporting metrics that are shared along the value chain on an annual basis.
Consistent pricing to breed associations	The optimisation of adoption of BREEDPLAN requires consistent cost of using BREEDPLAN across the breeds. This should be the starting point and its level determined by working back up the value chain based on operating costs and required surplus at each stage of the value-chain.
Accessing the unregistered sector	In the absence of a true cross-breed evaluation, establishing a direct service based on a database for all unregistered animals would seem to have limited value. It may be that breed associations will need to evolve their business models to cater for unregistered, cross-bred and composite animals by establishing different databases, and allowing an evaluation system to interrogate their registered animal database and through formal arrangements, the databases of other relevant breeds so that cross bred and composite animals can be compared with the appropriate pure bred animals. Obviously, this access and service offering would be the subject of commercial arrangements.
Develop and invest in a value chain owned innovation and product development plan	The perception of a slow and selective innovation and product development cycle associated with BREEDPLAN can be addressed by the value chain participants collectively agreeing on the priorities and making sure those priorities are addressed in the interests of all BREEDPLAN users and in the interests of optimising the rate of genetic gain across the industry.
Resource breed associations to promote and support BREEDPLAN	While most of the main breed associations have an interest in SBTS or TBTS, the fact that SBTS and TBTS are the subject of some criticism and market research suggests that breed associations are the most trusted source of advice for seed-stock producers and some commercial producers, indicates that if they were adequately resourced to do so, breed associations would be a more effective mechanism for promoting BREEDPLAN and encouraging and supporting their members to use BREEDPLAN rigorously. This may need to be complemented by a breed association independent source of BREEDPLAN training for members of breed associations that are less supportive of BREEDPLAN, but wish to

Initiative	Description
	use BREEDPLAN. Such an arrangement would need to revolve around clear delivery KPIs for both BREEDPLAN and the breed associations.
Responsibly introduce competition to the value chain	Once the value chain has been reset according to these initiatives, a project to identify if competition can be introduced to various aspects of the value chain that delivers BREEDPLAN such that it does not disrupt or reduce the quality of the product delivered by the value chain, but improves value for money for the end-user should be undertaken. However, this should not be contemplated until the reinvigoration program is completed, as to do so prematurely would only increase uncertainty for existing participants in the BREEDPLAN value chain. This should also not be interpreted as a proposal to develop competition for the BREEDPLAN service itself, as a single genetic evaluation platform is important to ensuring that the rate of genetic gain is maximised. The proposal is to examine the sensible introduction of competition to aspects of that value chain that contribute to the delivery of the BREEDPLAN service.

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1 Background

While primary (agriculture, forestry and fisheries) production's share of the Australian economy has been declining, currently accounting for approximately 2.2 percent of National output, output from the sector has been growing in recent years. For example, in 2014-15, the sector grew at 1.5 percent in real terms.[3] However, if Australian agriculture is to achieve higher levels of growth and reach its potential, it must maintain and grow its share of key global markets, particularly the rapidly growing Asian markets.

As per capita wealth continues to grow in emerging economies across the globe, a shift in consumer diets toward animal produce is continually gaining momentum. This global trend is underpinning a very significant opportunity for Australian agriculture, whereby rising incomes in regional emerging economies, particularly the People's Republic of China (PRC), will drive increased demand for Australian agricultural produce for decades to come.[4] This macro-trend is expected to see demand for Australian beef double from 2013 levels by 2020.[5]

Australia's ability to capitalise on this opportunity is entirely a function of continued productivity improvement in the form of decreased operating costs and improved performance in product quality attributes that are valued by target customers, including product attributes such as product traceability and sustainable production systems from both an environmental and animal welfare perspective throughout the value-chain. In all sectors of the Australian agricultural industry, but particularly in the livestock sectors, genetics will continue to play a critical role in achieving ongoing productivity improvement in this regard. The Australian beef industry is no exception to this fundamental tenet of agribusiness.

As important background to this study, this section of the report provides:

- An overview of the current status of the Australian beef industry, as well as domestic and international trends impacting on the competitiveness of Australian beef produce;
- A brief overview of the range of contemporary initiatives that have been undertaken by the Australian beef industry to underpin and improve the competitiveness of Australian beef produce;
- A brief description of the role of genetic science, as well as BREEDPLAN more specifically in driving improvements in productivity and product quality in the Australian beef industry; and
- The specific objectives of this study.

[3] Australian Bureau of Statistics in: Office of the Chief Economist (2015), *Australian Industry Report,* Department of Industry, Innovation and Science, Australian Government, Canberra
[4] Australian Bureau of Agriculture, Resources and Energy Statistics (2015), *Agricultural Commodities,* September Quarter, Department of Agriculture and Water Resources, Australian Government, Canberra
[5] Australian Bureau of Agriculture, Resources and Energy Statistics (2013), *What Asia Wants: Long Term Food Consumption Trends in Asia,* Department of Agriculture and Water Resources, Australian Government, Canberra

1.1 The Australian Beef Cattle Industry

While it technically should not be the case, the commercial reality is that demand for BREEDPLAN and the extent to which it is used rigorously by many customers is at least in part a function of the prevailing market conditions for Australian beef cattle, as well as the commercial implications of specific macro-events that impact the industry from time-to-time. For example, generally speaking:

- When beef producers are endeavouring to take advantage of high beef prices by producing as much market ready cattle as possible, demand for bulls is generally higher and seed-stock producers are typically able obtain relatively high prices for bulls regardless of whether the bulls have BREEDPLAN figures; and
- When demand for bulls is softer, or driven primarily by a need to rebuild herds, buyers of bulls tend to apply greater scrutiny to the genetic merit of the bulls they are purchasing and as such, demand for bulls with BREEDPLAN numbers tends to be higher.

As such, a brief overview of recent trends and the contemporary status of the Australian beef cattle sector is important context for the analysis in this study.

1.1.1 The Australian Beef Cattle Herd

1.1.1.1 The Australian Beef Cattle Herd

The cattle sector is a very important component of the overall Australian agriculture industry. For example, in 2015-16:

- Approximately 58 percent of all Australian farming enterprises ran some cattle; and
- The gross value of Australian cattle and calf production (including live exports) was $14.3 billion, accounting for some 25 percent of total farm value[6] and approximately 50 percent of the total value of Australian livestock industries[7].

In 2015, there were approximately 72,000 farming enterprises in Australia running a total of 27.6 million head of cattle, including 2.8 million head of dairy cattle and 12.5 million head of beef cows and heifers.[8] Queensland accounts for just over 40 percent of the national cattle herd, 56 percent of national feedlot production and just under 50 percent of national beef and veal production. Approximately 80 percent of the national herd is located on the eastern seaboard (Queensland, New South Wales, Victoria and Tasmania), with those states also accounting for approximately 94 percent of feedlot production and 91 percent of national beef and veal production.

However, the Australian beef industry is more conventionally segmented according to the very different production environments of the northern or tropical sector (Queensland, Northern Territory and approximately 50 percent of the Western Australian herd) and the southern sector (New South Wales, Victoria, Tasmania and approximately 50 percent of the Western Australian herd). The

[6] Australian Bureau of Statistics and Australian Bureau of Agriculture, Resources and Energy Statistics IN: Meat and Livestock Australia (2016), *Fast Facts: Australia's Beef Industry*
[7] Australian Farm Institute (2015), *The Economic Importance of Australia's Livestock Industries and the Role of Animal Medicines and Productivity Enhancing Technologies,* Animal Medicines Australia
[8] Australian Bureau of Statistics and Australian Bureau of Agriculture, Resources and Energy Statistics IN: Meat and Livestock Australia (2016), *Fast Facts: Australia's Beef Industry*

northern or tropical sector accounts for approximately 54 percent of the national herd (with no dairy cattle), 59 percent of feedlot operations and 53 percent of beef and veal production, with Queensland obviously accounting for the vast majority of production. In the southern industry, the states of New South Wales and Victoria collectively account for the majority of production.

The southern and northern sectors differ considerably with respect to pasture type, grazing intensity, to some extent target market and very importantly, genetics. Not only are the foundation breeds substantially different, but the northern herd is characterised by a larger portion of cross-bred and composite animals, whereas the southern industry tends to revolve more around pure-bred animals. The geographical distribution of the Australian beef production is illustrated in Figure 1[9] below.

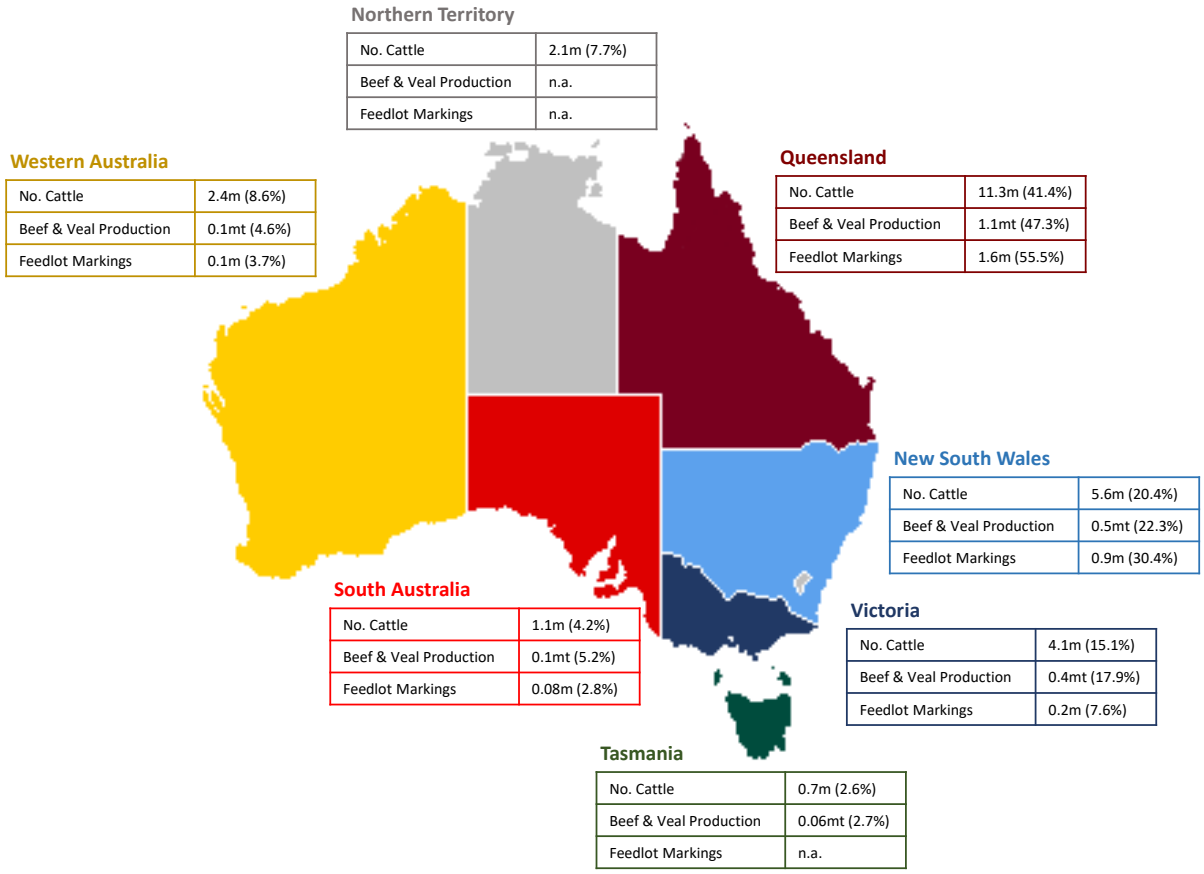

Figure 1 – Geographical Distribution of the Australian Cattle Herd – 2015

1.1.2 Recent Macro Trends and Events Impacting the Australian Beef Cattle Industry

For the first decade of this millennium, the following macro-scale events were the main determinants of the economics of the Australian beef industry:

- Extended drought across southern Australia from 2002-03 to 2009-10;
- The Australian Government ban on live export trade in mid-2011; and

[9] Adapted from Meat and Livestock Australia (2016), *Fast Facts: Australia's Beef Industry*

- In more recent years, drought conditions in western Queensland and north-western New South Wales.[10]

This was followed by three years of herd build-up between 2011 and 2013. Since 2013, relatively high global beef prices (see Sections 1.1.3 and 1.1.4) drove much higher slaughter and export rates that have subsequently resulted in a dramatic decline in the national beef herd from around 26 million head in 2014 to around 24.5 million head in 2015. The size of the Australian cattle herd during the period 2006 to 2015 is illustrated in Figure 2[11] below.

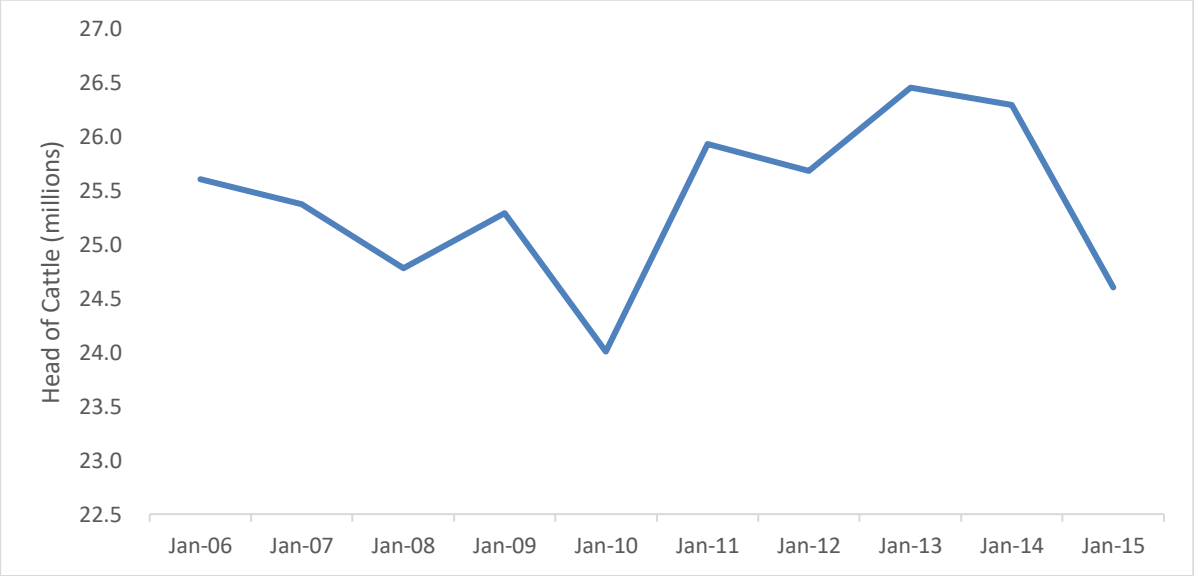

Figure 2- Australian Beef Cattle Herd 2006 to 2015

1.1.3 Australian Domestic Beef Market

Since the late 1970s, Australian consumers have increasingly substituted white meat (chicken and pork) for red meat (beef and lamb), placing downward pressure on domestic demand for beef. However, relatively high population growth in Australia has meant that demand for beef has remained relatively constant over this period.[12] In more recent years, periods of sustained drought have seen increased turnoff of beef cattle from properties in Queensland and New South Wales. This has kept downward pressure on domestic beef prices in an environment where prices in global markets have reached record highs.

The Eastern Young Cattle Indicator (EYCI) is an indicator of the general cattle market in Australia. It is an index that is calculated on a seven-day rolling average expressed in cents per kilogram of carcase(or dressed) weight (c/kg cwt). The EYCI is produced daily by Meat and Livestock Australia's (MLA) National Livestock Reporting Services and includes vealer, yearling, heifers and steers and includes

[10] Australian Farm Institute (2015), *The Economic Importance of Australia's Livestock Industries and the Role of Animal Medicines and Productivity Enhancing Technologies,* Animal Medicines Australia

[11] Meat and Livestock Australia (2016), *Australian Cattle Herd by Category*, Market Information

[12] Australian Bureau of Agricultural, Resources and Energy Statistics IN: Rural Bank (2015), National Beef Update, May Edition,

purchased for slaughter, restocking or feed-lotting. As illustrated in Figure 3[13] below, the domestic market for beef cattle in Australia has improved dramatically over the course of the past couple of years.

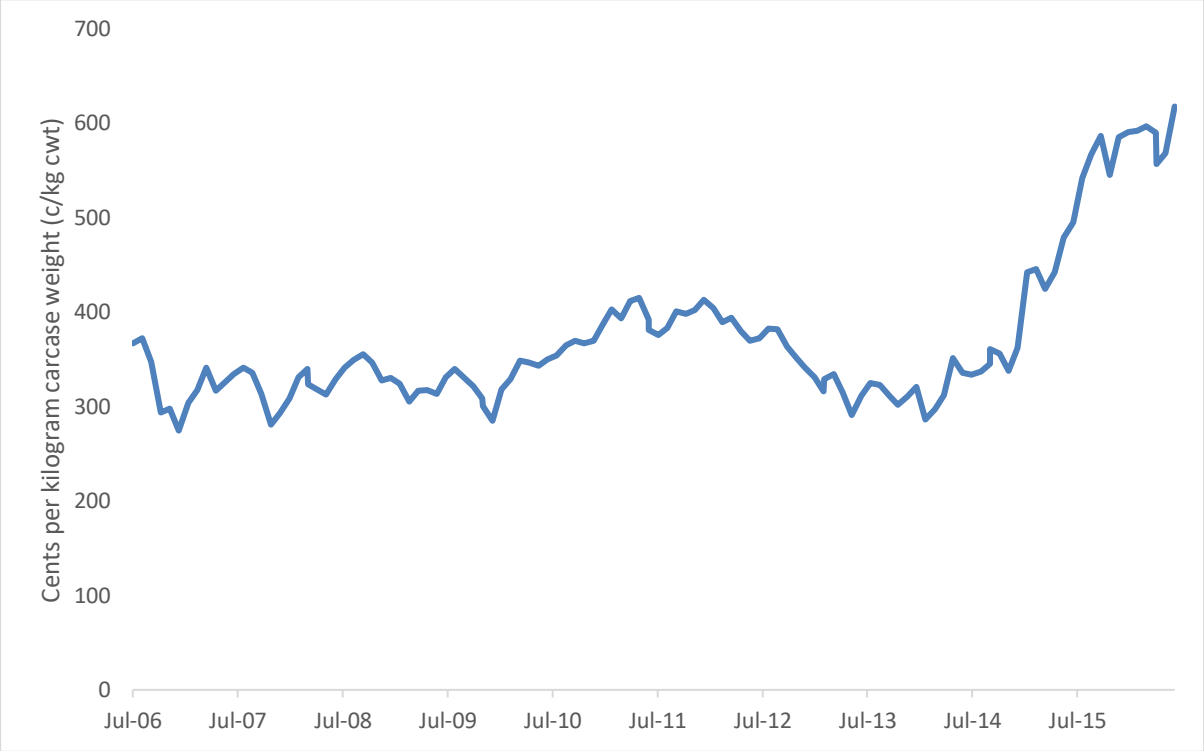

Figure 3 – Eastern Young Cattle Indicator (2006 to 2016)

1.1.4 Australian Beef in the Global Market

The world's largest producers of beef on a volume basis are the United States (19 percent), Brazil (17 percent), PRC (11 percent), India (7 percent), Argentina (5 percent) and Australia (4 percent). Whereby Australia exports approximately 60 percent of its beef production, the three largest producers of beef (United States, Brazil and PRC) are also major consumers of beef. As a result Australia is the third largest exporter of beef.[14] The world's largest importers of beef are the United States, Russia and Japan.[15]

Historically, Japan has been the largest market for Australian beef. Over the past decade there has been a steady decline in the volume of Australian beef exported to Japan, albeit there has been some recovery in exports to Japan over the past couple of years. This general decline in demand from Japan has been more than offset by a dramatic increase in Australian beef exports to the United States and to a lesser extent, the PRC. This is illustrated in Figure 4 below.

[13] Meat and Livestock Australia (2016), *Eastern Young Cattle Indicator*, MLA Market Information
[14] United States Department of Agriculture IN: ANZ (2015), *Australian Beef Industry*
[15] United States Department of Agriculture IN: ANZ (2015), *Australian Beef Industry*

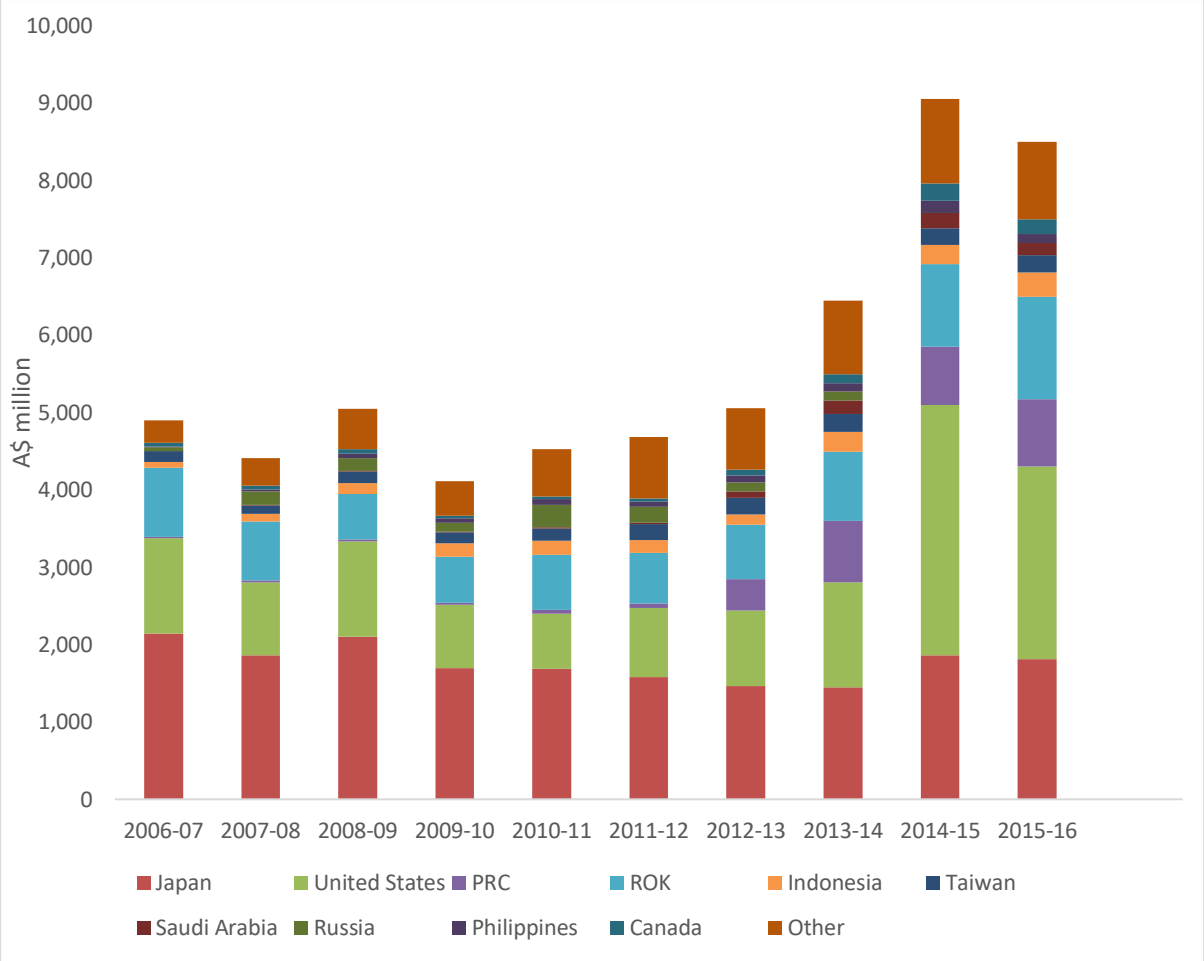

Figure 4 – Australian Beef Exports (2006-07 to 2015-16)

The recent increase in demand for Australian beef from the United States is a function of:

- The well-understood United State cattle cycle[16], whereby the cycle is passing through the post liquidation phase shortage of domestic supply, requiring higher than normal imports;
- A lower Australian dollar, rendering Australian beef more competitive in the United States market; and
- As a result of drought induced turn-off, a higher than normal supply of Australian beef (see Section 1.1.3).

As the United States herd begins to rebuild, it is highly probable that demand for Australian beef from the United States will plateau or even decline. The United States is both a major market for Australian beef, as well as a major competitor, particularly in the Pacific Rim markets.

Historically, the People's Republic of China (PRC) has been a small but consistent net exporter of beef. However, a transition to animal based diets in expanding middle-class has resulted in the PRC becoming a net importer of beef, with recent data suggesting it is a net importer of approximately 300,000 tonnes through formal trade and at least an additional 1 million tonnes through informal

[16] Griffith, G. and Alford, A. (2003), 'The US Cattle Cycle and the Australian Beef Industry', *Proceedings of the Growing and Selling Cattle Workshop,* Alice Springs

trade.[17] The Australian beef industry has been a major beneficiary of this transition, with the PRC now Australia's fourth largest beef export market behind Japan, Republic of Korea (ROK) and United States. Between 2011-12 and 2014-15 Australian beef exports to the PRC increased from approximately 10,000 tonnes to 130,000 tonnes of mostly frozen, grass-fed beef of various cuts and quality. Most of this produce originated from Queensland where the majority of PRC-approved abattoirs and cold storage facilities are located.[18]

While it is true that other major beef exporting countries (India, Brazil and United States) command a higher percentage of the PRC beef market, as a result of bovine spongiform encephalopathy (mad cow disease) and foot and mouth disease quarantine restrictions, Australia is one of only a few countries that is able to export beef to the PRC.[19] This competitive advantage is further underpinned by a bilateral trade and a live export protocol agreement between Australia and the PRC[20], as well as significant equity investment by PRC companies in Australian beef production, whereby as at 2015, nine PRC companies had invested a total of approximately $430 million in Australian beef production properties and supply chain assets.[21]

Combined, these domestic industry and international beef market dynamics are expected to ensure that Australia remains a major supplier of beef produce to the global market out to at least 2023. This is illustrated in Figure 5[22] below.

[17] Edwards, B., Waldron, S., Brown, C. and Longworth, J, (2016), *The Sino-Australian Cattle and Beef Relationship: Assessment and Prospects,* China Agricultural Economics Group, School of Agriculture and Food Science, The University of Queensland
[18] Edwards, B., Waldron, S., Brown, C. and Longworth, J, (2016), *The Sino-Australian Cattle and Beef Relationship: Assessment and Prospects,* China Agricultural Economics Group, School of Agriculture and Food Science, The University of Queensland
[19] Edwards, B., Waldron, S., Brown, C. and Longworth, J, (2016), *The Sino-Australian Cattle and Beef Relationship: Assessment and Prospects,* China Agricultural Economics Group, School of Agriculture and Food Science, The University of Queensland
[20] Edwards, B., Waldron, S., Brown, C. and Longworth, J, (2016), *The Sino-Australian Cattle and Beef Relationship: Assessment and Prospects,* China Agricultural Economics Group, School of Agriculture and Food Science, The University of Queensland
[21] Rowley 2015 IN: Edwards, B., Waldron, S., Brown, C. and Longworth, J, (2016), *The Sino-Australian Cattle and Beef Relationship: Assessment and Prospects,* China Agricultural Economics Group, School of Agriculture and Food Science, The University of Queensland
[22] FAO and OECD IN: ANZ (2015), *Australian Beef Industry*

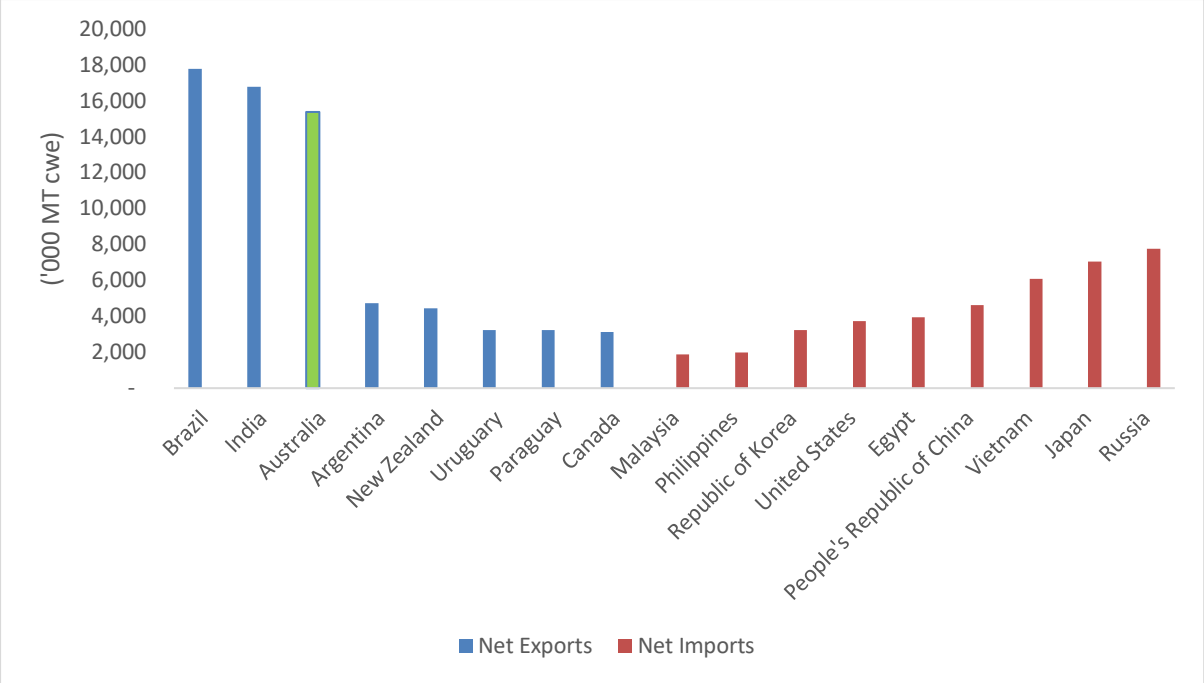

Figure 5 – Major Beef Exporters and Importers – Cumulative 2015 to 2023

The Australian beef industry's ability to achieve these forecasts and entrench its status as a major competitive force in global beef market is, in part, dependent on continued genetic improvement that delivers the productivity and quality improvements that are necessary for Australian beef produce to remain competitive.

1.1.5 The Australian Beef Cattle Supply Chain

The Australian beef cattle supply chain for both the domestic and export market is long, characterised by multiple intermediaries between the primary producer and retail customer, and multiple possible product pathways. Figure 6[23] below illustrates the Australian beef cattle supply chain from seed-stock production to end consumers in the domestic and export markets.

[23] Adapted from: Jie, F., Parton, K., Jenkins, R. and Cox, R. (2007), 'Supply chain performance indicators for Australian beef industry: an empirical analysis, *ANZAM Conference Proceedings*

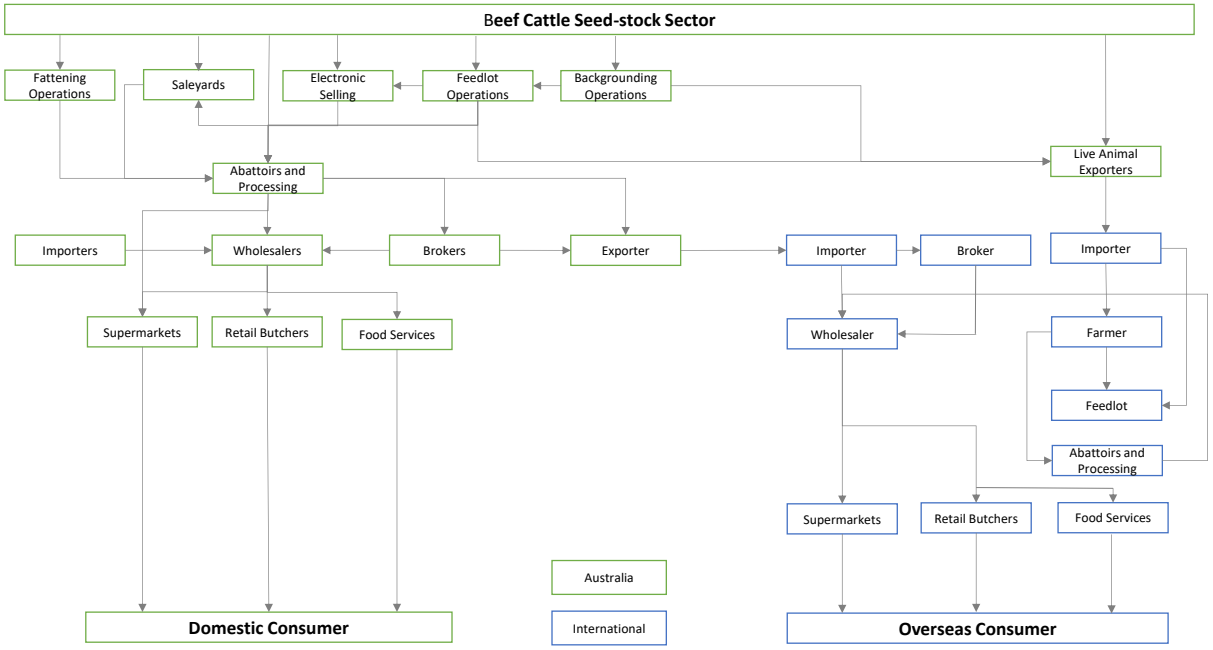

Figure 6 – Australian Beef Supply Chain for Domestic and International Markets

While this supply chain has proven effective at delivering high quality Australian beef products to both the domestic and important international markets, its length and complexity presents two key challenges to BREEDPLAN. Firstly, while seed-stock producers and their breed associations bear almost the entire cost of BREEDPLAN, the majority of the surplus that results from improved genetics is realised by downstream participants in the supply chain. Secondly, because there are so many sequential participants, it is difficult for improvements in customer valued product attributes to be attributed to the BREEDPLAN informed decisions made by seed-stock producers.

1.2 Australian Beef Industry Investment in Competitiveness

The average cost of production in the Australian beef industry is lower than that of European and Asian producers, comparable to African and CIS producers, but significantly higher than North, Central and South American producers. Relative to other major cattle producing jurisdictions, land and capital costs associated with beef production in Australia are comparable and non-factor costs are typically less. The Australian beef industry's major cost disadvantage is labour, which accounts for approximately 12 percent of total beef production cash costs in Australia, compared to a global average of 6.2 percent.[24]

Labour costs are unlikely to substantially decline in Australia. Therefore, productivity gains must be achieved through other means such that the beef industry's multifactor productivity outweighs, or at least mitigates, any productivity penalty associated with Australia's high labour costs. To this end, industry has made a number of investments, primarily through MLA, in initiatives designed to improve productivity, product quality and supply chain effectiveness, as well as to promote Australian beef in key global markets.

[24] ANZ (2015), *Australian Beef Industry*

These initiatives revolve around marketing initiatives including systems that warrant biosecurity, food safety and eating quality, as well as various aspects of production including pasture improvement and genetics, including the subject of this study, BREEDPLAN. In the context of this study, it is very important to note that all of these initiatives are data driven and interrelated. Table 1[25] below summarises the key industry initiatives designed to improve the competitiveness of Australian beef in international markets.

Program	Summary
Meat Standards Australia (MSA)	Beef eating quality program designed to provide endorsement of quality for graded cuts of red meat (including beef).
National Livestock Identification System (NLIS)	System allows individual animals to be identified and traced electronically over their life for food safety, product integrity and market assessment purposes.
Livestock Production Assurance (LPA)	Focuses on five key elements of compliance ensuring meat from livestock is fit for human consumption. The five key elements are property risk assessment, safe animal treatments, preparation for dispatch of livestock, livestock transactions and movements and stock foods, fodder crops and pasture treatments.
National Residue Survey (NRS)	Monitors residues of agricultural and veterinary chemicals and environmental contaminants in Australian food commodities.
National Feedlot Accreditation Scheme (NFAS)	Provides independent audits of feedlots each year to ensure compliance with animal welfare, environment, food safety and product integrity legislation.
BREEDPLAN	National beef genetic improvement service that is the subject of this paper.

Table 1 – Key Australian Beef Industry Productivity Improvement Programs

Underpinning the effectiveness of these initiatives is a world-best-practice product traceability system that distinguishes Australian beef produce in international markets that, for biosecurity, food safety or culinary purposes, increasingly require food origin and process information, in some cases expecting a very high degree of specificity. Combined with the initiatives set out in Table 1, this provides a greater link between the end customer and the various participants in the long Australian beef industry supply chain depicted in Figure 6 above.

As illustrated in Figure 7[26] below, strict regulation controlling traceability in the Australian beef industry has delivered Australia a significant competitive advantage in the increasing number of markets that expect origin and process information as an attribute of the food products they purchase.

[25] ANZ (2015), *Global Beef Industry Overview*
[26] ANZ (2015), *Australian Beef Industry*

	Farm to Slaughter Plant					Farm to Slaughter Plant				
Country	**Location ID**	**Producer ID**	**Animal ID**	**Movement ID**	**Data Monitoring and Linking**	**Specific Product ID**	**Producing Party ID**	**Production Party ID**	**Movement ID**	**Data Monitoring and Linking**
Australia	M	M	M	M	M	V	V	V	M	V
United States	V	V	V	V	V	M	V	V	M	V
Brazil	M	M	M	M	V	V	V	V	M	V
Argentina	M	M	M	M	V	M	M	M	M	V
Uruguay	M	M	M	M	V	M	M	M	M	V
Mexico	V	V	V	M	M	V	V	V	M	V
Canada	M	M	M	M	M	M	V	V	M	V
New Zealand	M	M	M	M	M	V	V	V	M	V

Figure 7 – Traceability of Beef Products – International Comparison (M = Mandatory; V = Voluntary)

1.3 The Critical Role of Genetics and BREEDPLAN in the Australian Beef Industry

1.3.1 Genetics and the Modern Livestock Industry

A key issue when considering the future direction of any livestock industry is determining the nature of future markets, as well as what breeds or breed types should be reared, and the breeding objectives that should pertain to those breeds and breed types in order to meet those future market needs.

Since the domestication of animals, producers have mated specific sire and dams in the hope that their progeny will demonstrate certain desired characteristics possessed by those sires and/or dames such as fecundity, disease resistance, high biological feed conversion rate, manageable temperament, suitable physique and high product quality and yield. For centuries, the selection of sires and dames for this purpose was based exclusively on a visual assessment of the characteristics of sires and dames and observations as to the apparent heritability of specific traits from those sires and dames.

Over the course of the last half century modern science has played a greater role in this endeavour. Commencing with the use of technology to more accurately measure the phenotype of specific desired traits, the combination of this standardised objective measurement with increased knowledge of heritability, statistical methods, and vastly improved data processing capacity, has seen increased application of quantitative genetics methodology as an important tool in breeding decisions across a range of livestock industries.

'The five key attributes of animal breeders who have the longest-lived breeding programs are:

1. Being knowledgeable and using good information
2. Taking time to think
3. Being consistent
4. Keeping the system simple, while using advanced breeding technology
5. Being patient

- Richard Bourdon (1997), *Understanding Animal Breeding*

While the importance of genetics in achieving breeding and production goals is non-contentious, there is some contention as to the effectiveness of quantitative genetics over traditional selection methods, and significant contention as to how quantitative genetics can best be used in a commercial operating environment. The different breeding philosophies and associated practices that are used by individual enterprises in a livestock industry are derived from and determined by the individual skills, tradition, emotion, social, operationally practical and/or economic drivers of that enterprise.[27] At the very least, the extent to which quantitative genetics is used by seed-stock and commercial producers in any livestock industry is a function of personal perceptions as to the relative effectiveness of the system, as well as practical commercial considerations such as cost and operational fit with the specific nature of an individual enterprise and its production targets. Most seed-stock and commercial producers that use quantitative genetics, use it in combination with traditional selection techniques to varying degrees to inform breeding and purchase decisions.

The emergence of genomic technologies in the past decade and their commercial application in livestock industries over the past few years, has bought an even greater degree of certainty in the application of genetic science to breeding and animal purchase decisions.

1.3.2 The Global Livestock Genetics Industry

There has been considerable expansion of the livestock genetics industry over the past decade. This has been driven by:

- The significant advances in livestock genetics technology discussed above;
- Increased demand for products and services designed to help producers profitably produce larger volumes of animals that meet specific market specifications that is derived from the increasing global market demand for animal based food discussed in Section 1.1; and
- A greater awareness among livestock producers of the genetic influences on veterinary diseases and disorders.[28]

The market for livestock genetic products and services can be segmented according to products and testing services, by geography and then according to live animal and genetic materials. The live animal segment is the largest and fastest growing segment. This segment is further segmented according to species (e.g. canine, equine, poultry, porcine, bovine, ovine etc). The genetic material market is segmented into semen and embryos. From a geographical perspective, North America is the largest market, followed by Europe and the Asia Pacific region, with the strongest immediate growth expected in the less mature Asia Pacific region.[29]

[27] Cardellino, R. (2015), *Global Sheep Flock – What Happened and Where to Now?,* Mercado Expert Market Analysis
[28] MarketsandMarkets (2015), *Animal Genetics Markets by Products*
[29] MarketsandMarkets (2015), *Animal Genetics Markets by Products*

Figure 8 below illustrates the segmentation of the global animal genetics industry.

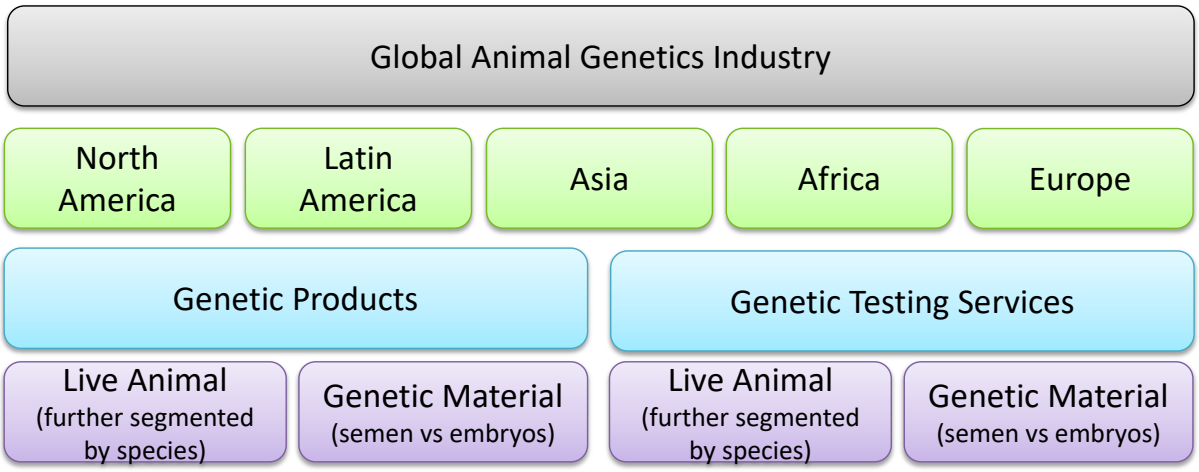

Figure 8 – Structure of the Global Animal Genetics Industry

The main players in the global livestock genetics industry are summarised in Table 2 below. It is important to note that bovine production is a significant focus of this industry.

Company	Sector Focus	Product Focus
Animal Genetics Inc. (United States)	Avian, canine, equine, bovine, reptile, feline, sheep & alpaca	Genetic testing
Genus Plc (United Kingdom)	Porcine and bovine	Proprietary lines of breeding animals
Topigs Norsvin (Netherlands)	Porcine	Proprietary lines of breeding animals
Harlan Laboratories Inc (United States)		
Hendrix Genetics BV (Netherlands)	Poultry, porcine and aquaculture	Proprietary lines of breeding animals
Aviagen Group (United States)	Poultry	Proprietary lines of breeding animals
Neogen Corporation (United States)	Bovine, canine, equine, ovine and porcine	Genomics testing and services
Alta Genetics (Canada)	Bovine	Proprietary lines of semen
VetGen (United States)	Canine, feline, equine, porcine and bovine	Genetic testing
Zoetis Inc (United States)	Bovine, feline, canine, equine, porcine, poultry, ovine and rabbits	Genetic testing

Table 2 – Major Players in the Global Animal Genetics Industry

1.3.3 Genetics and the Australian Beef Industry

In the context of the Australian beef industry, the importance of modern genetic science in meeting production objectives and managing disease is emphasised by the following observations. Firstly, with respect to achieving production goals, Figure 9 below illustrates the genetic gain that has been achieved by clients of Southern Beef Technology Services and Tropical Beef Technology Services, which are extension programs focused on training seed-stock and commercial producers on the use of genetic technologies in animal selection decisions. While this gain may not be attributable solely to the use of genetic technologies by these seed-stock operators, it stands to reason that the technology has had a significant impact.

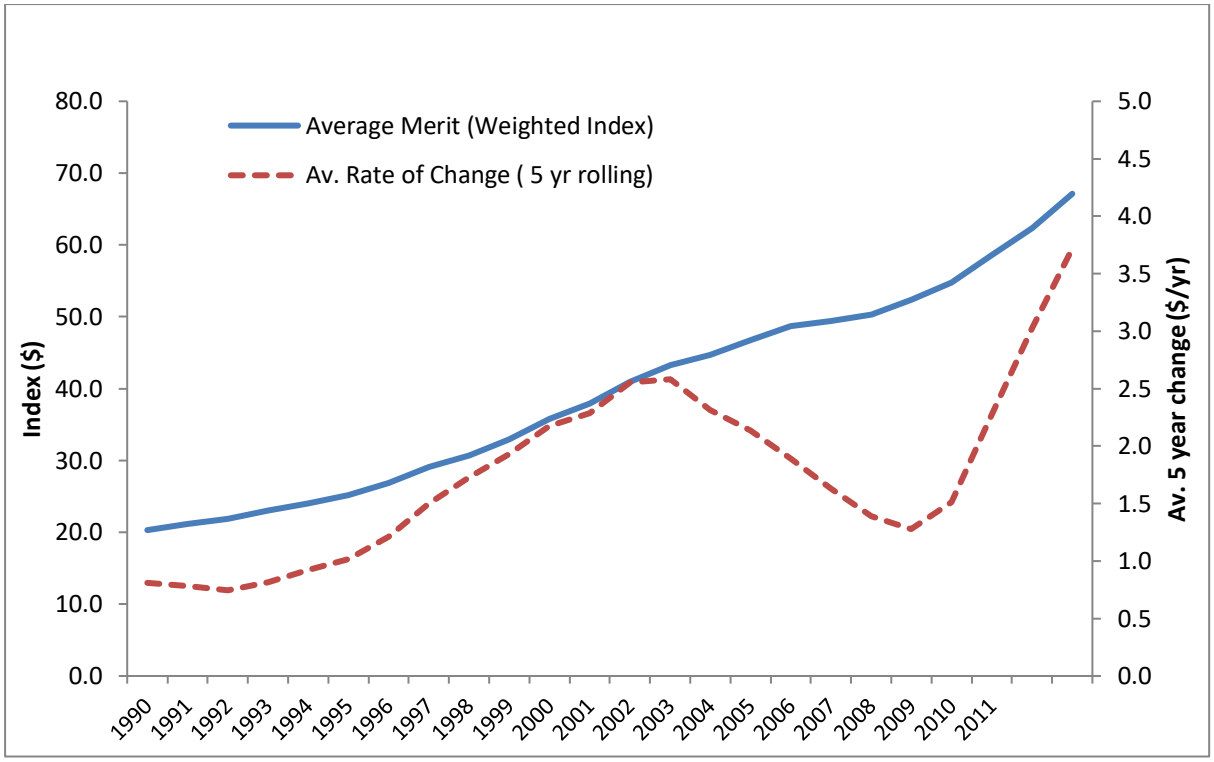

Figure 9 – Genetic Change ($) – All Breeds on Southern Beef Technology Services and Tropical Beef Technology Services (1990 to 2016)

Secondly, in the area of animal health, it has been estimated that prevention, treatment and lost production associated with various diseases that affect the northern and southern Australian cattle industry costs the industry between $506 million and $535 million annually. These estimates are summarised in Table 3[30] below. The Australian beef industry has much to gain from using genetic technology to select for resistance to these diseases.

Disease	National Economic Cost Estimate 2006 (Sackett et al)	National Economic Cost Estimate 2015 (Lane et al)
Cattle tick	$147m	$161m
Bovine Ephemeral Fever	$101m	$59.8m
Buffalo Fly	$78m	$98.7m
Bloat	$49m	$76.8m
Mastitis	$40m	n.a.
Vibriosis	n.a.	$21m
Bovine Respiratory Disease	$40m	n.a.
Internal parasites	$39m	$93.6m
Grass tetany	$12m	$24.3m
TOTAL	$506m	$535.2m

Table 3 – Estimated Annual Costs of Major Health Issues in the Australian Cattle Industry

1.3.4 BREEDPLAN

Central to the application of modern genetics science and technology to breeding and purchasing decisions in the Australian beef cattle industry is BREEDPLAN. BREEDPLAN is the national genetic

[30] Sackett et al and Lane et al IN: Australian Farm Institute (2015), *The Economic Importance of Australia's Livestock Industries and the Role of Animal Medicines and Productivity Enhancing Technologies,* Animal Medicines Australia

evaluation system for beef cattle in Australia, also used for various breeds in other countries. BREEDPLAN uses a quantitative genetics methodology known as Best Linear Unbiased Prediction (BLUP) to generate a statistical estimate of genetic value of individual animals in the form of Estimated Breeding Values (EBVs) or indices that represent a collection of EBVs

BREEDPLAN is used by a significant portion of the Australian beef cattle seed-stock sector and some commercial producers for informing joining and animal selection decisions (see Section 5.3). However, as is the case in most livestock industries, BREEDPLAN is not used by all seed-stock and commercial operators, and even those producers who do use BREEDPLAN, use it with varying degrees of rigour (see Section 5.4).

For decades, BREEDPLAN has been distributed to the Australian beef cattle seed-stock sector through a relatively long supply chain involving several intermediaries (see Section 5.2). This model has resulted in significant adoption of BREEDPLAN among some breeds, particularly in the seed-stock sector, which in turn has unquestionably contributed to genetic gain. However, espoused concerns among some stakeholders as to cost, service quality and pace of innovation, level of adoption and an evolving seed-stock sector structure, are raising concerns that the current model is compromising or beginning to compromise the BREEDPLAN owner's objective of optimising the rate of genetic gain across the Australian beef industry.

2 Project objectives

From many respects BREEDPLAN has delivered. It has achieved a relatively high rate of adoption across some of the main breeds that comprise the Australian beef cattle seed-stock sector, and the general consensus is that it has at least contributed to genetic gain across animals that are produced by the seed-stock sector. However, there is also evidence of some frustration if not dissatisfaction with BREEDPLAN among some stakeholders.

Concerns have been raised by some stakeholders that escalating costs, declining quality of service and slow and selective innovation projects are slowing the rate of adoption and resulting in customers not using BREEDPLAN with an adequate degree of rigour. This combined with a perception based on some anecdotal evidence that there is a growing unregistered sector that, under current arrangements, face some challenges with respect to accessing BREEDPLAN, has led to concern among the owners of BREEDPLAN that it is not delivering an optimal rate of growth in genetic gain.

2.1 Project Purpose

The purpose of this project is to prepare a revised or new commercialisation plan for BREEDPLAN that ensures that it is a sustainable enterprise, continues to facilitate an optimal rate of genetic gain by adequately meeting the service expectations of the industry it serves and is compliant with Meat and Livestock Australia's (MLA) statutory and contractual responsibilities with respect to the use of Commonwealth Government and levy-payer funds.

2.2 Project Objectives

The specific objectives of the project are as follows:

1. Conduct a desktop review of the current commercialisation arrangements and identification of issues that currently limit impact including:
    a. Role and responsibility of all stakeholders in the delivery of BREEDPLAN, including accountability, KPIs and commerciality of KPIs;
    b. Operation and service delivery cycle and planning execution around that cycle;
    c. Data access rights for supporting research and ongoing product development; and
    d. Barriers to commercialisation contained in the license agreement and any other legal or commercial arrangements pertaining to BREEDPLAN
2. Consultation with key industry stakeholders to scope the attributes of a revised BREEDPLAN commercialisation model that will enhance the impact of BREEDPLAN delivery to industry.
3. Conduct an economic evaluation of the revised BREEDPLAN commercialisation model, including sensitivity analysis and risk assessment.
4. Present the results of activities 1, 2 and 3 in a new or revised BREEDPLAN commercialisation plan, including steps for ensuring successful implementation is achieved and demonstrable measures of performance.
5. Include recommendations for further R&D to be conducted that will underpin ongoing enhancement and development of BREEDPLAN delivery to industry.

3 Methodology

3.1 Literature Review

This analysis has involved an extensive review of contemporary literature pertaining to BREEDPLAN and the environment in which it operates. This has included data and analysis pertaining to:

- Structure and trends in the Australian beef industry and the markets in which it operates;
- Adoption and usage of BREEDPLAN across the various breeds that comprise the Australian beef cattle industry;
- Genetic gain across the various breeds that comprise the Australian beef cattle industry;
- Strategic and business planning documentation relating to the various participants in the value chain that delivers BREEDPLAN to the Australian beef cattle seed-stock sector;
- Licensing and other contractual arrangements between participants in the value chain that delivers BREEDPLAN to the Australian beef cattle seed-stock sector;
- The economics of various participants in the value chain that delivers BREEDPLAN to the Australian beef cattle seed-stock sector;
- Market surveys relating to BREEDPLAN and its usage; and
- Previous technical and commercial reviews of BREEDPLAN.

Some of the information that has been provided to Australian Venture Consultants by third parties for the purposes of this review is the subject of a confidentiality and non-disclosure agreement. In order to comply with the provisions of this agreement, some results that are presented in this study are deliberately vague and provided for indicative purposes only. This applies particularly to the economic analysis contained in Section 5.5.

3.2 Semi-structured Interviews

A series of semi-structured interviews were undertaken with the following categories of BREEDLAN stakeholders:

- Management in the organisations that own the BREEDPLAN core analytical software;
- Management in ABRI;
- Management in AGBU;
- Management of the breed associations for Shorthorn, Charolais, Angus, Red Angus, Santa Gertrudis, Simmental, Droughtmaster, Bahman, Wagyu and Hereford Breeds;
- Seed-stock producers in the Shorthorn, Charolais, Angus, Red Angus, Santa Gertrudis, Simmental, Droughtmaster, Bahman, Wagyu and Hereford Breeds.

The semi-structured interviews were designed to ascertain different perspectives on benefits and drawbacks associated with using BREEDPLAN, how BREEDPLAN is used and the effectiveness of the current value chain through which BREEDPLAN is delivered to the Australian beef cattle seed-stock sector.

Semi-structured interviews were undertaken with individuals listed in Table 4 below.

Interviewee	Position	Organisation	Category
Frank Archer	Proprietor	Landfall Angus	Producer (Angus)
Alex Ball	Chief Executive Officer	Herefords Australia	Breed Association
Robert Banks	Director	Animal Genetics Breeding Unit (AGBU	
Robert Biddle	Chief Executive Officer	Australian Brahman Breeder's Association	
David Bondfield	Proprietor	Palgrove	Producer (Charolais)
Andrew Chapman	Proprietor	Rowanlea Stud	Producer (Santa Gertrudis)
John Croaker	Former General Manager	Australian Brahman Breeders' Association	Breed Association
Steve Crowley	Proprietor	Tycolah	Producer (Hereford)
Heiko Daniel	Pro Vice-chancellor – Research	University of New England	BREEDPLAN Owner
Neil Donaldson	Chief Executive Officer	Droughtmaster	Breed Association
Andrew Donoghue	Commercial Development Officer	Herefords Australia	Breed Association
Greg Frizell	Proprietor	Wakefield Study	Producer (Charolais)
Dougal Gordon	Group Director – Livestock Systems	New South Wales Department of Primary Industries	BREEDPLAN Owner
Marc Greening	Proprietor	Injemira Beef Genetics	Producer (Hereford)
David Greenup	Proprietor	Rosevale Stud	Producer (Santa Gertrudis)
Ben Hill	Proprietor	Bulliac Angus	Producer (Angus)
Sion Jones	Director – Beef Industries	New South Wales Department of Primary Industries	BREEDPLAN Owner
Peter Mahony	Proprietor	Gyranda Stud	Producer (Santa Gertrudis)
Kate McDonald	Executive Officer	Red Angus Society of Australia	Breed Association
Ian McDouall	Proprietor	Dunbeacon Shorthorn	Producer (Shorthorn)
Hugh Nivison	Managing Director	Agricultural Business Research Institute (ABRI)	BREEDPLAN Operator
Tom Nixon	Proprietor	Devon Court Herefords	Producer (Hereford)
Ben Noller	General Manager	Santa Gertrudis Breeders (Australia) Association	Breed Association
Peter Parnell	Chief Executive Officer	Angus Australia	Breed Association
Felicity Reeves	Executive Officer	Simmental Australia	Breed Association
Colin Rex	Breed Development Manager	Charolais Society of Australia	Breed Association
Carel Teseling	Technical Services Manager	Australian Wagyu Association	Breed Association
Graham Truscott	Chief Executive Officer	Australian Wagyu Association	Breed Association
Neil Watson	Proprietor	Watasanta Stud	Producer (Santa Gertrudis)
Sam White	Proprietor	Bald Blair Angus	Producer (Angus)
Graham Winnell	Business and Promotions Manager	Shorthorn Beef	Breed Association
Peter Wenn	President	Simmental Australia	Breed Association

Table 4 - Interviewees

3.3 Value Chain Economic Modelling

Based on limited information that has been provided under the confidentiality and non-disclosure arrangements discussed in Section 3.1 above, an economic model of the value chain that delivers BREEDPLAN to market has been developed. This model estimates the revenues and costs incurred by each participant in the value chain that delivers BREEDPLAN, in order to illuminate the economics (revenues, costs and surplus) faced by those participants with respect to their involvement in that value chain.

3.4 Synthesis and Issues Analysis

The research and analysis referred to in Sections 3.1, 3.2 and 3.3 is discussed in detail in Section 5 of this report. This research and analysis is then synthesised into the elements that comprise the perceived problem and they key issues that contribute to it.

3.5 Options Generation and Assessment

Based on the synthesis and issues analysis in Section 5, Section 6 identifies and discusses the comparative merits of several options designed to address the problems and issues identified with respect to the delivery of BREEDPLAN for the purpose of optimising the rate of genetic gain across the industry. Section 4, discusses in more detail the preferred option and a plan for its implementation.

4 Results

The analysis the subject of this report has concluded that the existing value chain should continue to deliver BREEDPLAN to market. However, a number of initiatives should be undertaken to reinvigorate the effectiveness of the BREEDPLAN value chain, namely:

- Adopt a strategic approach to managing the value chain overall;
- Implement an Owner's Agreement;
- Implement a degree of financial transparency between participants along the value chain;
- Migrate to a model of relatively consistent pricing of BREEDPLAN to breed associations;
- Develop a strategy for improved engagement with the unregistered sector;
- Develop and invest in a value chain owned innovation and product development plan;
- Resource breed associations to promote and support BREEDPLAN; and
- Responsibly introduce competition to aspects of the existing BREEDPLAN value chain, but not to the BREEDPLAN service itself.

5 Discussion

5.1 The BREEDPLAN Service

This section provides a brief overview of the history of BREEDPLAN, its technical basis, future development trajectory and current product and services portfolio.

5.1.1 The Formation of BREEDPLAN

BREEDPLAN is founded in the National Beef Recording Scheme (NBRS). Established in 1972, the NBRS revolved around the recording of basic objective measurements of individual animal weight on a national database, with that data being widely available to producers for the purpose of informing breeding decisions.

In 1976, the Animal Genetics and Breeding Unit (AGBU) was established as a joint venture between the New South Wales Department of Primary Industries (NSWDPI) and the University of New England

(UNE). In 1978, NSWDPI appointed a national coordinator to the NBRS and contracted AGBU as a provider of technical services to the NBRS.

Over the course of the following several years, AGBU worked with the NBRS to develop a system to assess individual cattle with records submitted to the NBRS according to their estimated genetic merit. This was achieved by objectively measuring commercially relevant traits in individual animals that had been produced in adequately similar production environments, making adjustments in measurements to account for any known differences in production environments, ranking animals for the specific measured trait and estimating the heritability of those traits from those animals. This allowed AGBU to use the NBRS database as a basis for predicting (with varying degrees of accuracy) the genetic value of individual animals registered with the database. Expressed as Estimated Breeding Values (EBVs), the first breed to publish EBVs from this system was Simmental in 1982.

Over the course of the next three years, this service evolved into a service based on quantitative genetics methodology and was officially launched as BREEDPLAN in 1985.

5.1.2 The Technical Basis of BREEDPLAN

Traits that are determined by genetics are of the following types:

- **Discontinuous (or discrete) traits** are binary in that they are either expressed or not and are typically determined by a single, or small number of genes.
- **Continuous traits** are presented as a distribution of phenotypes in the population along a continuum whereby individuals within a population will display a particular trait to varying degrees. Continuous traits are polygenic, meaning they are determined by a much larger number of individual genes than discontinuous traits.

In livestock industries most traits that are of commercial interest such as biological food conversion rate, fecundity and maternal characteristics, temperament, disease resistance and product yield are continuous traits. The polygenic nature of continuous traits means that the extent to which those exhibited by a sire and/or dame are expressed in progeny is very difficult to predict without the application of modern genetic science.

5.1.2.1 Quantitative Genetics and Best Linear Unbiased Prediction

Quantitative genetics is a mathematical tool used to estimate the likely inheritance of continuous traits by studying the correlation between parent and offspring to quantify the degree to which a continuous trait is inherited. That is, rather than considering changes in the frequencies of specific allele of genotypes, quantitative genetics seeks to quantify changes in the frequency distribution of traits that cannot easily be placed in discrete phenotypic classes.

The basic tenet of quantitative genetics is that variation seen the phenotypic expression of continuous traits is due to a combination of many genes each contributing a small amount, as well as environmental factors that influence the extent to which that continuous trait is expressed. In quantitative genetics the phenotypes of individuals of known genetic relationship (typically parents and offspring or siblings) are measured and the genetic and environmental sources of phenotypic variation are determined statistically.

This calculation requires a mixed statistical model that can accommodate both fixed and random effects. As the basis for its quantitative genetics calculations, BREEDPLAN uses a mixed statistical model known as Best Linear Unbiased Prediction (BLUP), a well-established methodology for generating breeding values for the purpose of supporting breeding decisions in livestock industries.[31]

The BLUP based model used by BREEDPLAN requires a range of data inputs including pedigree, performance measurement records and other information on the management of individual animals.

5.1.2.2 Estimated Breeding Values

The base output from BLUP is an estimate of an individual animal's genetic merit for a specific trait, known as an Estimated Breeding Value (EBV). EBVs are expressed in units in which a specific trait would be measured. For example, EBVs pertaining to weight gain are expressed in kilograms at a particularly point in time.

The current BLUP based BREEDPLAN analytical software can accommodate up to 26 traits in an analysis and facilitates comparison within and across herds at different points in time. BREEDPLAN is able to calculate a range of EBVs, broadly categorised as those pertaining to weight, fertility or calving, carcase attributes and other traits. BREEDPLAN EBVs are listed in Table 5 below, and described in detail in Appendix 1.

Weight EBVs	Fertility/Calving EBVs	Carcase EBVs	Other EBVs
Birth weight	Scrotal Size	Eye Muscle Area	Docility
200 Day Milk	Days to Calving	Fat Depth	Net Feed Intake
200 Day Growth	Gestation Length	Retail Beef Yield	Structural Soundness
400 Day Weight	Calving Ease	Intramuscular Fat	Flight Time
600 Day Weight		Carcase Weight	
Mature Cow Weight		Shear Force	

Table 5 – BREEDPLAN Estimated Breeding Values (EBVs)

5.1.2.3 BREEDPLAN is a Within Breed Analysis

EBVs are expressed as the difference between an individual animal's genetic merit and the genetic base to which the animal is being compared. Because, in the case of BREEDPLAN, each breed association conducts its own evaluation, only animals within a specific breed can be compared under BREEDPLAN. Therefore, the genetic base for BREEDPLAN is the historical genetic level of each breed.

For most beef cattle breeds, the historical genetic level was set in the mid-1990s. However, importantly, the genetic base is different for each breed, so only EBVs for animals within a specific breed evaluation program can be directly compared under BREEDPLAN.

EBVs are only available if sufficient data has been recorded for that trait and as such, a full range of EBVs may not be available for each particular breed, and even where adequate data exists, the accuracy of the EBV will be affected by the volume and range of information that is available to calculate the EBV.

[31] Ober, U., Erbe, M., Long, N., porcu, E., Schlather, M., Simianer, H. (2011), 'Predicting genetic values: A kernel-based best linear unbiased prediction with genomic data', *Genetics,* 188(3), pp.695-708

This differs to the evaluation framework used in the Australian sheep industry, where evaluation is undertaken across defined groups of breeds where the data available allows such comparison to be made with known reliability (see Section 5.6).

5.1.2.4 Accuracy of BREEDPLAN Estimated Breeding Values

Because EBVs are a statistical estimate of an animal's true breeding value they are subject to confidence intervals, which based on the data from which they have been derived, are variable across datasets. To counter this, BREEDPLAN also produces an accuracy estimate for each EBV. These accuracy factors provide a measure of the stability of the EBV and give an indication of the amount of information that has been used in the calculation of the EBV. The higher the accuracy factor, the more information that has been used in the calculation of the EBV and therefore, the lower the likelihood of change in the animal's EBV as more information comes to hand for that animal, its progeny or its relatives.

The accuracy factor ranges and their approximate descriptions are summarised in Table 6[32] below.

Accuracy Factor Range	Approximate Description
Less than 50 percent	EBVs are preliminary and will have been calculated on very limited information. EBVs with an accuracy factor in this range could change substantially as more direct performance information becomes available on the animal.
51 to 74 percent	EBVs are of medium accuracy. EBVs in this range will usually have been calculated based on the animal's own performance and some limited pedigree information.
75 to 90 percent	EBVs are of medium-high accuracy. EBVs in this range will usually have been calculated based on the animals own performance coupled with the performance for a small number of the animal's progeny.
Greater than 90 percent	EBVs are highly accurate. It is unlikely that the EBVs will change considerably with the addition or more progeny data.

Table 6 – BREEDPLAN EBV Accuracy Factors

All things being equal, the breed associations that have large quantities of animal records for specific traits that have been accumulated over multiple generations, will demonstrate higher accuracy factors for those traits than breed associations that typically don't have the same breadth and depth of pedigree and performance measurement data.

5.1.2.5 BREEDPLAN Indices

In 1990, BREEDObject software was developed to combine traits into single indices, such as the Profit Index, which is a combination of a range of economically weighted traits. Different indices have been developed for different breeds, production systems and goals. These Index products are designed to render animal selection using BREEDPLAN simpler for customers who are unable or do not wish to assess and analyse individual EBVs. They provide the best estimate of overall genetic merit for the whole value chain for the production system and target market being modelled.

5.1.2.6 Genomics

The term *genome* refers to the complete set of genes and genetic material that comprise an organism. *Genomics* is the science of understanding the structure, function, evolution and mapping of the genome.

[32] The ranges set out in Table 6 are not formally or theoretically defined. They are simple ranges used in extension material to describe the potential change in the EBV as more data is used in the evaluation.

In 2011, BREEDPLAN began combining genomic information with traditional trait measurements to produce what are referred to as genomically enhanced EBVs (GEBVs).[33] The introduction of genomics to BREEDPLAN has two main advantages:

- Improving the accuracy of EBVs by validating the statistical assessment; and
- Reducing the labour involved in assessing an animal.

In order to attain a GEBV the following three data points are required:

- Pedigree;
- Performance measurement dataset; and
- Genotype, which is typically acquired from a DNA test.

Producers will be able to access a GEBV simply by acquiring a DNA test on an animal. However, this risks demotivating producers to undertake labour intensive performance measures, ultimately diluting the performance measurement database and undermining the effectiveness of the system. This is a significant risk to the ongoing effectiveness of BREEDPLAN.

5.1.3 BREEDPLAN Product Components

5.1.3.1 BREEDPLAN Core Analytical Software

All BREEDPLAN products are services are based on the BREEDPLAN Core analytical software, which is jointly owned by MLA, University of New England and New South Wales Department of Primary Industry. The BREEDPLAN core analytical software has undergone numerous version upgrades since it was launched in 1985. The evolution of the BREEDPLAN Core Analytical Software is summarised in Figure 10.

[33] Cumming, B. (2015), 'BREEDPLAN – 30 years of taking the guesswork out of cattle breeding', *2015 Graham Centre Beef Forum*, Charles Sturt University and New South Wales Department of Primary Industries

1985	First Generation BREEDPLAN	Within-herd evaluation only
1986	GROUP BREEDPLAN Module	Accommodation of across-herd evaluation
1988	Second Generation BREEDPLAN and GROUP BREEDPLAN	Direct and maternal effects for birth weight, repeated measures and MOET, calving ease (CE) and calculation algorithms enhanced
1990	BREEDPLAN International	International service
1991	Third generation BREEDPLAN	Completely new computing algorithm, increasing the range of traits and improving efficiency of use of information. Capability for plotting trends made available
1996	Version 4	Ability to analyse all traits except CE in a single analysis eliminating some anomalies that occurred when traits were analysed separately, some new traits introduced
1999	Version 4.1	Accounting for sire X herd interactions, heterogeneous variances, use of overseas information, a new genetic grouping strategy, carcase trait module and methods for including crossbred and across-breed EBVs, as well as some enhancements to BREEDObject
2002	Version 4.2	Separate analyses for docility and net feed intake, revised handling of mature cow weight data and some revision to trait ranges and parameters
2005	Version 4.3	Revised procedures for handling imported expected progeny differences from overseas and new solving algorithm introduced
2011	Version 6.1	Migrated to Linux platform, revised solving algorithm and capacity for post-BLUP blending of genomic prediction values into BLUP solutions
2011	Version 6.2	Revised methodology for genetic groupings, additional traits (flight time, shear force, net feed intake) added to the multi-trait BLUP, commencement of development of genetically enhanced EBVs
2013	Version 6.4	Revised version of docility code
2017	Single Step	First release of Single-step Analysis

Figure 10 – Development History of the BREEDPLAN Core Analytical Software

5.1.3.2 BREEDPLAN Value Adding Software Modules

The Owners, AGBU, ABRI and other entities have developed complementary software modules that enhance the functionality of BREEDPLAN for different target markets. These products are summarised in Figure 11 below.

Online Database	Through the BREEDPLAN website, members can access the online database to search for a range of animal and EBV details, research pedigrees, view online sale and semen catalogues, search member details, download files, predict mating and inbreeding outcomes and make online submissions of pedigree and performance information
BREEDObject	BREEDObject calculates selection indexes which enable animals to be ranked on their overall genetic value for a particular breeding purpose. This overall objective is distilled into a series of weightings placed on individual EBVs relative to the contribution that each trait makes to the profitability of commercial enterprises targeting that particular production system and market endpoint.
GeneProb	GeneProb is a tool for managing genetic condition which predicts the probability of untested animals being carriers for undesirable recessive conditions.
MateSel	MateSel evaluates a list of available sires and dams and predicts which matings would result in the greatest genetic gain subject to certain constraints such as minimising inbreeding.
TakeStock	TakeStock allows breeders to assess and improve their rates of genetic progress by benchmarking herd progress and identifying key performance indicators.
Completeness of Performance	This tool summarises the quantity of information that each herd has recorded with BREEDPLAN through annual distribution of reports and the calculation of an overall ‘star’ rating for each herd. It is designed to encourage complete performance recording by breeders. It is based on DataAudit software developed by AGBU.

Figure 11 – BREEDPLAN Complementary Software Products

5.2 BREEDPLAN Value Chain

The value chain through which BREEDPLAN is delivered to the Australian beef cattle seed-stock sector is relatively long and complex for what is a fairly simple information technology based product. The value chain is characterised by five levels, some of which are connected by relatively complex equity, intellectual property and licensing arrangements. The levels that comprise the BREEDPLAN value chain are summarised in Table 7 below.

BREEDPLAN Value Chain Element	Description
Owners	BREEDPLAN is based on core analytical software that is jointly owned by MLA, UNE and NSWDPI and licensed to the Agricultural Business Research Institute (ABRI), a not-for-profit entity that is wholly-owned by UNE.
BREEDPLAN service business	With support from AGBU, ABRI uses the core analytical software to process animal performance data submitted by seed-stock producers (and some commercial producers) and breed associations to produce EBVs and Indices and reports those back to its customers. ABRI has also developed or licensed a suite of complementary software products that enable their customers to better use BREEDPLAN or derive other functionality from BREEDPLAN.
Distribution channel	ABRI distributes BREEDPLAN and its proprietary complementary software services almost exclusively[34] through the various breed associations that comprise the Australian beef cattle seed-stock sector. It does this under contractual terms and conditions that are specific to each breed association. While the terms of these agreements may not necessarily provide contractual exclusivity, the fact is that there are cost and practical limitations with respect to accessing BREEDPLAN without going through a breed association, and most importantly, a user of BREEDPLAN that is not a breed association member is not able to access the breed association's BREEDPLAN database, and is therefore limited to within-herd analysis.
Seed-stock producers	Seed-stock producers (and some commercial producers) who subscribe to BREEDPLAN perform various objective performance measurements on animals and submit that data to ABRI either directly or through their breed association, depending on the nature of the commercial arrangements between ABRI and their breed association. Those seed-stock producers (and some commercial producers) use the EBVs and indices that are then provided by BREEDPLAN to inform breeding decisions and/or to market bulls.
Commercial producers	Commercial producers purchase bulls from seed-stock producers using BREEDPLAN EBVs and Indices to inform their purchasing decision. Additionally, some commercial producers subscribe to BREEDPLAN, undertake and submit performance measurements and use the resulting EBVs and/or indices to inform their own on-farm breeding decisions. While commercial producers do not necessarily need to be a member of a breed association to use BREEDPLAN, they do need to be a breed association member if they want to get EBVs within a specific breed's BREEDPLAN analysis (i.e. GroupBREEDPLAN).

Table 7 – Levels of the BREEDPLAN Value Chain

Figure 12 below illustrates the organisational relationships that comprise the BREEDPLAN value chain, as well as the equity, licensing, service agreement and other transactional arrangements that define those relationships.

[34] A small number of unregistered seed-stock and commercial producers (10 in total) access a within-herd, or very limited across herd BREEDPLAN evaluation product directly through ABRI (see Section 5.2.4).

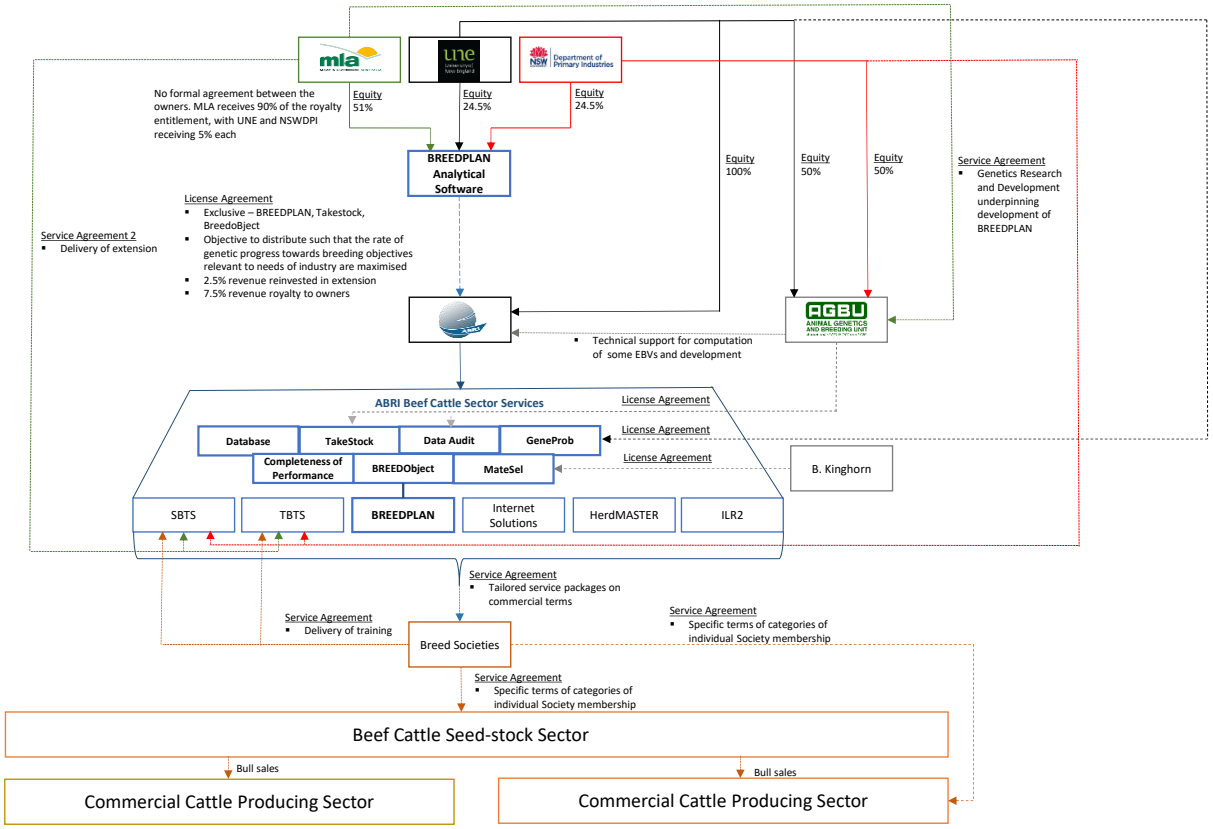

Figure 12 – BREEDPLAN Value Chain

The participants in the BREEDPLAN value chain and the relationship between those participants are described in detail in the following subsections.

5.2.1 Owners of the Core Analytical Software

The core analytical software that is used to calculate EBVs and indices is owned by MLA (51.0 percent), UNE (24.5 percent) and NSWDPI (24.5 percent) (the 'Owners'). While there is not a formal agreement between Owners that articulates the ownership or regulates the relationship between them, it is understood that:

- The equity holdings of the individual Owners is intended to reflect their relative historical in-kind and cash investment in the development of the BREEDPLAN core analytical software;
- It has been agreed that modifications to the terms of the licensing agreement with ABRI (see Section 5.2.1.1) or termination of that agreement can only be effected upon the unanimous consent of the Owners; and
- In 2010, the Owners agreed that UNE and NSWDPI would forgo 80 percent of their annual royalty entitlement under the licensing agreement, allocating that revenue to MLA in recognition of its ongoing investment in the research and development that underpins BREEDPLAN (see Section 5.5.5.1).

5.2.1.1 Core Analytical Software Licensing Agreement

Appendix 2 details the key operative clauses of the BREEDPLAN core analytical software licensing agreement between the Owners and ABRI. The commercial implication of these clauses are summarised as follows:

- The objective of the licensing agreement is to commercialise and distribute the software for the purpose of maximising the rate of genetic progress toward breeding objectives that are relevant to industry;
- ABRI has been granted the license on a world-wide exclusive basis;
- ABRI must pay the Owners a royalty equivalent to 7.5 percent of the BREEDPLAN revenue generated by ABRI through the use of the software;
- ABRI must spend 2.5 percent of revenue each year on the coordination of a national extension program designed to promote a better understanding of BREEDPLAN among the seed-stock sector;
- There is a prescribed role for AGBU to deliver a range of technical services to ABRI on behalf of the Owners, and some limitations with respect to ABRI using an alternative provider of some technical services to the exclusion of AGBU;
- There is a requirement that AGBU not provide genetic evaluation to any beef party using the Analytical Software of similar;
- ABRI must produce an annual operating plan pertaining to the development and commercialisation of BREEDPLAN to be approved by the Owners, whereby non-approval is a trigger for termination of the license agreement;
- ABRI must routinely report to the Owners with respect to performance of the BREEDPLAN business and progress on the operational plan; and
- In any event, changes to or termination of the licensing agreement may only be given effect by the unanimous consent of the Owners.
- Requirement for any changes to the licensing agreement either negotiated with ABRI or as a result of a termination event having been triggered, must be agreed unanimously among the Owners.

5.2.1.2 The Strategic Intent and Fiduciary Duties of the Owners

5.2.1.2.1 Meat and Livestock Australia

Meat and Livestock Australia (MLA) holds a 51 percent equity interest in the BREEDPLAN Core Analytical Software, provides research and development grants to AGBU in order to support the ongoing development of BREEDPLAN and provides financial and in-kind assistance to the extension programs that support BREEDPLAN, Southern Beef Technology Services and Tropical Beef Technology Services.

MLA is an industry owned Rural Research Development Corporation (RDC) that has been enacted and has adopted its form by declaration of the Australian Government Minister for Agriculture and Water Resources pursuant to Part 3 Division 2 of the *Australian Meat and Livestock Industry Act 1997* (Cth).

MLA is a company limited by guarantee and therefore operates under the jurisdiction of the *Corporations Act 2001* (Cth). Section 2(1) of MLA's Memorandum and Articles sets out a number of objectives for MLA that are summarised in Appendix 3.

MLA is resourced primarily by a levy that is charged by the Australian Government on primary producers of meat products from beef cattle, meat sheep and goats pursuant to Part 3 Division 3 of the *Australian Meat and Livestock Industry Act 1997* (Cth). This levy is matched 1:1 by the Australian Government from consolidated revenue sources and the total amount is provided to MLA under a

funding agreement. The current funding agreement between MLA and the Australian Government came into effect in October 2016 and expires in October 2020.

Very specifically, Clause 26.2 of the funding agreement between MLA and the Commonwealth states that funds that are the subject of the funding agreement may only be applied by MLA as follows:

- Marketing funds may only be spent on marketing activities related to the industry and for the benefit of the industry;
- Research and development funds may only be spent on research and development activities related to the industry and for the benefit of the industry; and
- Commonwealth matching payments for research and development activities related to the industry and for the benefit of the industry and flow-on benefits to the Australian community.

Clause 30.1 of the funding agreement requires MLA to maintain a strategic plan that covers a three to five year period. The current MLA strategic plan is for the period 2016 to 2020. MLA also ensures that its strategic plan is aligned with the Australian Government Science and Research Priorities, Rural Research, Development and Extension Priorities, Levy Principles and Guidelines and the Meat Industry Strategic Plan. Details of these various documents are contained in Appendix 3. Table 8 summarises how MLA's continued Ownership of the BREEDPLAN Core Analytical Software and investment in research and development that supports BREEDPLAN is aligned with these various documents.

Document	BREEDPLAN Alignment
MLA Memorandum and Articles	MLA's interests in BREEDPLAN are aligned with all objectives set out in MLA's Memorandum and Articles
MLA Strategic Plan	MLA's interests in BREEDPLAN are aligned with MLA's strategic priorities ▪ Genetics research will improve breeding values for traits that drive profit, ensuring a closer relationship between what producers breed for and what they get paid in terms of eating quality; ▪ Genetics and genomic programs and services will help provide producers and lot-feeders with options to improve efficiency of operations
Australian Government Science and Research Priorities	MLA's interests in BREEDPLAN are aligned with the following Australian Government science and research priority: ▪ Genetic composition of food sources appropriate for present and emerging Australian conditions.
Rural Research, Development and Extension Priorities	MLA's interests in BREEDPLAN are aligned with the following Australian Rural Research, Development and Extension Priority: ▪ Advanced technology to enhance innovation of products, processes and practices across the food and fibre supply chains through technologies such as robotics, digitisation, big data, genetics and precision agriculture.
Levy Principles and Guidelines	MLA's investment in research and development that underpins the ongoing development of BREEDPLAN is consistent with the following levy principle: ▪ The proposed levy must relate to a function for which there is market failure.
Meat Industry Strategic Plan	MLA's interests in BREEDPLAN are aligned with the following priorities in the Meat Industry Strategic Plan: ▪ Optimising product quality and cost efficiency ▪ Production efficiency in farms and feedlots

Table 8 – BREEDPLAN Alignment with MLA's Strategic Intent

Prima facie, it would appear that MLA's continued ownership of BREEDPLAN and investment in research and development that supports BREEDPLAN is aligned with its strategic intent and contractual and fiduciary obligations. The question as to whether the current framework through which BREEDPLAN is commercialised is achieving this is the subject of this Review.

5.2.1.2.2 University of New England

Of all the Owners, the University of New England (UNE) has the most extensive commercial interests along the BREEDPLAN value chain. UNE holds a 24.5 percent equity interest in the BREEDPLAN Core Analytical Software, a 100 percent equity interest in ABRI and a 50 percent interest in the AGBU joint venture.

UNE was established in 1938 and the University's Armidale (New South Wales) campus was the first university in Australia to be established outside of a capital city. Research at UNE revolves around interdisciplinary and cross institutional collaborations, underpinned by five thematic research priorities that are pursued by research activity undertaken within eight research clusters. These themes and supporting clusters are summarised in Table 9 below.

Research Themes	Research Clusters
1. Australia's future food and water security: smart science, smart technology 2. Climate change and environmental sustainability: protecting biodiversity, effective policies 3. Health and wellbeing in rural communities: social exclusion, health inequity, mental health, social policy 4. Our communities, our neighbours: regional and rural development, sustainability, prosperity and peace 5. Our past, present and future: documentation, protection and promotion of cultural heritage, history, memory and identity in Australia and internationally.	1. Agricultural sciences 2. Biological sciences 3. Earth sciences 4. Education and human society 5. Environmental sciences 6. Humanities and creative arts 7. Mathematical and computational sciences 8. Medical and health sciences

Table 9 – University of New England Research Themes and Clusters

Of primary interest to this analysis is UNE's agricultural sciences cluster, which addresses the UNE thematic priorities 1, 2 and 4 as listed in Table 9 above. The importance of livestock genetics in the structure of the UNE Agricultural Science Cluster is illustrated in Figure 13 below.

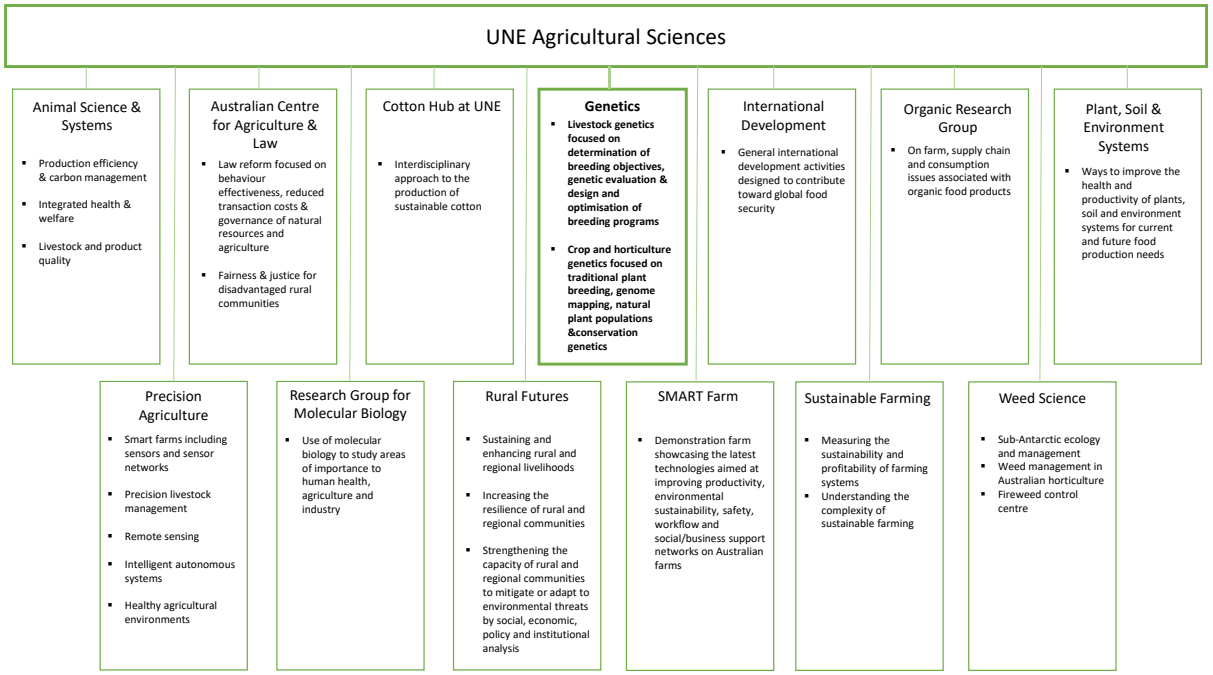

Figure 13 – University of New England Agricultural Sciences Research Cluster

Agricultural sciences are very important to UNE's research performance. Agriculture and Veterinary Sciences is the only broad field of research that UNE received a 'well above world standard' ranking in the most recent Australian Research Council (ARC) Excellence in Research Australia (ERA) assessment. Furthermore, the following related specific fields of research accounted for five out of the eight fields in which UNE received a 'well above world standard' ranking in the most recent ERA assessment:

- Agriculture, Land and Farm Management
- Animal Production
- Soil Sciences
- Zoology
- Ecology

Underpinning performance in many of these areas of in-house research excellence is a major focus on livestock genetics. Livestock genetic science accounts for approximately 25 percent of UNE's research revenue and is core to the University's brand recognition and 'organisational DNA' (pardon the pun). UNE's expertise in livestock genetics is also a major factor in its long-standing relationships with various livestock industry RDCs and CRCs.

The maintenance of UNE's equity position in the BREEDPLAN core analytical software, the AGBU joint venture and the ABRI business are strategically aligned with its research capability and focus on livestock genetic science. While these holdings yield limited direct financial return for UNE (see Section 5.2.3), they are strategically aligned with UNE's research focus and capabilities and a major source of research funding for the University. Most importantly, they provide the University with a strong operational link with the industry at which its research outputs are targeted, as well as, to extent allowed by intellectual property arrangements (see Section 5.2.7), access to industry data for research purposes.

Furthermore, to the extent that ABRI is a 'commercial' entity operating at 'arms-length' from UNE, the 'commercialisation' of BREEDPLAN results in relatively high rankings on knowledge transfer metrics for UNE. In a university assessment (and therefore funding) environment where the Commonwealth Government is placing increasing importance on demonstrable industry and community impact of university research, the knowledge transfer aspects of mechanisms like BREEDPLAN are of increasing importance to universities like UNE.

5.2.1.2.3 New South Wales Department of Primary Industry

The New South Wales Department of Primary Industries (NSWDPI) holds a 24.5 percent equity interest in the BREEDPLAN Core Analytical Software and a 50 percent interest in the AGBU joint venture.

NSWDPI is part of the New South Wales Government Department of Industry, Skills and Regional Development, often referred to simply as the Department of Industry. NSWDPI manages a broad ranges of initiatives from resource to industry, including natural resource management, research and development, pest and disease management, food safety, industry engagement and market access and competition. NSWDPI is organised according to the following divisions:

- Agriculture
- Fisheries
- Biosecurity and food safety
- Water
- Land and natural resources
- Communications and stakeholder engagement
- Strategy and policy
- Business operations

The Agriculture Division is responsible for increasing productivity and resilience of the agricultural sector in New South Wales through agricultural productivity research across livestock, plants and natural resource management areas, as well as providing education and training in those areas through Tocal College. NSWDPI also delivers rural support and community development services through the NSW Rural Assistance Authority and provides scientific advice, quality assurance and management of research facilities that underpin the research programs of NSWDPI.

The New South Wales Government has an agriculture industry objective of increasing productivity by 30 percent by 2020, which includes an objective of doubling the rate of genetic gain in the beef industry and sees BREEDPLAN as a major contributor to this. NSWDPI remains involved in BREEDPLAN for the following reasons:

- A high portion of the national beef cattle herd is located in New South Wales and therefore it is a major component of the New South Wales agricultural industry;
- NSWDPI is a major research provider in the livestock genetics space;
- The New South Wales government is supportive of the Armidale livestock genetics research and development hub;
- NSWDPI has had a long association with BREEDPLAN;
- Until recently, NSWDPI operated a large extension network that promoted, among other things, BREEDPLAN; and

- NSWDPI is a lead proponent of the National Genetics Consortium, of which BREEDPLAN will be a component.

While the strategic relevance of BREEDPLAN to NSWDPI is somewhat diluted by the fact that BREEDPLAN is a national service and NSWDPI has much broader interests than genetic gain in the beef industry, for the reasons stated above, NSWDPI's interest in BREEDPLAN is strategically aligned.

5.2.2 Animal Genetics and Breeding Unit

The Animal Genetics and Breeding Unit (AGBU) is a 50:50 joint venture between NSWDPI (see Section 5.2.1.2.3) and UNE (see Section 5.2.1.2.2) that was established in 1976 to carry out research, development and training in the genetic improvement of livestock for the benefit of Australian agriculture. AGBU's purpose is to undertake industry focused applied research, application development and training in livestock genetics. While most of AGBU's activity in these areas revolves around the Australian beef cattle and sheep industries, it also undertakes such activity in the Australian pig, dairy, poultry, aquaculture, tree and honeybee industries. It also provides services to international livestock industries.

With respect to BREEDPLAN, AGBU provides the genetic science technical expertise that underpins the operation of BREEDPLAN and ongoing development of BREEDPLAN products and services. This obligation is placed on AGBU, via the Owner's interests in AGBU, as an express term of the Core Analytical Software Licensing Agreement. This role differs considerably to the role that AGBU performs in the sheep industry equivalent of BREEDPLAN, Sheep Genetics, where AGBU performs the core processing functionality (see Section 5.6).

Specific research that AGBU is currently undertaking to support BREEDPLAN includes research into:

- Use of genomic data;
- Genetic characterisation of beef cattle populations;
- Fertility of cattle in Northern Australia;
- Algorithms for genetic and genomic prediction;
- Designing breeding programs and experimental populations;
- Real time ultrasound scanning for carcase and fertility traits; and
- Inclusion of such data, as well as other data, in BREEDPLAN products and services.

AGBU is partly resourced from its joint venture partners, particularly UNE that provides significant in-kind support to AGBU. However, its ongoing viability is dependent on ongoing research contract funding from major livestock research and development funding organisations such as MLA, Australian Wool Innovation, Pork Limited, Pork CRC, Sheep CRC, Southern Tree Breeding Association and Riverlea Australia. Because MLA has significant interests in both beef and sheep genetics research and development, it is a major partner and funding source for AGBU.

AGBU is strategically aligned with respect to providing technical and research services to BREEDPLAN. However, its service arrangements with BREEDPLAN are one of many across various other sectors of the Australian and international livestock industries.

AGBU does not have a fiduciary obligation to maximise the rate of genetic gain in the Australian beef industry. Rather, its fiduciary obligations are to its owner's, UNE and NSWDPI. As discussed in Section

5.2.1.2.3, one of NSWDPI's objectives is to accelerate genetic growth in the New South Wales beef industry. However, NSWDPI has numerous other objectives, including supporting the development of livestock genetics innovation hub in Armidale. UNE's primary objective is to achieve relevant academic metrics and attract research income to the University.

5.2.3 Agriculture Business Research Institute

The Agriculture Business Research Institute (ABRI) is a public company limited by guarantee that is wholly owned (100 percent) by UNE (see Section 5.2.1.2.2). ABRI has been operating for over 40 years and currently employs approximately 85 people. Clause 6 of the ABRI's Constitution prescribes its Objects as being to:

- Promote Australian primary production industries;
- Conduct research into Australian primary production industries;
- Provide genetic evaluation services aimed at improving the productivity of Australian livestock industries;
- Develop software beneficial to members of Australian primary production industries; and
- Provide seminars, workshops and field days beneficial to members of Australian primary production industries.

The Owners (see Section 5.2.1) have provided ABRI with an exclusive license to commercialise the BREEDPLAN Core Analytical Software (see Section 5.2.1.1). Pursuant to the licensing agreement, ABRI must source specific technical services pertaining to BREEDPLAN from AGBU (see Section 5.2.2), which revolve primarily around ongoing development and problem solving and must pay a prescribed royalty to the Owners. Under Clauses 12 and 13 of the licensing agreement (see Appendix 2), ABRI is required to develop and present to the Owners an operational plan pertaining to the development and promotion of BREEDPLAN for a 12 month period for approval. A summary of the current ABRI BREEDPLAN operational plan is contained in Appendix 4.

In addition to the core BREEDPLAN functionality (determining the genetic merit of individual animals through the calculation and provision of EBVs and Indices), ABRI also offers a wide range of related functionality in the form of pedigree database, TakeStock, Data Audit, Geneprob, Completeness of Performance reporting, BREEDObject and Matesel genetic information products and services. Some of these products have been developed by ABRI, and some are offered under license from AGBU and other third parties.

In addition to BREEDPLAN and its directly related products, ABRI also offers a number of other related and complementary products and services. These products and services are summarised in Table 10 below, and described in detail in Appendix 4.

Product or Service	Brief Description
International Livestock Registry (ILR2)	A multi-species capable animal registry software package that is used by over 190 breed associations worldwide. It has the capacity to store individual animal BREEDPLAN data.
HerdMASTER	A multi-species herd management software package that can be customised for the individual needs of operations, catering for a wide variety of traits, procedures and treatments. It provides for integration with breed associations using ILR2, as well as with BREEDPLAN.
Internet Solutions	Internet Solutions is a web-based service operated by ABRI that provides instantaneous online access to a wide range of information on animals, members, pedigrees and breeding information on line.
Southern Beef Technology Services	A joint venture between MLA, ABRI, Herefords Australia, Shorthorn Beef, Murray Grey Beef Cattle Society, Charolais Society of Australia, Limousin, Simmental Australia, Red Angus Society of Australia, South Devon Cattle Society of Australia, Bonde d'Aquitane Society of Australia, Australian Wagyu Association and New Zealand and Speckle Park International that provides extension and technical support to breed association members with respect to using genetic technologies (including BREEDPLAN).
Tropical Beef Technology Services	A joint venture between MLA, ABRI, Australian Brahman Breeders Association, Australian Brangus Cattle Association, Droughtmaster Stud Breeders Association and Santa Gertrudis Australia that provides extension and technical support to breed association members with respect to using genetic technologies (including BREEDPLAN).
Breed Association Administration	A range of administrative functions, including executive officer function, undertaken for breed associations under a service agreement.
Graphic design	A graphic design service targeted at seed-stock operations and breed societies.

Table 10 – ABRI BREEDPLAN Related Products and Services

In addition to these BREEDPLAN related and complementary services, ABRI also offers products and services targeted specifically at other livestock sectors. These are summarised in Table 11 below

Product or Service	Brief Description
iCompete	A cloud based system for recording, managing, enquiring on and reporting on information pertaining to equestrian operations.
Other Livestock	Online functionality that, where the database is made available, allows users to access database information from a selection of international breed societies in the global buffalo, dairy cattle, elk, goat, horse and sheep sectors.
Dairy Express	Australia's largest supplier of herd management information services to the Australian dairy industry. The service is provided to 1,600 herds comprising 180,000 cows across three states. The service joint ventures with other organisations to provide a wide range of services through the platform.

Table 11 – ABRI Services Offered to Other Livestock Sectors

ABRI is a corporation operating under the jurisdiction of the *Corporations Act 2001* (Cth), meaning it has a fiduciary duty to act in the best interests of its shareholder, UNE, at both common law and under legislation. ABRI delivers a number of benefits to UNE:

- ABRI brings in research income in its own right, albeit this is mostly in the form of product development;
- While the individual breed associations own the data that is submitted (see Section 5.2.7), the data generated through ABRI informs research concept origination;
- ABRI can support research project bids from other research entities at UNE by virtue of its analytical capacity and networks to industry; and

- As a result of ABRI's commercialisation of livestock industry information technology products, UNE typically ranks very highly against other Australian universities on research commercialisation metrics.

This review has been provided with only limited financial information pertaining to ABRI. However, it is understood that cattle information services, which includes BREEDPLAN and its related products, account for approximately 75 percent of ABRI's total revenues. It is also understood that ABRI operates at 'arms-length' from UNE and does not acquire any services from UNE. ABRI owns the building and land from which it operates and is administratively independent from UNE. It is understood that ABRI trades at a surplus and has retained earnings. While the current amount of retained earnings held by ABRI is not known, it is understood that ABRI's policy is retain cash investments approximately equivalent to one year's operating expenditure. ABRI also uses surplus to reinvest in product development, including most recently a decision to invest approximately $2.0 million in the further development of the beef database platform, International Livestock Registry (ILR2).

The extent to which ABRI can provide a direct financial return to UNE is limited by ABRI's Constitution. Clause 7.1 of ABRI's Constitution requires that the income, profits and property of ABRI be used solely for the promotion of the objects prescribed in Clause 6 of its Constitution. Importantly, Clause 7.2 provides that the income, profits and property of ABRI may not be paid or distributed to any shareholder by way of dividend, distribution upon winding up of ABRI or otherwise. Clause 30(b) of the Constitution provides an exception to this whereby upon the winding up of ABRI and the payment of all liabilities, the surplus assets shall be paid or transferred to UNE specifically or another organisation whether incorporated or unincorporated having similar objects to those listed in Clause 6 of ABRI's Constitution.

As a business specialising in the development and delivery of livestock genetics and breeding information with a significant focus on the beef cattle industry, ABRI seems a strong operational fit to the commercialisation of BREEDPLAN. Furthermore, there is some alignment between ABRI's constitutionally defined Objects and the Objects of the BREEDPLAN core analytical software licensing agreement, albeit ABRI's objects do not require it to conduct its business with the intent of 'maximising' genetic gain in the Australian beef industry. ABRI's obligation to optimise the level of genetic gain is the subject of interpretation of the objects of the licensing agreement (see Section 5.2.1.1).

ABRI's primary fiduciary duty is to act in the best interests of its shareholder, UNE, not the Australian beef industry. From a pecuniary perspective, this is somewhat mitigated by the dividend and distribution restrictions placed on it by Clause 7 of its Constitution, albeit the final result of a unwinding of ABRI is for residual assets to be vested in an entity that is UNE controlled or otherwise that has similar objects to ABRI, which may or may not be in the interests of maximising genetic gain in the Australian beef industry.

5.2.4 Breed Associations

BREEDPLAN is distributed almost exclusively to participants in the Australian beef cattle seed-stock and commercial sectors via commercial arrangements between individual breed associations and ABRI (see Section 5.2.3). In most cases, for economic and practical reasons, only seed-stock and commercial

producers who register cattle with a breed association can effectively access BREEDPLAN. While the commercial arrangements between ABRI and the breed associations may not necessarily contain exclusivity conditions, there are practical and economic restrictions in accessing BREEDPLAN outside of a breed association. Most importantly, because the breed associations own the data submitted to BREEDPLAN, unregistered members of BREEDPLAN are restricted to within-herd analysis.

A small number of pastoral companies and groups of breeders (such as Performance Herds Australia) have utilised across herd evaluations using their own multi-herd data for comparison within those groups and individual breeders are able to use some composite databases such as the Tropical Composite database. However, the absence of genetic linkages represent significant restrictions to the effectiveness of BREEDPLAN in these circumstances. Furthermore, current BREEDPLAN technical requirements mean that some commercial, together with other clients have been restricted if they do not record date of birth, some pedigree detail or breed.

Because the Australian beef cattle industry, particularly the southern sector (see Section 1.1) is structured around pure-bred animals, the use of the breed associations that represent the various breeds is well aligned with the purpose of distributing BREEDPLAN to the seed-stock sector, albeit by virtue of the existence of an unregistered sector and the current commercial arrangements between ABRI and the breed associations, this is not necessarily a perfect distribution channel.

Breed associations owe their fiduciary duty to their members. This has two implications with respect to their alignment with the objective of optimising the rate of genetic gain. Firstly, breed associations have a primary obligation to protect and promote the breed. In the case of breed associations whose leadership and membership believe the effective use of BREEDPLAN accelerates genetic gain in the breed, there is strong alignment with the objective of optimising the rate of genetic gain in the Australian beef industry. This alignment can become diluted if the breed association leadership and membership is significantly divided with respect to perspectives on the value of BREEDPLAN. Secondly, the obligation to protect and promote the breed can also lead to breed association resistance to initiatives such as allowing access to the non-registered sector, or the development of a cross breed BREEDPLAN evaluation (see Section 5.1.2.3).

To effectively use BREEDPLAN, breed associations must also use the ABRI pedigree database system for animal registrations. While this is not a contractual requirement it is a practical reality as very few breed associations have adequate internal resources to develop a proprietary pedigree database system, or integrate third party software with ABRI's system.

There are currently 30 Australian breed associations that have service agreements with ABRI that include provisions allowing their members access to BREEDPLAN services. Using weaning weight[35] measurements recorded with BREEDPLAN as an indication of BREEDPLAN throughput, six breed associations account for over 75 percent of the BREEDPLAN data throughput, with the Angus breed alone accounting for approximately 45 percent of throughput. This is illustrated in Figure 14 below.

[35] Weaning weight measurements refer to any weight measurement of an animal prior to weaning that is recorded with BREEDPLAN (e.g. Birth Weight, 200 day weight, weaning weight etc)

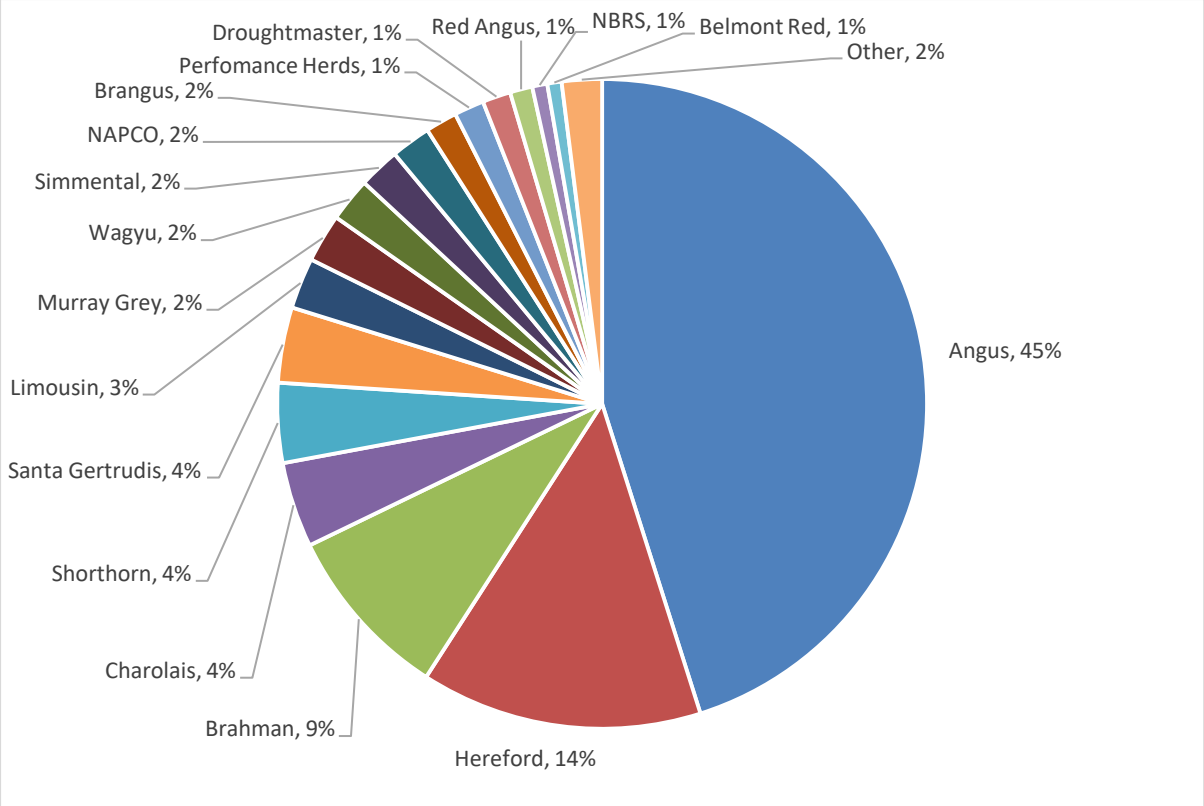

Figure 14 – Portion of Total Weaning Weights Processed through BREEDPLAN in 2015-16 by Breed

The terms by which breed associations and their members access BREEDPLAN and related and complementary products from ABRI are highly variable and the subject of confidentiality. For example:

- Some breed associations pay separate fixed annual fees that provides access to the full ABRI pedigree database functionality and the full suite of BREEDPLAN products and services, with variable charges only applying to a limited number of discrete products or services and/or usage of a discrete product or services over a certain threshold ;
- Some breed associations pay a more modest separate fixed annual fee for the ABRI pedigree database functionality and most of the BREEDPLAN products and services, as well as a more comprehensive set of variable charges on certain aspects of both the database functionality and BREEDPLAN transactions;
- Some breed associations pay a small fixed charge for access to ABRI pedigree database functionality and the full suite of BREEDPLAN products and services, together with a variable charge on data entry, processing and reporting transactions with both the database and BREEDPLAN products; and
- Some breed associations pay according to a pricing scheduled that is based entirely on transaction costs for both ABRI database and BREEDPLAN functionality and is therefore totally variable in nature.

In the case of some smaller breed associations, ABRI also provides a range of services pertaining to the administration of the breed association business. These services range from simple accounting support to full administrative function, including employment of an executive officer function for the breed association.

As discussed in Section 5.5.2, these arrangements mean that the economics of offering BREEDPLAN to members are highly variable across the breed associations. It would seem that the extent to which a breed association is paying a premium or discount for access to BREEDPLAN compared to other breed associations is a function of the fixed-variable charge ratio for services that it was able to negotiate as well as any discount it was able to negotiate and the time of entering the agreement based on member quantum and transaction volume, as well as other services that may have been acquired from ABRI. Very importantly, breed associations that incur a high portion of fixed costs and which have experienced decline in registrations and/or BREEDPLAN participation by their members, have experienced per unit cost escalation.

The degree to which BREEDPLAN costs incurred by the breed association under these arrangements is passed on to members that use BREEDPLAN ranges from almost full subsidisation of BREEDPLAN by the breed association, to partial cost recovery from members using BREEDPLAN to full cost recovery from members using BREEDPLAN. The terms under which a breed association makes BREEDPLAN available to its members is a function of:

- The financial capacity of an individual breed association to absorb the cost;
- The portion of breed association membership that are BREEDPLAN users; and
- The importance placed on BREEDPLAN as a tool for driving genetic gain by the breed association board and executive.

The extent to which the different breeds use BREEDPLAN is discussed in greater detail in Section 5.3.

5.2.5 Seed Stock Sector

By virtue of the exclusivity discussed in Section 5.2.4 above, the ability of a seed-stock producers to use Group BREEDPLAN for a specific breed (i.e. within-breed evaluation) is limited unless they are members of the breed association for that breed. The terms by which they can access Group BREEDPLAN for a specific breed are determined by the specific confidential service agreement between ABRI and the specific breed association, which as discussed in Section 5.2.4 are variable across breed associations, as well as the extent to which the breed association passes on the costs of BREEDPLAN to its members, which ranges from almost full subsidisation to full cost recovery. The commercial arrangement between ABRI and the breed associations also determines whether members interact directly with ABRI or through the breed association when using BREEDPLAN.

As with all value chains, the end-customer, in this case the beef cattle seed-stock producer is the most important element of the value chain. For example:

- From the perspective of the objective of optimising the rate of genetic gain across the Australian beef industry, the extent to and effectiveness by which seed-stock producers use BREEDPLAN is of paramount importance;
- From ABRI's perspective, BREEDPLAN delivers approximately $1.6 million of direct revenue and almost certainly facilitates other revenues indirectly (see Section 5.5.3) and therefore the extent to which the seed-stock sector uses BREEDPLAN (and thus derived demand for BREEDPLAN from breed associations) is important to ABRI's economics; and

- If breed associations are of the view that the use of BREEDPLAN by its members is in the interests of developing and promoting the breed, the extent to and effectiveness by which it is used is of paramount importance to breed associations.

The value chain must not only be effective in driving adoption of BREEDPLAN, but also in ensuring that seed-stock producers are using it effectively throughout the product cycle from measurement to breeding decision-making.[36] This is a function of individual economics that a seed-stock producers faces with respect to using BREEDPLAN, ease of use, alignment of breeding philosophy and practice and support in understanding and using BREEDPLAN. The economics faced by seed-stock producers when using BREEDPLAN is discussed in detail in Section 5.5.1 and perceptions as to other issues are discussed in Section 5.4.

5.2.6 Commercial Producers

Commercial producers purchase bulls from seed-stock producers with the intent of introducing genetics to their commercial operations that meet their production objectives. Many commercial producers assess EBVs and Indices produced by BREEDPLAN to assist them with their purchasing decision.

Additionally, some commercial producers subscribe to BREEDPLAN and undertake performance recording to inform their own, on-farm breeding programs. As with seed-stock producers, a commercial producer's ability to use Group BREEDPLAN effectively unless they are a member of a breed association is limited, and some breed associations only allow Full Members access to BREEDPLAN. Most breed associations have significant numbers of commercial members and in many cases, the number of commercial members is comparable to the number of seed-stock members, albeit small with respect to the total number of commercial producers. Furthermore, it is not clear what portion of commercial members of breed associations undertake performance recordings and submit data on their cattle to BREEDPLAN.

5.2.7 BREEDPLAN Intellectual Property Portfolio

As discussed in the introduction to this Section 5.2 and illustrated in Figure 12 above, the intellectual property portfolio and relationships that define the BREEDPLAN value chain is complex. Table 12[37] below summarises the intellectual property portfolio that defines the BREEDPLAN value chain and product portfolio.

[36] Woolaston, R. (2014), *Review of BREEDPLAN Commercialisation Model,* Project. B.BFG.0064, Meat and Livestock Australia

[37] Woolaston, R. (2014), *Review of BREEDPLAN Commercialisation Model,* Project. B.BFG.0064, Meat and Livestock Australia

Intellectual Property	Ownership
Phenotypes and pedigree information recorded by breeders	Individual breeders own data collected and stored on-farm and breed associations own information contributed to their database by breeders.
Research phenotypes and genotypes	Contracts specify ownership which typically resides with R&D providers, owners of animals, funders and/or breed associations.
Genotypes paid for by a breeder	Genomic service providers own SNP information, but supply breeders with genetic predictions. In the case of Angus, SNP data for Angus cattle is now supplied to Angus Australia.
Genomic prediction equations	Those developed by the previous Beef CRC are in the public domain, whereas others developed by the private sector are retained as trade secrets. Prediction equations will effectively be rendered redundant with the introduction of singe-step analysis to BREEDPLAN.
EBVs and Selection Indexes	Breeders own EBVs if the data was submitted through NBRS for within-herd analysis. It is generally understood that breed associations own coefficients for standard indexes plus EBVs and index values computed from breed association databases and/or registries, albeit there is some contention over this on the bases that EBVs and Index values are parameter files provided by AGBU and would therefore potentially form part of the BREEDPLAN Core Analytical Software Intellectual Property.
Analysis parameters	The majority of parameters have been developed as a result of research and development undertaken by AGBU. As far as possible, breed data is used as project intellectual property in that research and development, but the parameters themselves are owned by the BREEDPLAN Owners on the same equity basis as their ownership of the BREEDPLAN Core Analytical Software. The complete parameter sets are not in the public domain, with parameter sets and adjustment factors being almost entirely breed specific.
Software used for BREEDPLAN operation	The BREEDPLAN Core Analytical software is owned by MLA, UNE and NSWDPI and licensed to ABRI. Application software developed by the ABRI to service end-users is owned by ABRI or their clients.
Hardware	Hardware for BREEDPLAN specific R&D is owned by AGBU. Hardware for routine BREEDPLAN operation and for running application software is owned by ABRI. Some breed societies maintain their own application hardware.
Parentage Verification Software	Parentage Verification Software has been developed by AGBU and is owned by the BREEDPLAN Owners on the same equity basis that they own the BREEDPLAN Core Analytical Software.
Breed Composition Software	Breed Composition Software has been developed by AGBU and is owned by the BREEDPLAN Owners on the same equity basis that they own the BREEDPLAN Core Analytical Software.
Software used in BREEDPLAN R&D	Various
MateSel	B.P. Kinghorn
GeneProb	UNE
TakeStock	AGBU
Data Audit	AGBU
Internet solutions	ABRI
ILR2	ABRI
Completeness of Performance	ABRI

Intellectual Property	Ownership
Inbreeding calculator software	AGBU
New outlier strategy	ABRI
Diagnostics	Variously by ABRI and AGBU

Table 12 – BREEDPLAN Intellectual Property Portfolio

5.3 The Australian Beef Cattle Seed Stock Sector and Market Penetration of BREEDPLAN

This section of the report provides a detailed analysis of:

- Growth in the key breed sectors that comprise the Australian beef seed-stock market, the main market for BREEDPLAN;
- Historical trends in the penetration of BREEDPLAN in that market; and
- The rate of genetic gain that has been achieved in those key breed sectors.

5.3.1 Limitations to the Market Analysis

It should be noted that, as a basis for estimating the degree of market penetration of BREEDPLAN, the analysis in this section has the following limitations:

- The analysis uses registered animals as a proxy for the total addressable market for BREEDPLAN. In a sense this is reasonable, given that the vast majority of seed-stock and commercial users of BREEDPLAN are members of breed associations. However, there is a widely held view that the seed-stock and commercial breeding sector is characterised by a significant and growing unregistered component (a very small number of which are using BREEDPLAN outside of the breed associations), albeit there is no empirical evidence by which the extent or trends of the unregistered sector can be measured.
- The extent to which BREEDPLAN has penetrated the registered sector, and trends in the penetration of BREEDPLAN, has been estimated using the volume of weaning weight measurement record[38] data throughput as a proxy for BREEDPLAN usage. While this provides a reasonable estimate of the portion of registered cattle that are at least recording some performance measurement with BREEDPLAN, it does not provide an indication as to how rigorously BREEDPLAN is being used. While the analysis attempts to address this deficiency by also assessing scan data throughput as a proxy for the extent to which performance measurements are taken beyond weaning weights, this serves a fairly 'blunt' assessment of how rigorously BREEDPLAN is being used.
- Some Breed Associations only allow Full Members to register animals with BREEDPLAN and as such some higher-level estimates made on the basis of total breed association membership may underestimate the penetration of BREEDPLAN among the seed-stock sector.

[38] Weaning weight measurements refer to any weight measurement of an animal prior to weaning that is recorded with BREEDPLAN (e.g. Birth Weight, 200 day weight, weaning weight etc)

- The estimates of genetic gain are based on the tracking of specific production indices undertaken on members of SBTS and TBTS. This presents three potential deficiencies. Firstly, the data does not represent all users of BREEDPLAN. Secondly, while indices are based on weighting of EBVs which are calculated using models designed to 'remove' non-genetic effects, there is at least a perception that non-genetic effects are adequately removed in these models. Finally, as is the case for other livestock genetic information services that are based on quantitative genetics, there is also at least a perception that estimates of genetic gain do not account for the counter-factual. That is, they don't account for the amount of genetic gain that may have been achieved if BREEDPLAN was not used to support breeding decisions.

Regardless of these limitations the analysis in this section provides a reasonable indication as to the extent to which BREEDPLAN is being used, how rigorously it is being and the genetic gain that it is contributing to. Most importantly, the analysis is undertaken at the breed association level, which in light of the pure bred orientation of the Australian beef cattle industry, is an appropriate level of granularity.

5.3.2 Breed Structure of the Australian Beef Cattle Seed-stock Sector

There are over 800 breeds of cattle recognised world-wide. The domestication of cattle in Australia dates back to the First Fleet in 1788. Today, there are approximately 100 breeds of cattle produced in Australia, but as discussed in Section 5.2.4, commercial beef production is concentrated across a small number of pure-bred animals and their composites. In many cases the breeds of cattle produced in Australia are biologically very similar and can be broadly categorised according to the main breed groups summarised in Figure 15 below. [39]

[39] Adapted from: Cummings, B. (2007), 'Cattle breed types', *Primefacts,* No. 623, New South Wales Department of Primary Industries

BREED GROUP	SUB-GROUP	BREED EXAMPLES
British	British	Angus, Hereford, Poll Hereford, Shorthorn, Galloway, Murray Grey, Devon
	Large British	South Devon
European	Dual Purpose	Simmental, Gelbvieh, Maine Anjou, Brown Swiss
	Meat – Large Mature	Charolias, Romagnola, Chianina,
	Meat – Medium Mature Size	Limousin, Blonde Aquitaine
	Double Muscled	Belgian Blue, Piedmontese
Bos Indicus	Bos Inidicus	Brahman, Sahiwal
Adapted Taurine/Sanga	Adapted Taurine/Sanga	Tuli, Senepol, Belmont Red
Dairy	Dairy	Holstein, Jersey
Japanese	Japanese	Black Wagyu, Red Wagyu
Composite	Composite	Santa Gertrudis
	Bos Indicus Composite	Braford, Brangus, Droughtmaster, Charbray

Figure 15 – Major Australian Beef Cattle Breed Groupings

This analysis uses a simpler grouping that is typically used to describe breeds from an Australian commercial beef industry perspective. This simpler categorisation is demonstrated in Figure 16 below, and while it maintains the definition of British and European breed, it combines Bos Indicus, Adapted Taurine/Sanga and Composite breeds into a single category referred to as 'Tropical Breeds', and categorises all other breeds as 'Other'.

BREED GROUP	SUB-GROUP	BREED EXAMPLES
British	British	Angus, Hereford, Poll Hereford, Shorthorn, Galloway, Murray Grey, Devon
	Large British	South Devon
European	Dual Purpose	Simmental, Gelbvieh, Maine Anjou, Brown Swiss
	Meat – Large Mature	Charolias, Romagnola, Chianina,
	Meat – Medium Mature Size	Limousin, Blonde Aquitaine
	Double Muscled	Belgian Blue, Piedmontese
Tropical	Brahman, Droughtmaster, Santa Gertrudis, Brangus, Charbray, Braford, Belmont Red, Senepol	
Other Breeds	Wagyu, Speckle Park, Mandalong Specials, Tropicana	

Figure 16 – Alternative Australian Beef Cattle Breed Categorisation

The registered Australian beef cattle seed-stock sector is comprised of primary and secondary registered animals. Primary registrations represent the herd books of the breed associations. Whereas, secondary registrations include animals that are bred for seed-stock production (i.e. the production of bulls for use in the registered and commercial sectors) and recorded by a breed association, but not included in the breed association's herd book. During the period 2002 to 2015, secondary registrations accounted for an average of 30.8 percent of all registrations, however in some breeds, particularly breeds that are the focus of the northern sector such as Brahman, secondary registrations can account for a very significant portion of registrations.

The trend in new calves recorded in the registered sector[40] together with BREEDPLAN weaning weight records submitted with BREEDPLAN across all breeds is illustrated in Figure 17 below.

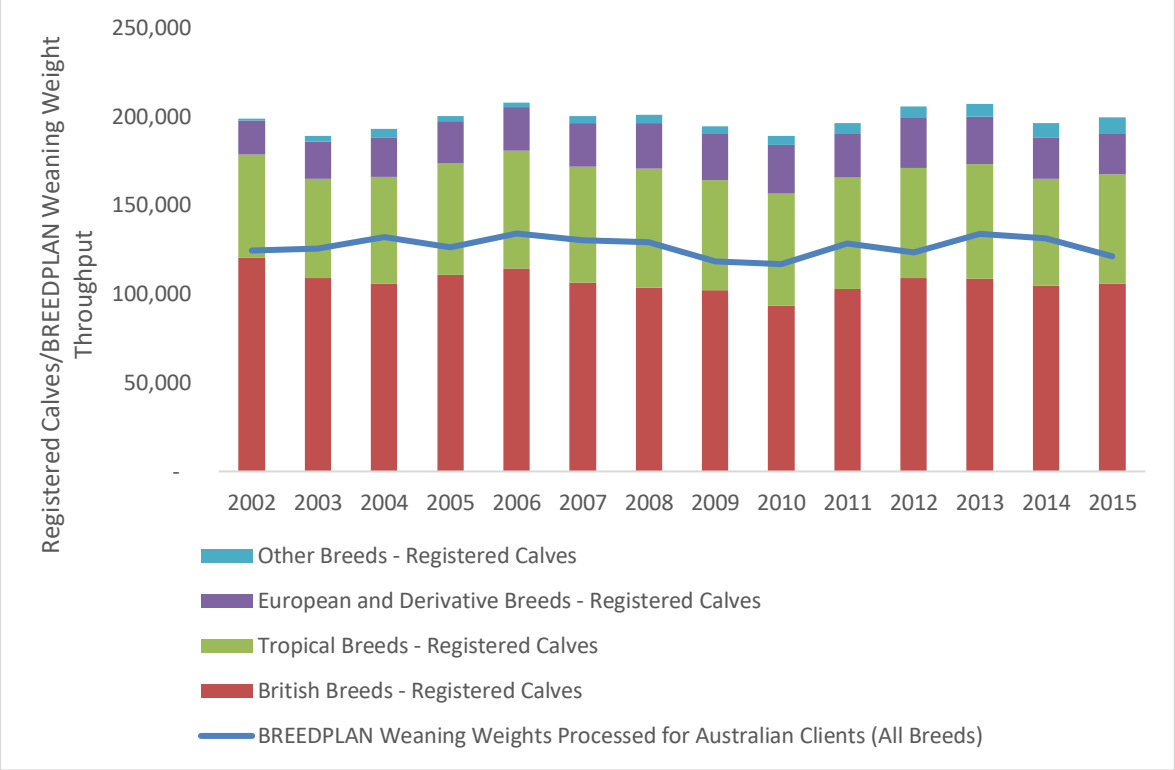

Figure 17 – Number of New Calves Registered (Primary and Secondary) – Australian Beef Cattle Seed-stock Registered Sector

5.3.3 Trends in the British Breed Seed Stock Sectors

Generally and comparatively speaking, British cattle breeds are early maturing and capable of achieving market weights from less feed. This renders them suitable to the pastures of moderate nutritional value that are characteristic of much of southern Australia where most beef cattle farms are located. This combined with their tendency to demonstrate high fertility, strong maternal traits

[40] Australian Registered Cattle Breeder's Association (2015), *Registration Statistics – 2015 Australian Beef Cattle Registrations*

and good eating quality helps explain their dominance in the Australian herd, particularly in the southern sector. However, as illustrated in Figure 17 above, British breeds as a collective have declined from representing 60.5 percent of all new calves from the registered sector in 2002 to 53.2 percent of all registered calves in 2015.

During the period 2002 to 2015, secondary registrations accounted for an average of 25.6 percent of all British breed calf registrations. Over the same period primary and secondary registrations in British breeds decreased at a Compound Annual Growth Rate (CAGR) of 1.0 percent. However during the more recent period of 2010 to 2015, primary registrations grew at a CAGR of 1.6 percent and secondary registrations at a CAGR of 5.3 percent, representing total growth of 2.5 percent. This is illustrated in Figure 18 below.

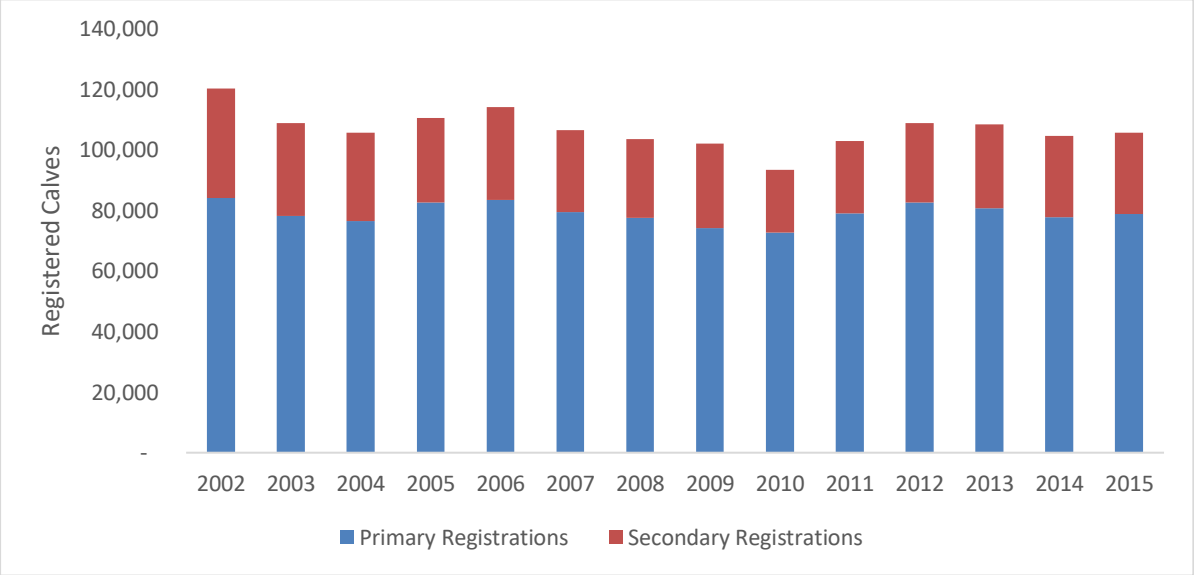

Figure 18 – Number of New Calves Registered – British Breeds

The following subsections discuss trends in the market for BREEDPLAN in the main British breeds that comprise the Australian beef cattle seed-stock sector.

5.3.3.1 Angus

The Australian association for the Angus breed is Angus Australia. Angus Australia has been intimately involved in the development of BREEDPLAN since the establishment of BREEDPLAN. It has made a considerable investment in using BREEDPLAN for the progress of the Angus breed, including the employment of internal technical staff who work with AGBU and ABRI to ensure Angus members achieve optimal benefits from the use of BREEDPLAN and to assist members with the use of BREEDPLAN.

Originating from Scotland, Angus cattle were first introduced to Australia in the mid-1800s. Angus are a moderate sized, muscular animal that are widely renowned for producing high quality carcases that are suited to the vealer, steer or bullock market. The breed's high propensity to marble, white fat and bright-red lean meat, means they are particularly suited to the premium Japanese market.

The Angus breed forms a significant component of the Australian beef cattle industry. In 2002, Angus cattle accounted for 45.5 percent of all registered British Breed calves and 27.5 percent of all new

calves produced the registered sector overall. In 2015, the breed accounted for 62.2 percent of all registered British breed calves and 33.0 percent of all new calves produced by the registered sector.

Currently, there are just over 1,000 full members and 2,250 commercial members of Angus Australia, of which approximately 700 use BREEDPLAN. In 2015, the number of weaning weight records recorded represented 92.5 percent of all registered Angus calves.

While Angus Australia was a long standing participant in SBTS, it recently withdrew from the service. The reason for this is that because the majority of its members have been using BREEDPLAN for the past 30 years, their specific training needs are more advanced and beyond that which is currently provided by SBTS.

As the largest breed association in the Australian beef industry by orders of magnitude, Angus Australia pays relatively high total fees to ABRI. In order to reduce costs and its operational dependence on ABRI, Angus Australia is in the process of developing its own pedigree database software that will interface with BREEDPLAN. It is likely that Angus Australia is one of, if not the only, breed association that has adequate financial resources to develop its own pedigree database software.

During the period 2002 to 2015, primary and secondary registrations with Angus Australia increased at CAGR of 1.4 percent and the number of weaning weight measurements submitted to BREEDPLAN grew at 1.8 percent. The rate of growth in both registrations and weaning weight measurements submitted to BREEDPLAN has increased in recent years with registrations and weaning weight records growing at 7.7 percent and 2.1 percent respectively over the past five years.

This is illustrated in Figure 19 below.

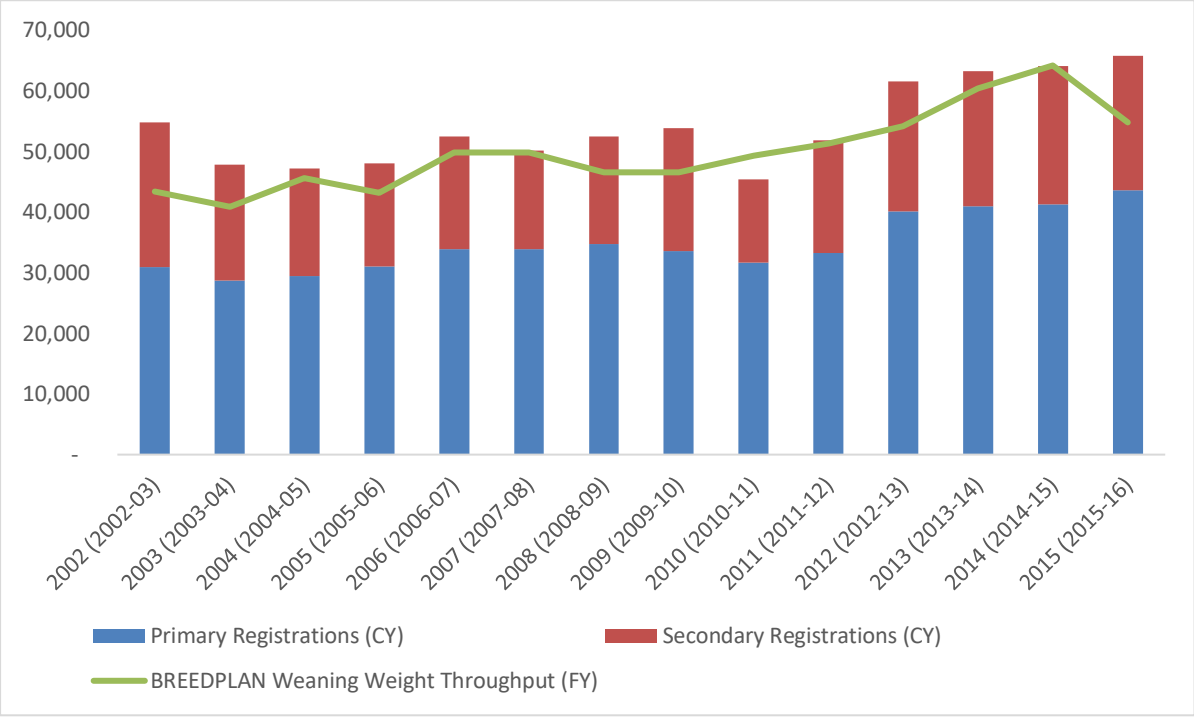

Figure 19 – Number of New Calves Registered – Angus Australia

Since 2002, the volume of scan records submitted by members of Angus Australia has increased at a fairly consistent CAGR of approximately 2.7 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 53.6 percent of the number of weaning records in 2002 to 60.4 percent in 2015. This is illustrated in Figure 20 below.

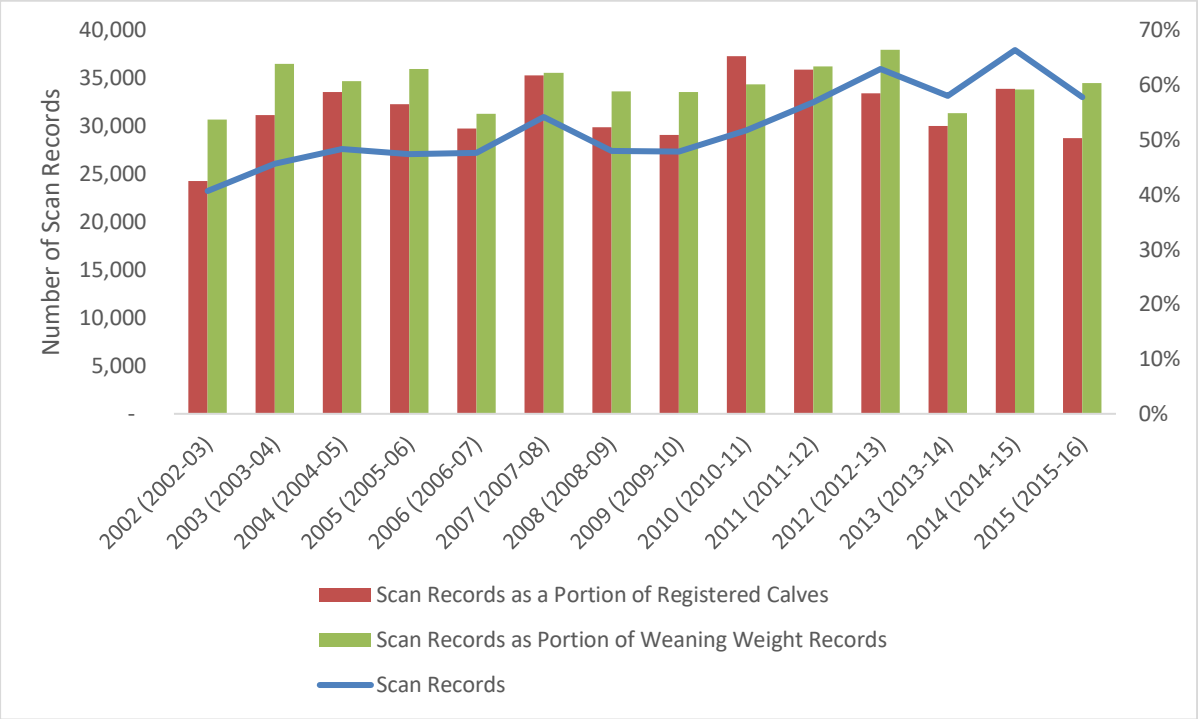

Figure 20 – Scan Data Records Submitted to BREEDPLAN – Angus Australia

Figure 21 below illustrates the historical trend in the Angus breeding, domestic, heavy grain and heavy grass indices since 1970.

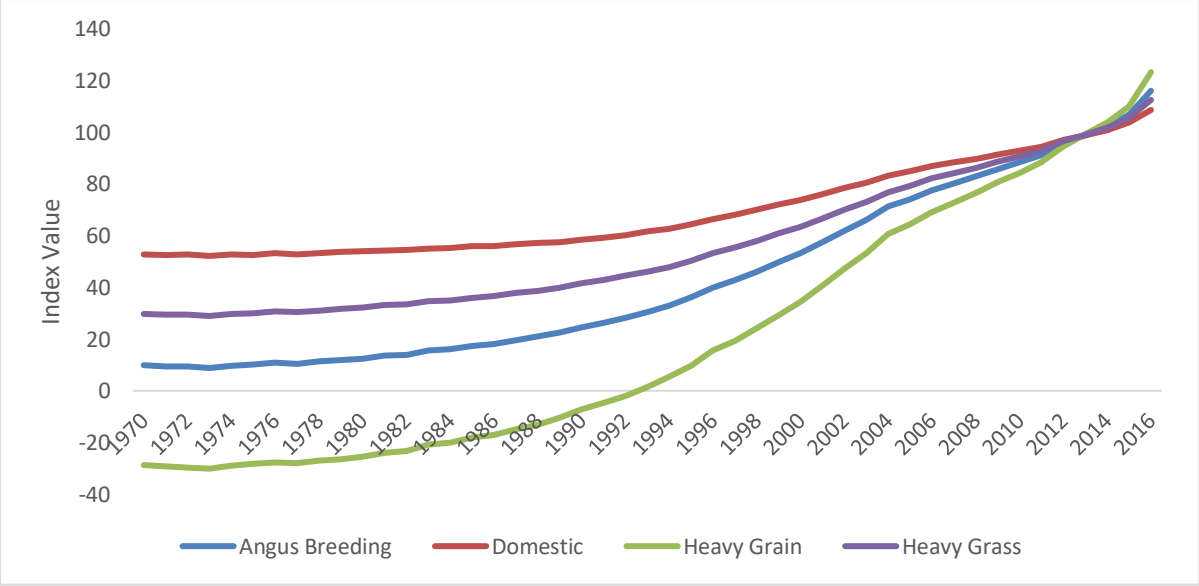

Figure 21 – Angus Breeding, Domestic, Heavy Grain and Heavy Grass Indices – Angus

As demonstrated in Table 13 below, the introduction of BREEDPLAN in 1985 has coincided with a dramatic increase in the rate of improvement in all three indices.

Index	CAGR 1970 to 1984	CAGR 1985 to 2016
Angus Breeding	3.5%	6.3%
Domestic	0.3%	2.2%
Heavy Grain	-2.5%	25.8%[41]
Heavy Grass	1.1%	3.8%

Table 13 – Change in Key Angus Indices

A separate analysis indicates that genetic improvement in key economic traits achieved in Angus cattle bred in Australia over the past two decades general exceeds those achieved in other major Angus populations globally and the accumulated present value of returns resulting from genetic improvement currently stands in excess of $1.6 billion.[42]

5.3.3.2 Hereford and Poll Hereford

Up until approximately 20 years ago there were separate associations for Hereford and Poll Hereford cattle. Since the merger of the two separate associations, both breeds have been regulated under Herefords Australia as a single breed comprised of horned and polled animals. Both the initial Hereford and Poll Hereford associations were foundation breeds in BREEDPLAN and the combined Herefords Australia has remained active in the development of BREEDPLAN.

Originating from the south-west of England, the Hereford breed was first introduced to Australia in 1826. The popularity of Herefords in the Australian cattle industry has been based on their ability to perform well on a range of pastoral conditions and to assimilate roughage, foraging ability, docility and strong fertility traits. Depending on nutrition and husbandry, the breed can be farmed to produce high quality carcase traits that range from heavy marbled fat, through to small, young and lightly finished product. They are suited to vealer, steer and bullock production or as a maternal – rotation place in crossbreeding programs. The Poll Hereford breed was introduced to Australia in 1920 and apart from its polled characteristics, it demonstrates almost identical carcase, temperament and fertility traits to horned Hereford.

Hereford and Poll Hereford cattle are farmed across Australia, but particularly in the central and south-eastern states, South Australia and south Western Australia. While the substitution of Angus for Hereford cattle in Australia in some areas and across some enterprise types has driven a decrease in the number of Hereford cattle, Hereford remains the second most common breed in the Australian cattle industry.

In 2002, the Hereford breed accounted for 32.3 percent of new British breed calves and 19.6 percent of all new calves produced by the registered sector. In 2015, the breed's share had decreased to 22.1 percent of new British breed calves registered and 11.7 percent of all new calves produced by the registered sector.

[41] Adjusted CAGR (negative denominator)
[42] Parnell, P. (2015), 'Has the beef genetic improvement pipeline been effective?', *Proceedings of the Association for the Advancement of Animal Breeding and Genetics,* Angus Australia

There are currently 575 full members and 500 commercial members of Hereford Australia, of which 332 use BREEDPLAN. In 2015, the number of weaning weight records for the Hereford breed represented 73.5 percent of Hereford calf registrations.

A single Hereford breed evaluation is undertaken by BREEDPLAN for Australian and New Zealand cattle.

The number of new Hereford calves in the registered sector has declined by a CAGR of 3.8 percent since 2002. While a similar total rate of decline was experienced during the more recent period of 2010 to 2015, a higher rate of decline in primary registrations of 4.6 percent was partially offset by growth in secondary registrations of 2.0 percent. The trend in total registrations since 2002 is reflected in weaning weight records submitted with BREEDPLAN by Hereford breeders, which declined at a CAGR of 3.6 percent between 2002 and 2015 and 3.8 percent between 2010 and 2015. It is understood that most of the decline has been breeders, primarily horned Hereford breeders who do not use BREEDPLAN leaving the association.

This is illustrated in Figure 22 below.

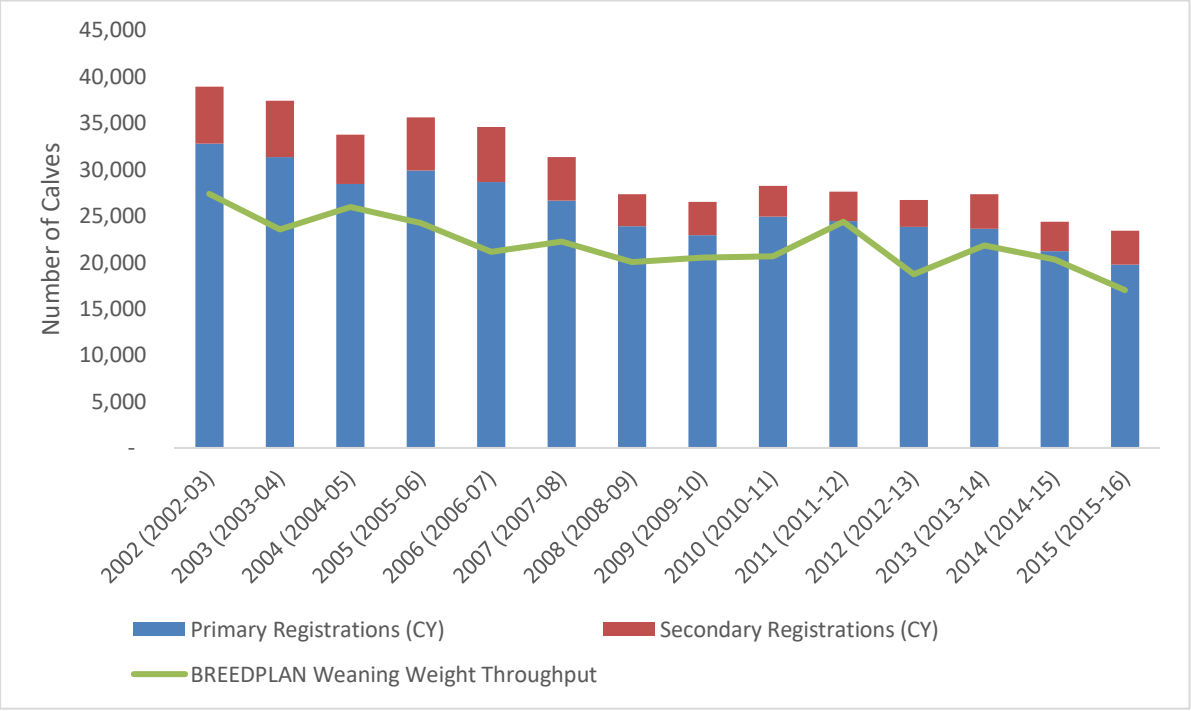

Figure 22 – Number of New Calves Registered and BREEDPLAN Weaning Weight Throughput– Hereford and Poll Hereford

Since 2002, the volume of scan records recorded with BREEDPLAN has increased at a CAGR of 1.2 percent. As an indication of the conversion of weaning weight recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 31.0 percent of the number of weaning records in 2002 to 58.2 percent in 2015. This is illustrated in Figure 23 below.

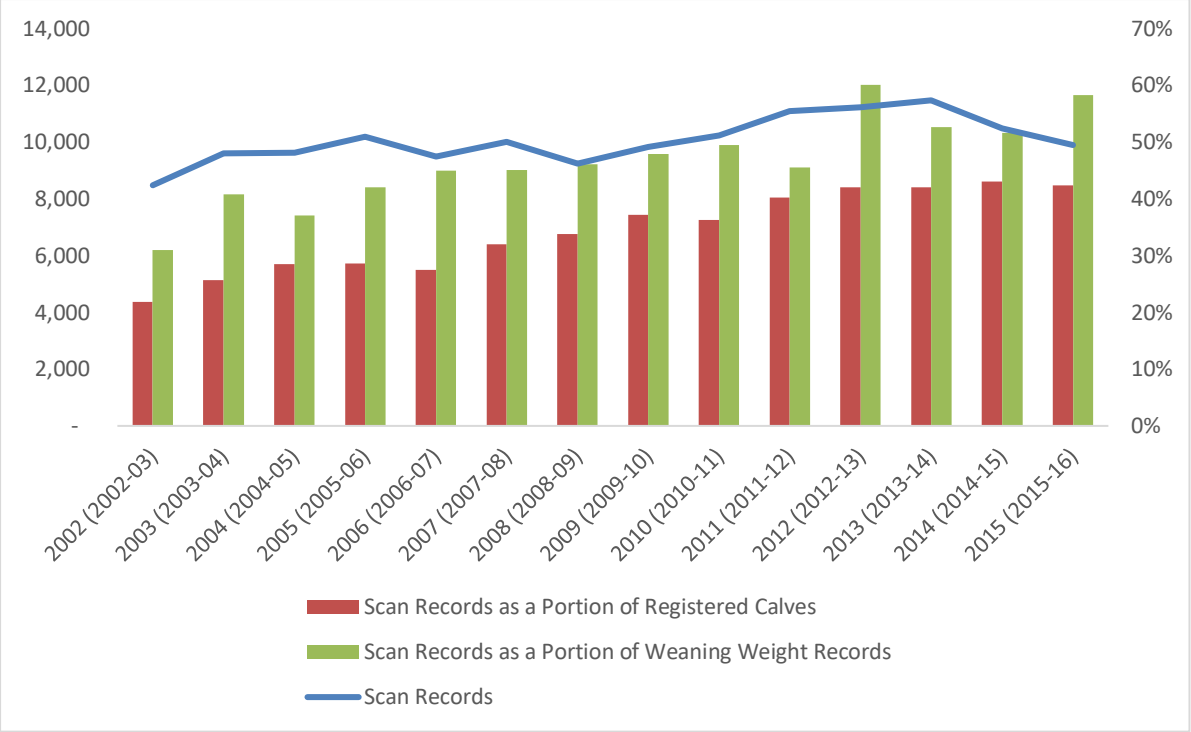

Figure 23 – Scan Data Records Submitted to BREEDPLAN – Herefords Australia

Figure 24 below illustrates the historical trend in the supermarket, grass fed steer, grain-fed steer and EU indices for the Hereford breed.

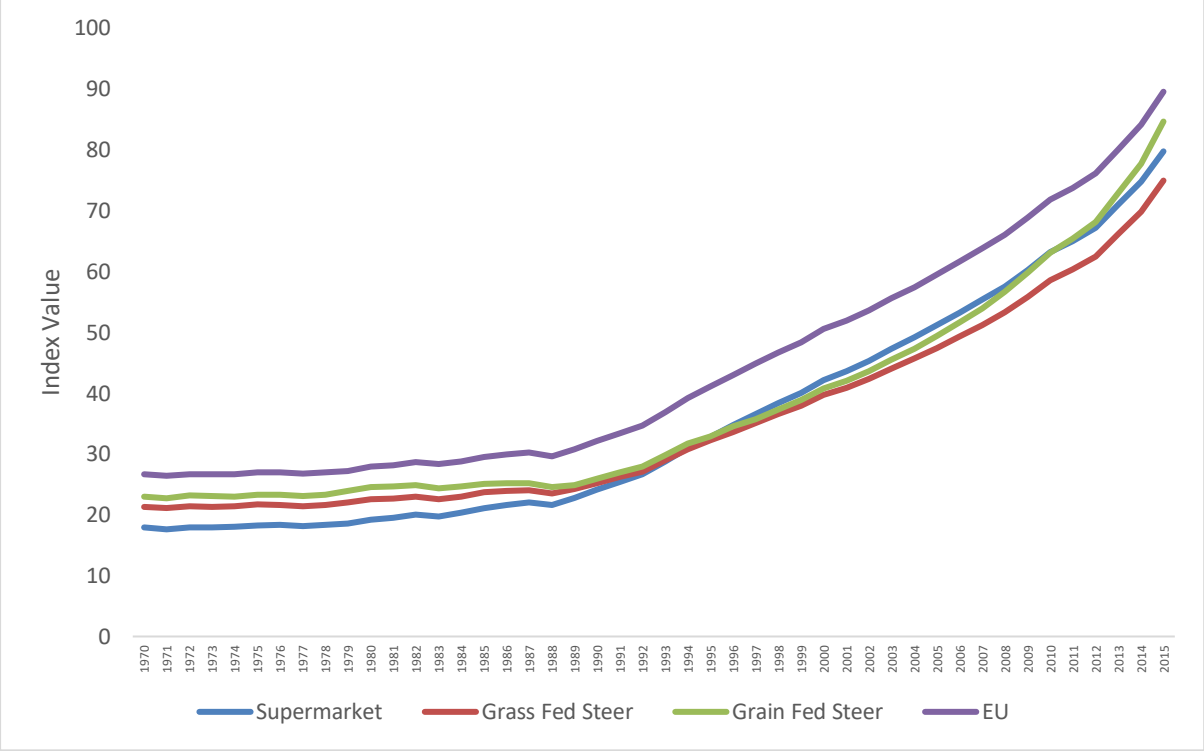

Figure 24 – Supermarket, Grass Fed Steer, Grain Fed Steer and EU Indices – Hereford (1970 to 2015)

Table 14 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the supermarket, grass fed steer, grain-fed steer and EU indices for Hereford.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Supermarket	0.9%	4.4%
Grass Fed Steer	0.5%	3.8%
Grain Fed Steer	0.5%	4.1%
EU	0.6%	3.7%

Table 14 – CAGR Supermarket, Grass Fed Steer, Grain Fed Steer and EU Indexes - Hereford

5.3.3.3 Shorthorn and Poll Shorthorn

The Australian association for Shorthorn and Poll Shorthorn breeds is Shorthorn Beef and the Shorthorn breeds have been involved with BREEDPLAN since its inception.

Introduced from north-eastern England to Australia in the late 1800's Shorthorn cattle were one of the first purebred cattle to become established in Australia. The Shorthorn breed has a wide genetic base with numerous closely related strains including Beef Shorthorn, Durham, Dairy Shorthorn, Australian Shorthorn and Poll Shorthorn. This results in differing maturity patterns, allowing producers to select Shorthorns best suited to their production environment and goals. The breed's genetics have also contributed to the development of other breeds that are common to the Australian beef cattle industry including the Murray Grey (see Section 5.3.3.4), Droughtmaster (see Section 5.3.4.3), Santa Gertrudis (see Section 5.3.4.2) and Belmont Red breeds.

Shorthorn cattle demonstrate good fertility and mothering characteristics and are characteristically docile in temperament. They finish readily on good quality pastures and when finished on grain typically produce good marbling characteristics. The breed tends to lay-down fat early in its life, with the carcase typically in prime condition at a relatively early age, rendering them best suited to vealer and prime weaner markets.

Prior to the turn of the last century, Shorthorn genetics accounted for approximately 50 percent of cattle in the temperate parts of Australia and 100 percent of cattle in the more challenging northern areas of Australia. While the substitution of European and *Bos indicus* breeds for shorthorn cattle in the northern beef industry has resulted in a decline in Shorthorn numbers in Australia, Shorthorn cattle are still farmed throughout most of Australia.

In 2002, the Shorthorn breed accounted for 7.8 percent of new British breed calves and 4.7 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 5.9 percent of new British breed calves registered and 3.1 percent of all new calves produced by the registered sector.

There are currently approximately 600 members of Shorthorn Beef, of which 105 are BREEDPLAN users. The cost of BREEDPLAN membership is included in the association membership fees. In 2015, the number of weaning weight measurements submitted represented 79.6 percent of new Shorthorn calf registrations.

Since 2002, the number of new registered Shorthorn calves has declined at a CAGR of 3.2 percent. However over the period 2010 to the 2015, the number of primary registrations actually grew at a CAGR of 5.3 percent, but the number of secondary registrations declined by almost 32 percent, resulting in an over decline for 2.7 percent over this more recent period. Since 2002, the number of weaner weight records submitted to BREEDPLAN decreased by 3.5 percent in total with a faster rate of decline of 5.5 percent experienced since 2010. This is illustrated in Figure 25 below.

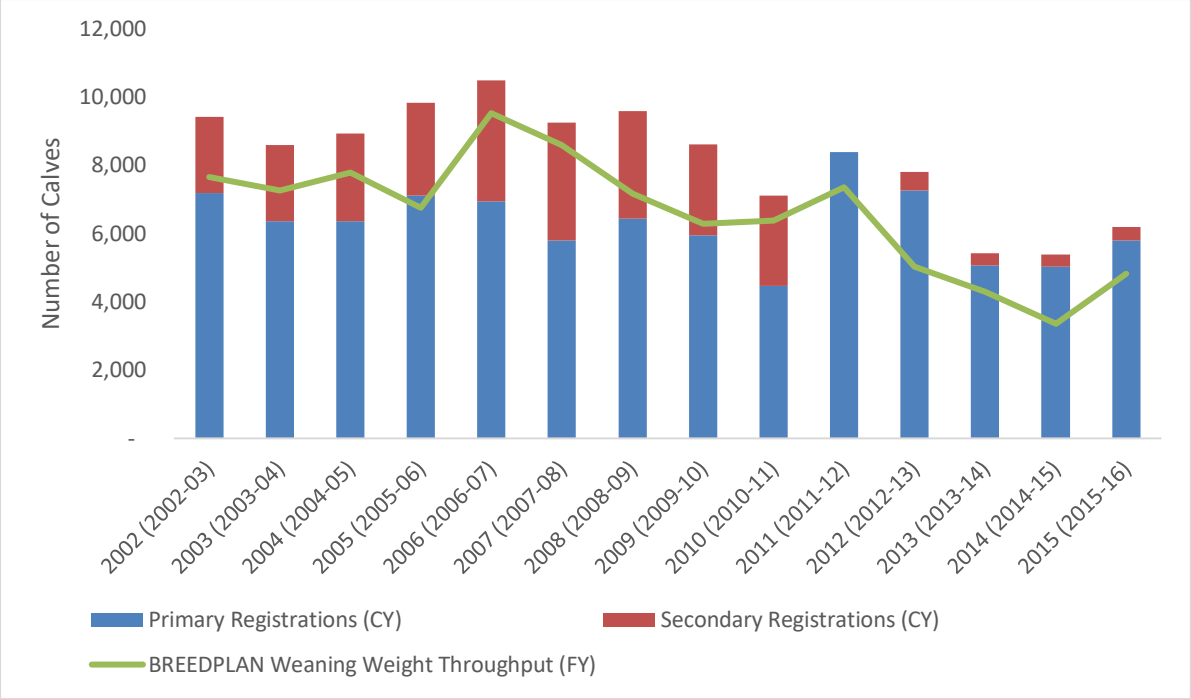

Figure 25 – Number of New Calves Registered and BREEDPLAN Weaner Weight Throughput – Shorthorn and Poll Shorthorn

Since 2002, the volume of scan records submitted remained fairly constant with a CAGR of 0.6 percent, but a significant decline over the past five years. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 29.8 percent of the number of weaning records in 2002 to 51.5 percent in 2015. This is illustrated in Figure 26 below.

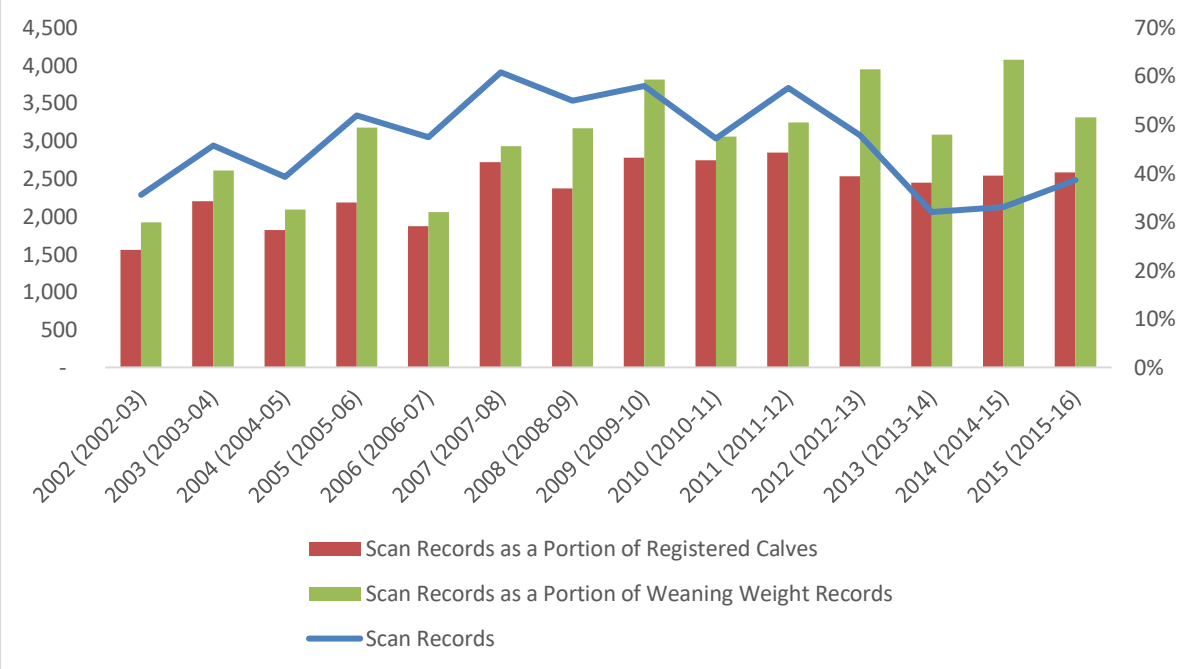

Figure 26 – Scan Data Records Submitted to BREEDPLAN – Shorthorn

Figure 27 below illustrates the trend in the domestic maternal, export maternal and northern maternal indices for the Shorthorn breed since 1970.

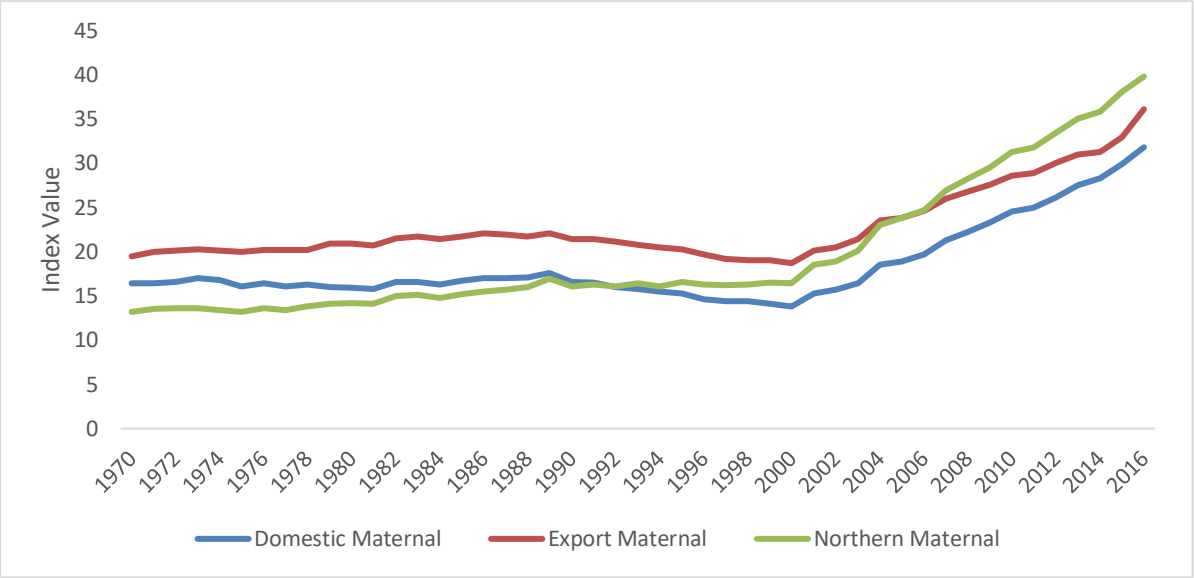

Figure 27 – Domestic Maternal, Export Maternal and Northern Maternal Indices – Shorthorn (1970 to 2016)

Table 15 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the supermarket, grass fed steer, grain-fed steer and EU indices for the Shorthorn breed.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Domestic Maternal	0.0%	2.1%
Export Maternal	0.7%	1.7%
Northern Maternal	0.8%	3.2%

Table 15 – Domestic Maternal, Export Maternal and Northern Maternal Indices GAGR - Shorthorn

5.3.3.4 Murray Grey

The Murray Grey breed was developed in Wodonga, Victoria in 1905 by crossing Angus bulls (see Section 5.3.3.1) with Shorthorn cows (see Section 5.3.3.3) and was formalised as a breed with the establishment of the Murray Grey Beef Cattle Society in 1962.

Murray Greys are an early-to-mid maturing, medium-sized breed that is recognised particularly for its good temperament. Calves tend grow quickly as a result of easy calving and strong milking characteristics. The breed produces a high yielding carcase, with good eye muscle and optimal fat cover. They are suited to vealer, steer and bullock markets, as well as on a maternal – rotational place in a cross-breeding program. The breed is found in most good rainfall areas of southern Australia, particularly in New South Wales and Victoria.

In 2002, the Murray Grey breed accounted for 8.3 percent of new British breed calves and 5.0 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 4.2 percent of new British breed calves registered and 2.2 percent of all new calves produced by the registered sector.

In 2015, the number of weaning weight records submitted to BREEDPAN for the Murray Grey breed represented 61.5 percent of new registered Murray Grey calves.

Since 2002, the number of new Murray Grey calves registered as declined by a CAGR 6.0 percent and during the period 2010 to 2015, by 6.4 percent. This decline is reflected in the number of registered Murray Grey calves producing weaning weights, which have experienced similar rates of decline over the two periods. This is illustrated in Figure 28 below.

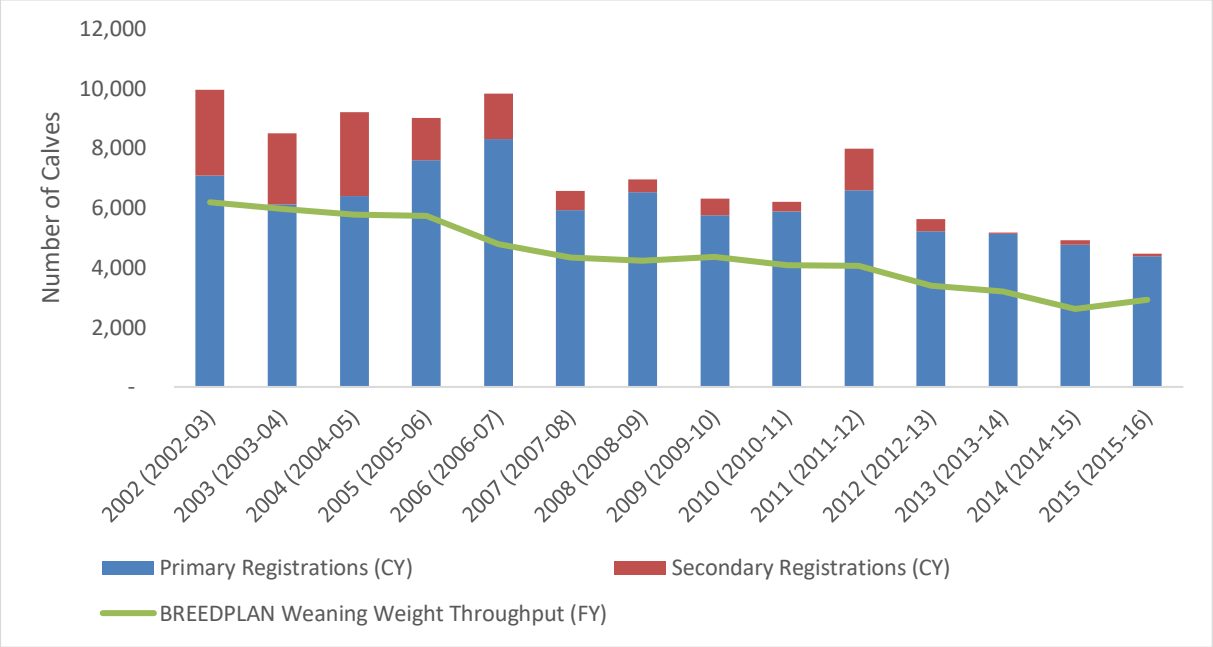

Figure 28 – Number of New Calves Registered and BREEDPLAN Weaner Weight Throughput – Murray Grey

Since 2002 the volume of scan records submitted has decreased at a CAGR of approximately 3.9 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 33.1 percent of the number of weaning records in 2002 to 41.9 percent in 2015. This is illustrated in Figure 29 below.

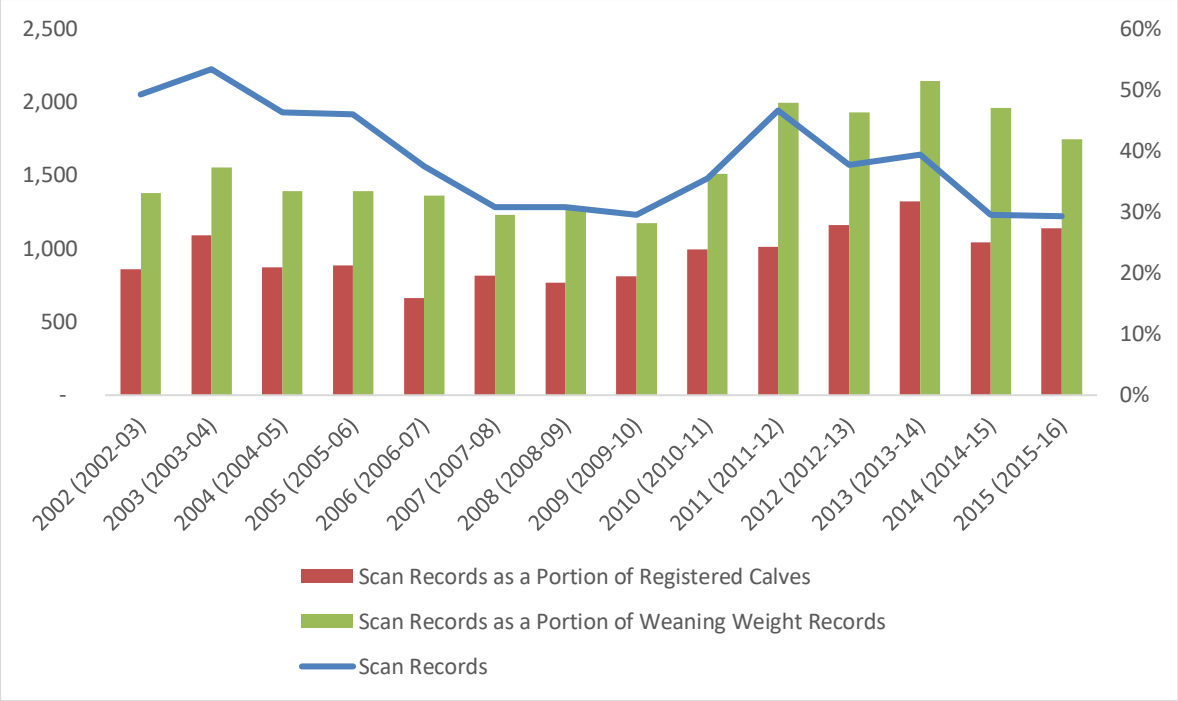

Figure 29 – Scan Data Records Submitted with BREEDPLAN – Murray Grey

Figure 30 below illustrates the trend in the vealer terminal, supermarket and EU heavy steer indices for the Murray Grey breed since 1970.

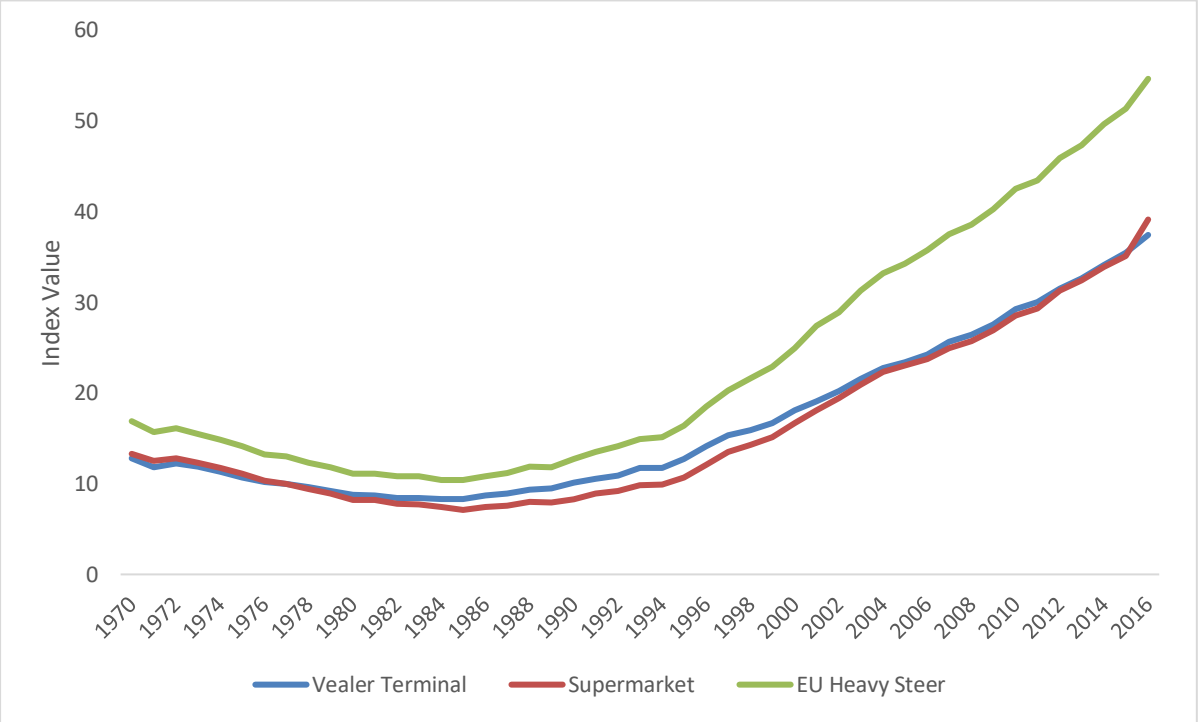

Figure 30 – Vealer Terminal, Supermarket and EU Heavy Steer Indices – Murray Grey (1970 to 2016)

Table 16 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the vealer terminal, supermarket and EU heavy steer indices for Murray Grey.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Vealer terminal	-3.0%	5.0%
Supermarket	-4.1%	5.7%
EU heavy steer	-3.4%	5.5%

Table 16 – Vealer, Supermarket and EU Heavy Steer Indices CAGR – Murray Grey

5.3.3.5 Red Angus

The breed association for Red Angus in Australia is the Red Angus Society of Australia.

In the late eighteenth century Scottish farmers crossed English Longhorn cattle that are predominately red in colour with black Scottish cattle in an attempt to produce larger draught oxen. The resultant offspring were all black in colour as a result of the red colour being recessive. Nevertheless all offspring carried to recessive red colour gene and subsequent interbreeding produced an average of one red calf in every four.

When the breed was bought to Australia, naturally red calves started appearing in herds. These animals were recognised as having the same temperament, maternal and carcase characteristics as the Angus breed (see Section 5.3.3.1) with the exception of the homozygous red coat. Because the red coat reflects sunlight better than the darker coat of Angus, Red Angus are better suited to hotter climates.

In 2002, the Red Angus breed accounted for 1.9 percent of new British breed calves and 1.2 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 2.9 percent of new British breed calves registered and 1.5 percent of all new calves produced by the registered sector.

There are currently 170 full members and 150 commercial members of the Red Angus Society of Australia, including 39 full members who use BREEDPLAN. Membership of the society is growing as the breed becomes increasingly popular in the northern and live export sectors.

In 2015, weaning weight records submitted to BREEDPLAN for the Red Angus breed represented 46.3 percent of new Red Angus calf registrations.

The treatment of Red Angus as a separate breed to Black Angus is problematic with respect to BREEDPLAN usage by Red Angus. Even through Angus and Red Angus are effectively the same breed because they have different breed societies that are maintained as separate databases for the purposes of BREEDPLAN. Because there are far fewer records for Red Angus, Red Angus animals that are otherwise comparable to Angus animals will typically demonstrate poorer BREEDPLAN figures and higher degrees of inaccuracy.

The number of new calves produced by the registered sector has grown at a CAGR of 2.2 percent since 2002 and during the period 2010 to 2015 at a rate of 5.1 percent. Since 2002, the number of Red Angus calves recording weaning weights with BREEDPLAN has grown at a CAGR of 4.8 percent, albeit the rate of growth has plateaued over the past five years. This is illustrated in Figure 31 below.

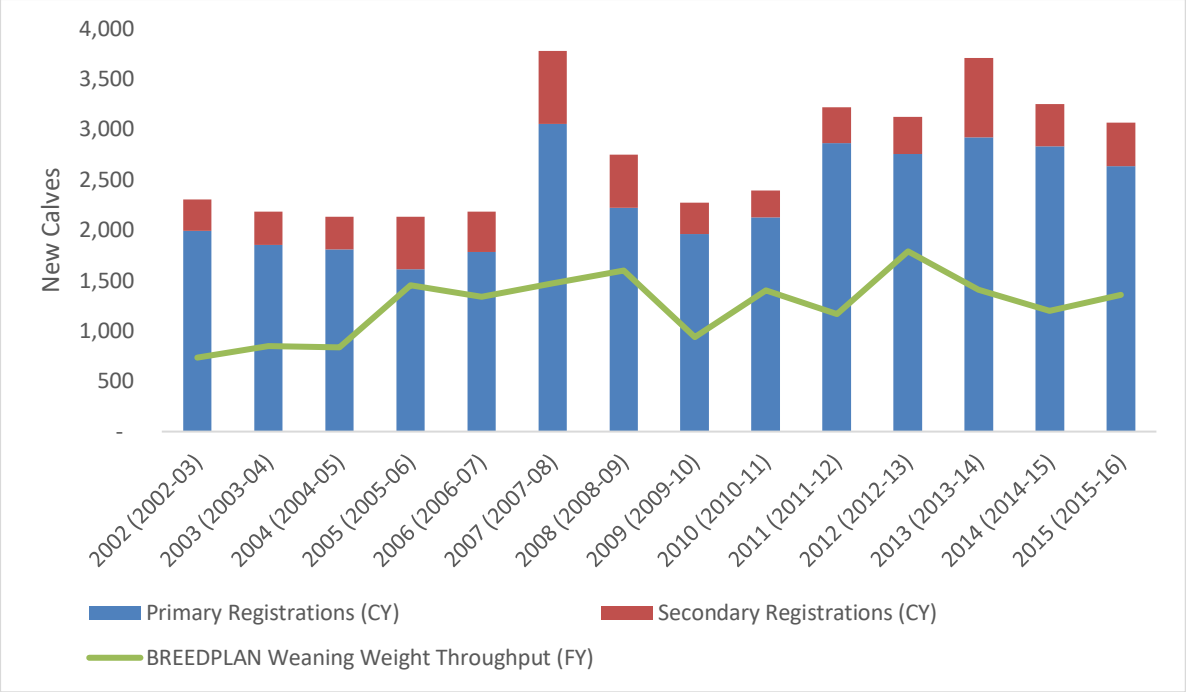

Figure 31 – New Calf Registrations and BREEDPLAN Weaning Weight Throughput– Red Angus

Since 2002, the volume of scan records submitted with BREEDPLAN has grown at a CAGR of 9.6 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 22.2 percent of the number of weaning records in 2002 to 39.4 percent in 2015. This is illustrated in Figure 32 below.

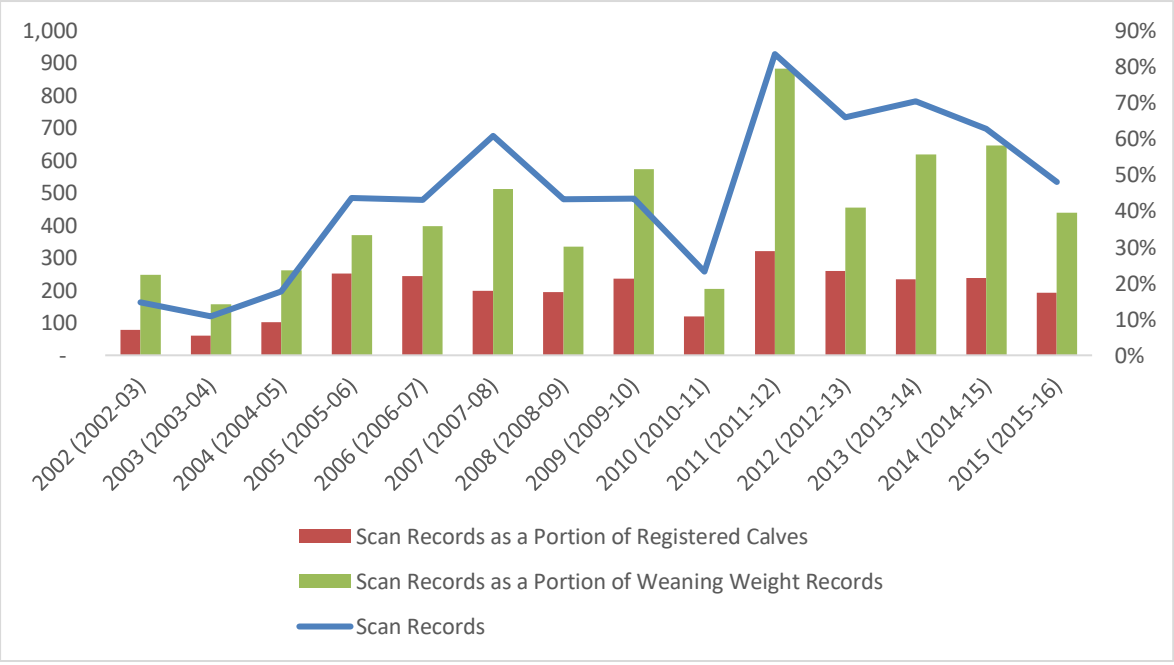

Figure 32 – Scan Data Records Submitted with BREEDPLAN – Red Angus

Figure 33 below illustrates the trend in the supermarket, vealer and northern steer indices for the Red Angus breed.

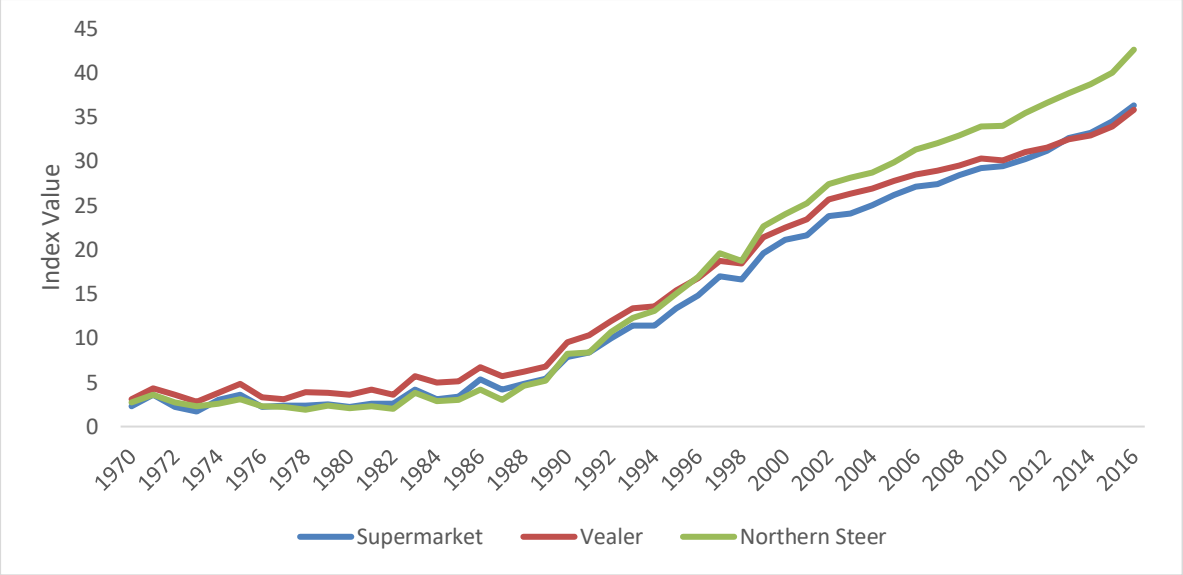

Figure 33 – Supermarket, Vealer and Northern Steer Indices – Red Angus (1970 to 2016)

Table 17 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the vealer terminal, supermarket and EU heavy steer indices for Red Angus.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Supermarket	2.2%	7.9%
Vealer	3.5%	6.5%
Northern Steer	0.5%	8.9%

Table 17 – Supermarket, Vealer and Northern Steer Indices CAGR – Red Angus

5.3.3.6 Other British Breeds

Other British breeds included in the Australian registered sector are Devon, Red Poll, South Devon, Galloway, Australian Lowline, Beef Shorthorn, Lincoln Red and British White. Collectively, these other British breeds accounted for 2.7 percent of all registered British breed calves and 1.4 percent of all registered calves in 2015.

5.3.4 Trends in the Tropical Breed Seed Stock Sectors

Tropical breeds exhibit relatively greater survivability, parasite resistance, heat tolerance and greater ability to adapt to poor grazing conditions characteristics, rendering them more suited to the harsher production environments of northern Australia.

As illustrated in Figure 17, since 2002, tropical breeds have accounted for between 28 and 34 percent of all new calves produced by the registered sector and in 2015, accounted for 31.1 percent of new calves.

During the period 2002 to 2015, secondary registrations accounted for 46.2 percent of all tropical breed registrations. Over the same period, primary registrations of tropical breeds declined by a CAGR of 1.2 percent with secondary registrations increasing by 2.2 percent. During the period 2010 to 2015, primary registrations of tropical breeds declined by a CAGR of 4.0 percent, while secondary registrations increased by a CAGR of 3.4 percent. This is illustrated in Figure 34 below.

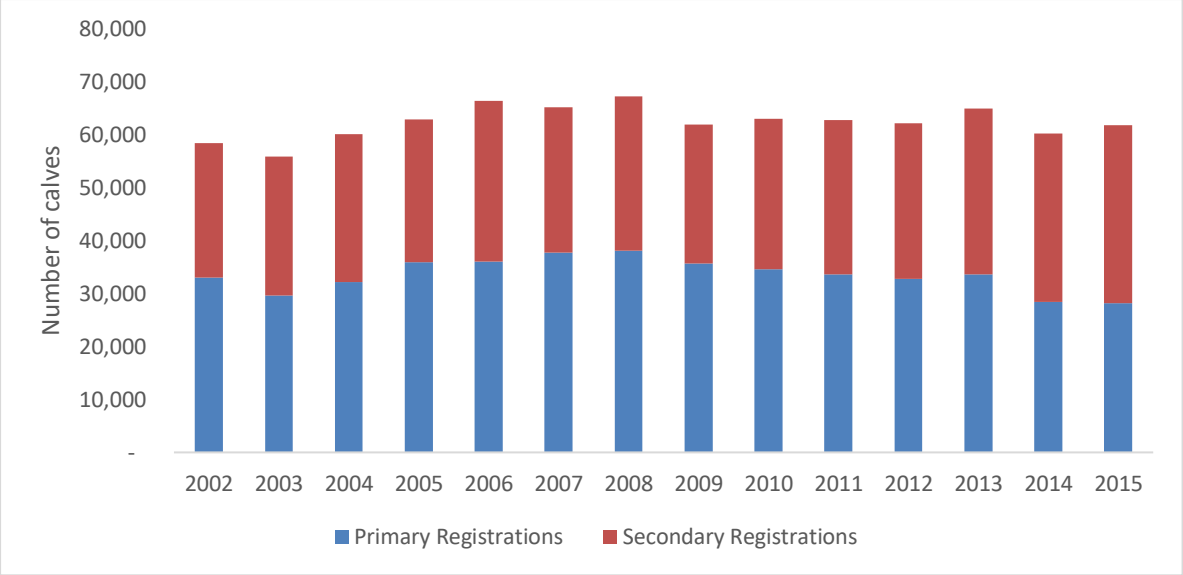

Figure 34 – Number of New Calves Registered – Tropical Breeds

The following subsections discuss trends in the market for BREEDPLAN in the main Tropical breeds that comprise the Australian beef cattle seed-stock sector.

5.3.4.1 Brahman

The Australian breed association for Brahman cattle is the Australian Brahman Breeder's Association. The Australian Brahman Breeder's Association has been involved with BREEDPLAN since its inception.

The Brahman breed was developed in the United States in the early 1800s by a cross-breeding program involving four Indian Zebu breeds and some infusion of *Bos Taurus*, a local British breed. While Brahman cattle were known to exist in northern Australia as early as the late 1800s, significant herds of the breed were not developed until 1933 when a syndicate of producers in Queensland began importing Brahman cattle.

Brahman cattle are medium sized, later maturing cattle resulting in young cattle with very lean carcases. The breed calves easily, produces good milk and are highly protective of their young. The breed is very suited to crossbreeding, typically delivering progeny that demonstrate significant hybrid vigour. They can be used as a maternal – rotational place in cross breeding programs and have been used in the development of stabilised tropical crossbreeds such as Droughtmaster (see Section 5.3.4.3), Santa Gertrudis (see Section 5.3.4.2), Braford, Brangus (see Section 5.3.4.4) and Charbray.

Brahman cattle are farmed in Western Australia, Northern Territory, Queensland and the north coast of New South Wales. Many Brahman seed-stock producers also operate large commercial herds that they supply with their own bulls, therefore transfers of bulls from seed-stock operations is relatively limited. In 2002, the Brahman breed accounted for 37.7 percent of tropical breed calves and 11.1 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 43.2 percent of new tropical breed calves registered and 13.4 percent of all new calves produced by the registered sector.

The Australian Brahman Breeder's Association has 934 full and 192 commercial members, of which 66 use BREEDPPLAN. In 2015, weaning weight records submitted to BREEDPLAN for the Brahman breed represented 42.8 percent of new Brahman calf registrations.

During the period 2002 to 2015, the number of new Brahman calves produced by the registered sector grew at a CAGR of 1.5 percent, and during the period 2010 to 2015 at a CAGR of 4.3 percent. All of this growth has been in secondary registrations, which grew at a CAGR of 5.0 percent in the period 2002 to 2015, and at 9.5 percent during the period 2010 to 2015. Since 2002, the number of Brahman registered calves submitting weaning weight records to BREEDPLAN remained constant. However, this period included a period of growth of 7.5 percent since 2010. This is illustrated in Figure 35 below.

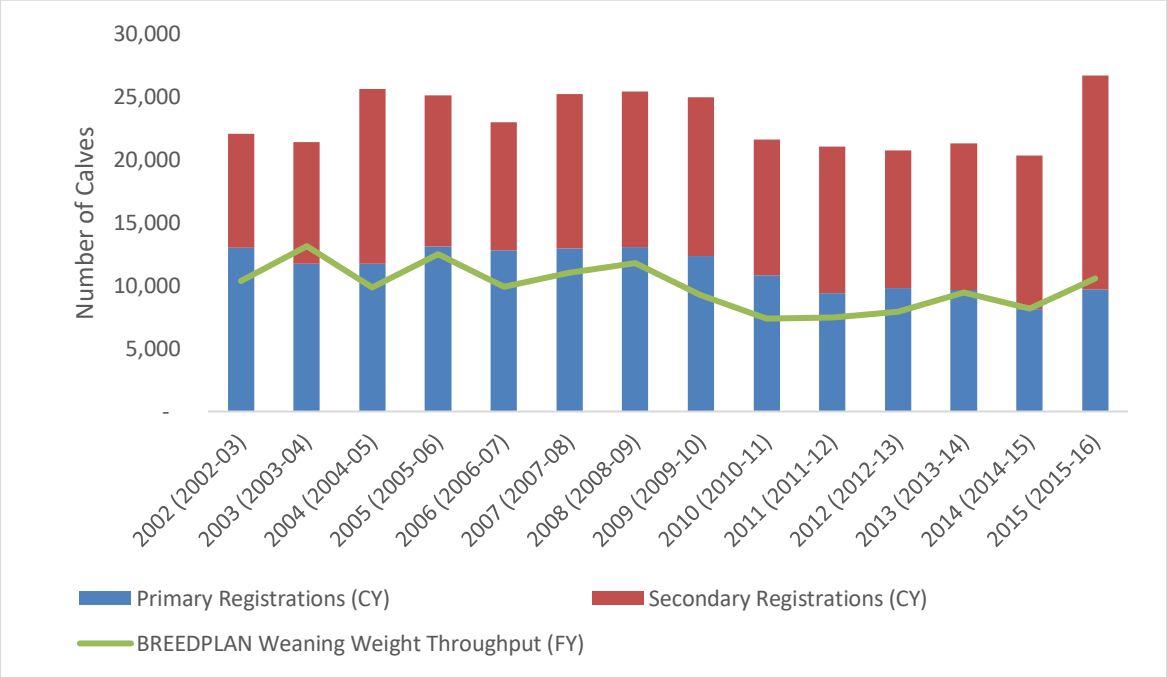

Figure 35 – New Calf Registrations and BREEDPLAN Weaning Weight Throughput – Brahman

Since 2002, the volume of scan records submitted to BREEDPLAN has increased at a CAGR of 12.3 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 5.6 percent of the number of weaning records in 2002 to 24.4 percent in 2015. This is illustrated in Figure 36 below.

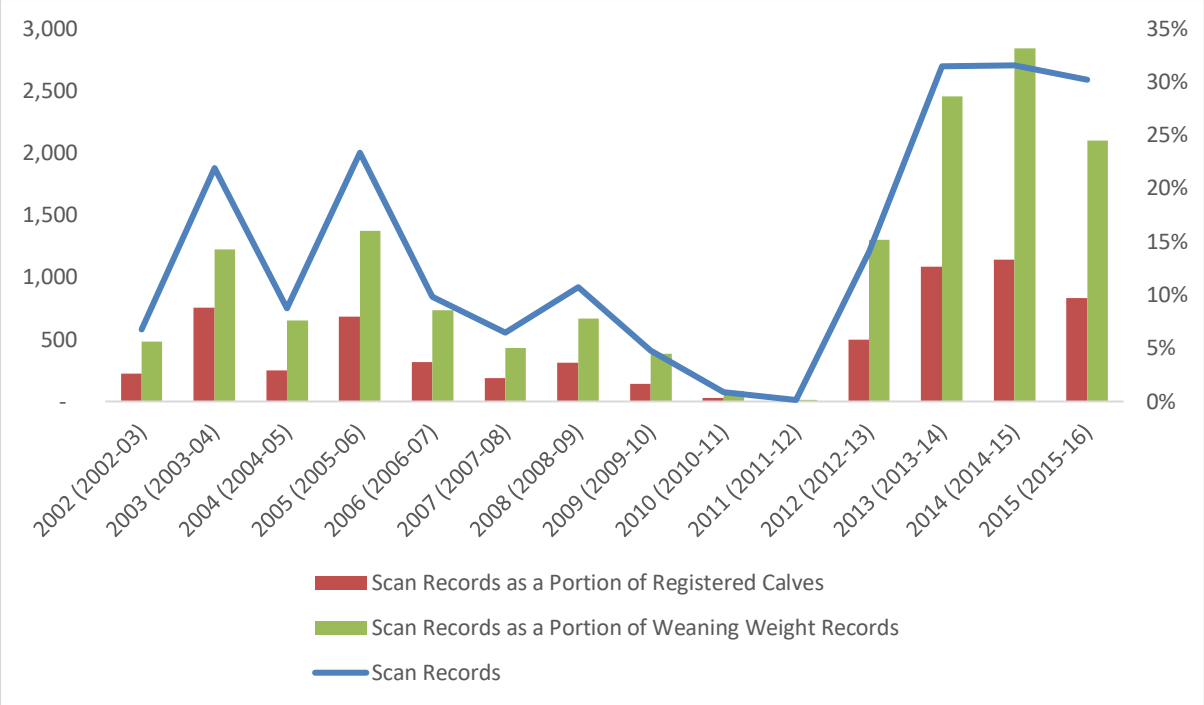

Figure 36 – Scan Data Submitted to BREEDPLAN - Brahman

Figure 37 below illustrates the trend in the Japanese Ox and Live Export Indices for the Brahman Breed since 1970.

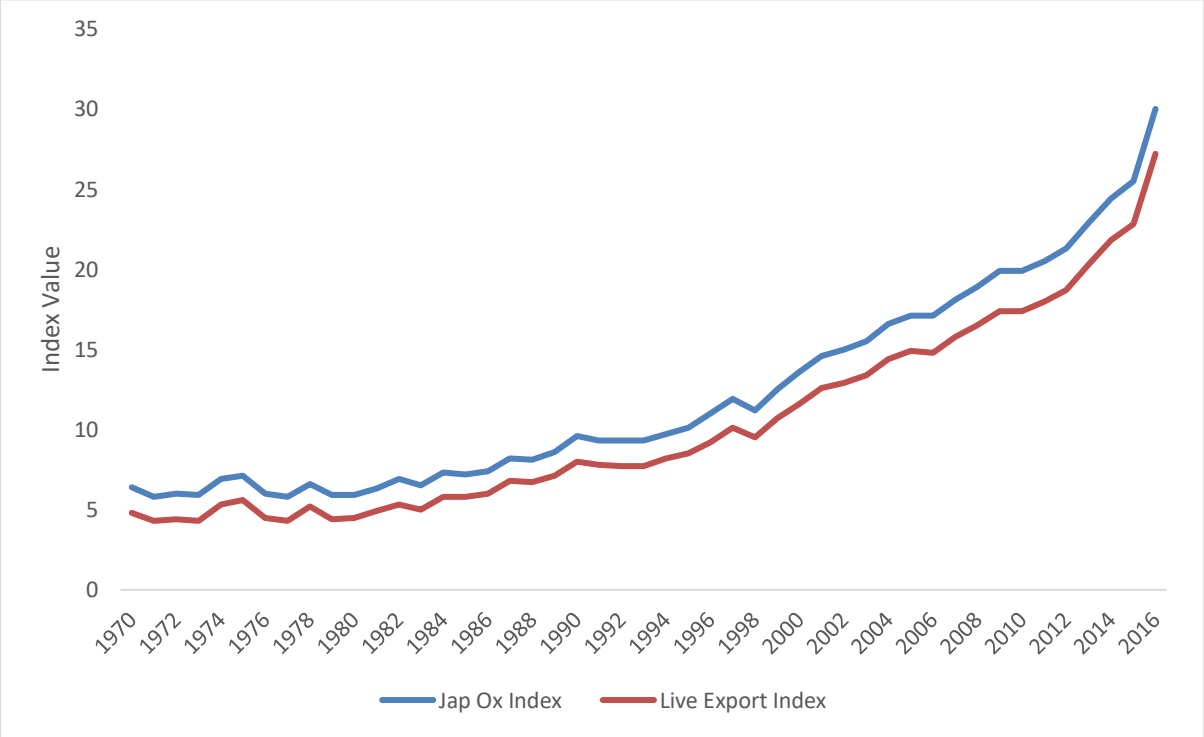

Figure 37 – Japanese Ox and Live Export Indices – Brahman (1970 to 2016)

Table 18 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the Japanese Ox and Live Export indices for the Brahman Breed.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Japanese Ox	0.9%	4.7%
Live Export	1.4%	5.1%

Table 18 – Japanese Ox and Live Export Indices - Brahman

5.3.4.2 Santa Gertrudis

The Australian breed association for the Santa Gertrudis breed is Santa Gertrudis Australia.

Introduced to Australia in 1952, the Santa Gertrudis breed was developed in Texas, United States in the 1920s by crossing Brahman (see Section 5.3.4.1) and Shorthorn (see Section 5.3.3.3) cattle with the objective of developing an animal that would perform well under local harsh, hot and dry conditions.

Santa Gertrudis cattle demonstrate high heat tolerance and bloat and tick resistance traits. Weight for age is a notable attribute of the breed, with the carcases of very young animals typically demonstrating large eye muscle with little or no waste fat. Older steers tend to yield well, with minimum fat cover. The breed can also be used as a maternal – rotational place in crossbreeding.

Santa Gertrudis cattle can be found in all climatic areas of Australia, but are most commonly used in tropical production environments. In 2002, the Santa Gertrudis breed accounted for 25.2 percent of tropical breed calves and 7.4 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 24.3 percent of new tropical breed calves registered and 7.5 percent of all new calves produced by the registered sector.

There are 319 full members and 221 commercial members of Santa Gertrudis Australia, of which 34 use BREEDPLAN. In 2015, weaning weight records submitted to BREEDPLAN for the Santa Gertrudis breed accounted for 45.1 percent of new Santa Gertrudis calf registrations.

During the period 2002 to 2015, the number of new Santa Gertrudis calves registered grew at a CAGR of 0.2 percent. During the period 2010 to 2015, the number of new Santa Gertrudis calves declined at a CAGR of 2.2%. Since 2002, the number of Santa Gertrudis registered calves submitting weaning weight records with BREEDPLAN decreased by a CAGR of 4.8 percent, albeit over the past five years record numbers seem to have plateaued. This is illustrated in Figure 38 below.

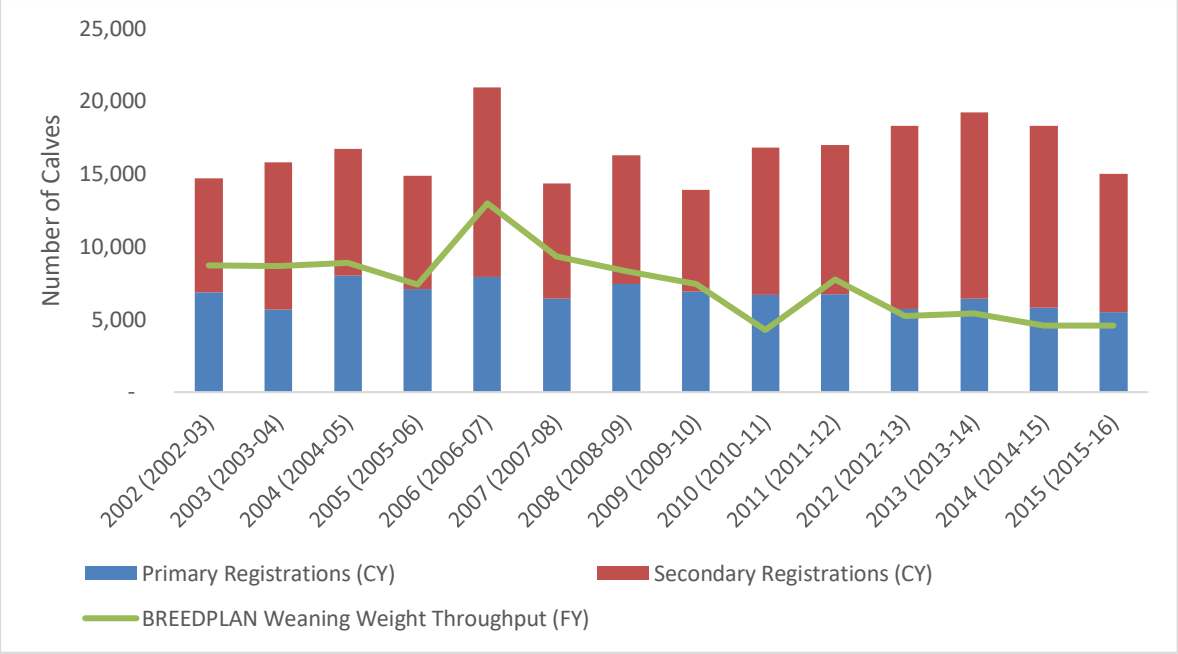

Figure 38 – New Calf Registrations and BREEDPLAN Weaning Weight Throughput – Santa Gertrudis

Since 2002, the volume of scan records submitted has increased at a CAGR of 1.4 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 23.3 percent of the number of weaning records in 2002 to 53.6 percent in 2015. This is illustrated in Figure 39 below.

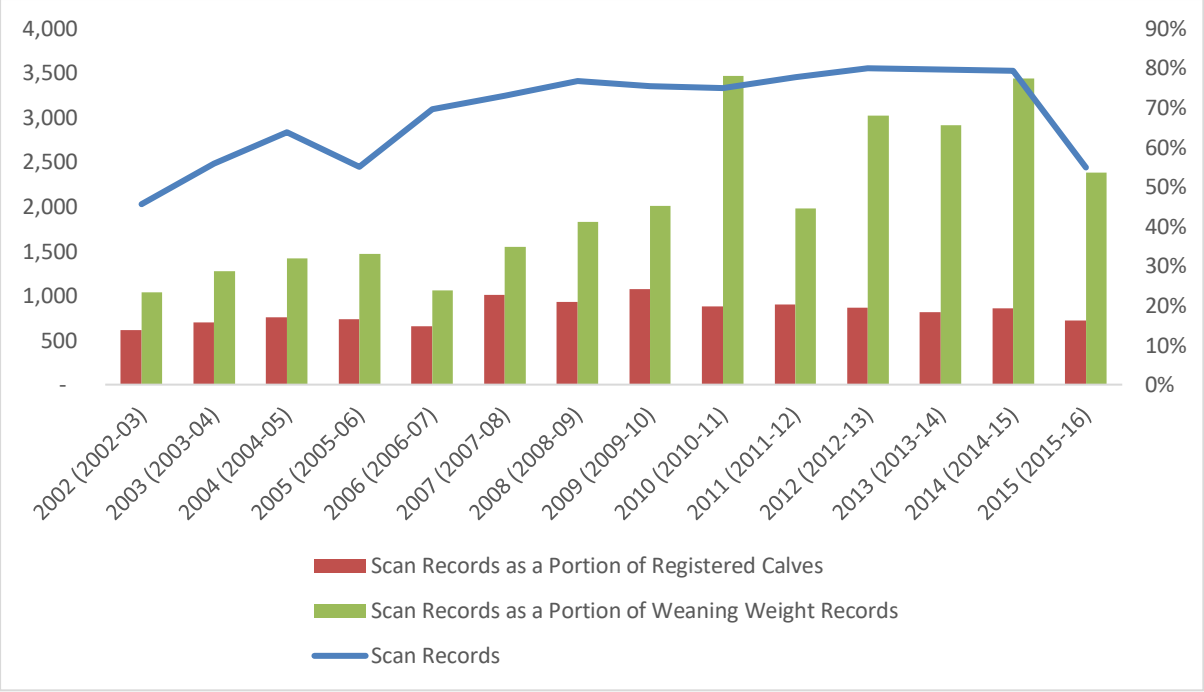

Figure 39 – Scan Data Submitted to BREEDPLAN – Santa Gertrudis

Figure 40 below illustrates the trend in the Domestic Production and Export Production Indices for the Santa Gertrudis breed.

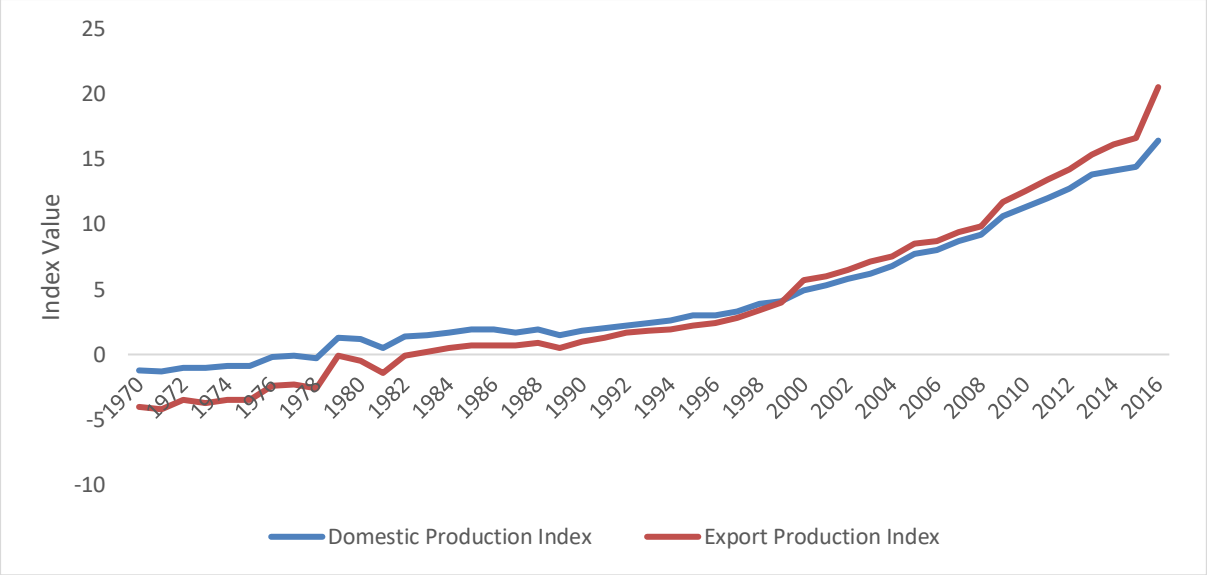

Figure 40 – Domestic Production and Export Production Indices – Santa Gertrudis (1970 to 2016)

Table 19 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the Japanese Ox and Live Export indices for the Brahman Breed.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Domestic Production Index	3.9%	7.2%
Export Production Index	-4.8%[43]	11.5%[44]

Table 19 – Domestic Production and Export Production Indices – Santa Gertrudis

5.3.4.3 Droughtmaster

The Australian association for the Droughtmaster breed is the Droughtmaster Stud Breeders Society. The Droughtmaster Stud Breeder's Society has been involved in BREEDPLAN for over 20 years.

The Droughtmaster breed was developed in northern Queensland primarily by crossing Brahman (see Section 5.3.4.1) and Shorthorn (see Section 5.3.3.3) cattle, as well as using other breeds such as Hereford (see Section 5.3.3.2) in development of the breed to arrive at a fixed tropical breed that is comprised approximately 50 percent *Bos taurus* and 50 percent *Bos indicus* bloodlines.

The Droughtmaster breed is a medium to large animal that demonstrates medium maturity. They are characterised by good body length and typically demonstrate reasonable fertility, ease of calving and good mothering behaviour under harsh conditions. Dressing percentage associated with the breed is high and they demonstrate a quiet temperament, are good foragers, have high resistance to bloat and are tolerant of heat and ticks.

While Droughtmaster cattle can be found across northern Australia, the highest concentration of the breed is found between Cape York and the New South Wales border. In 2002, the Droughtmaster breed accounted for 18.4 percent of tropical breed calves and 5.4 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 19.5 percent of new tropical breed calves registered and 6.0 percent of all new calves produced by the registered sector.

[43] Adjusted CAGR (Negative denominator)
[44] Adjusted CAGR (Negative denominator)

There are 417 full members and 73 commercial members of the Droughtmaster Stud Breeders Association, of which 23 use BREEDPLAN. In 2015, the number of weaning weight records submitted for the Droughtmaster breed to BREEDPLAN accounted for 20.3 percent of new registered Droughtmaster calves.

During the period 2002 to 2015, the number of new Droughtmaster calves registered grew at a CAGR or 0.9 percent, but during the period 2010 to 2015, declined at a CAGR of 5.8 percent. Since 2002, the number of Droughtmaster calves recording weaning weights with BREEDPLAN declined at a CAGR of 1.9 percent, including a decline of 5.5 percent since 2010. This is illustrated in Figure 41 below.

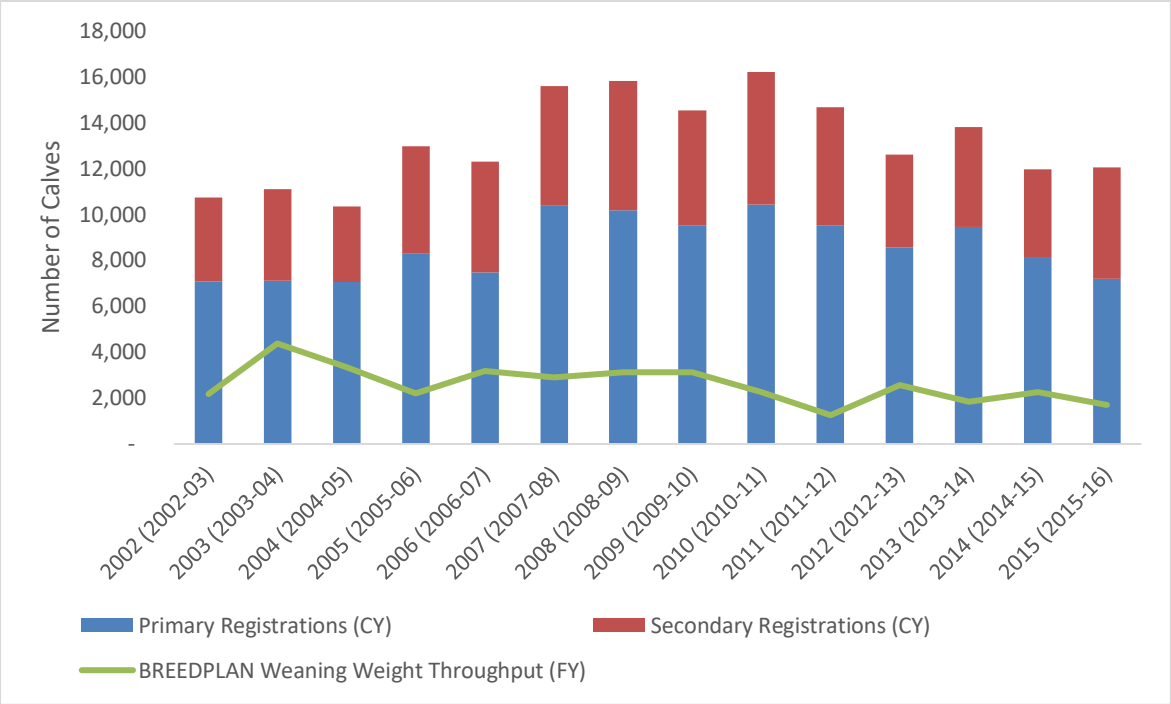

Figure 41 – New Calf Registrations – Droughtmaster

While the volume of scan records submitted to BREEDPLAN has increased at a CAGR of 29.1 percent since 2002, it has grown from a very low base. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 0.8 percent of the number of weaning records in 2002 to 29.2 percent in 2015. This is illustrated in Figure 42 below.

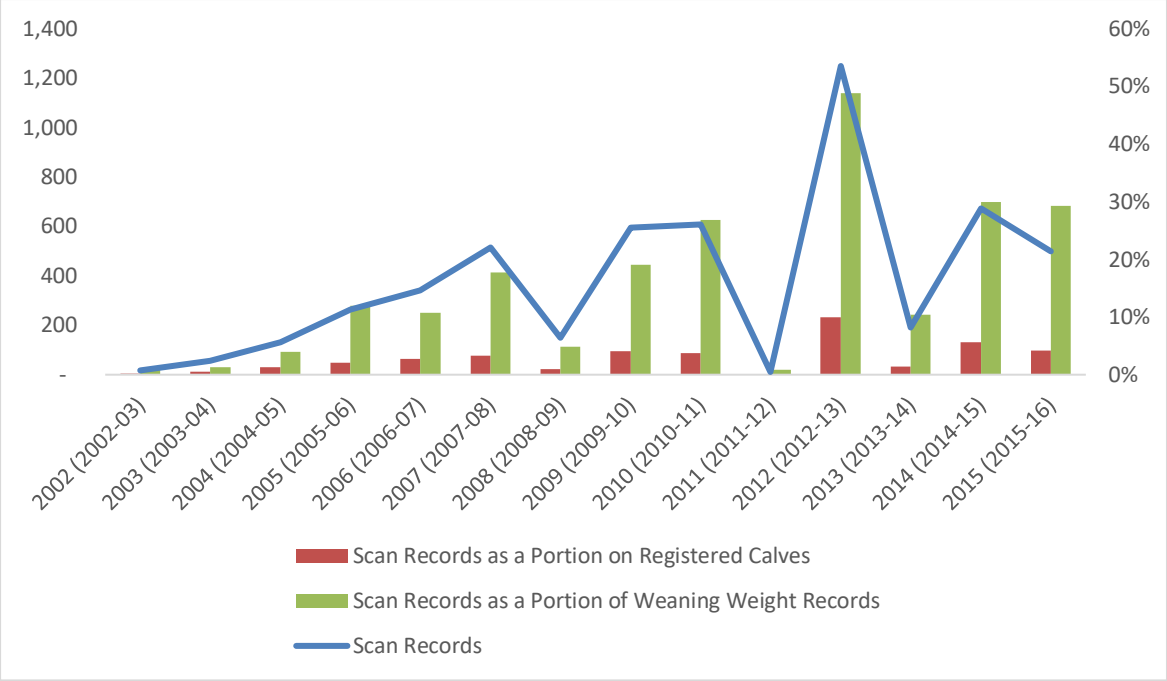

Figure 42 – Scan Data Submitted to BREEDPLAN – Droughtmaster

5.3.4.4 Brangus

The Australian breed association for the Brangus breed is the Australian Brangus Cattle Association.

The Brangus breed was developed by crossing Brahman bulls (see Section 5.3.4.1) with Angus cows (see Section 5.3.3.1) and has been recognised as a stabilised breed since the early 1950s. The breed is naturally polled and recognised for good fertility, easy calving, strong maternal characteristics, heat and parasite tolerance and longevity. It also demonstrates carcase qualities similar to the Angus breed.

Because the breed allows a variation in *Bos indicus* content, they are capable of being produced in most Australian environments. In 2002, the Brangus breed accounted for 5.4 percent of tropical breed calves and 1.6 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 7.5 percent of new tropical breed calves registered and 2.3 percent of all new calves produced by the registered sector.

In 2015, the number of weaning weight records submitted to BREEDPLAN for the Brangus breed accounted for 36.1 percent of new Brangus calves registered.

During the period 2002 to 2015, the number of new Brangus calves registered grew at a CAGR of 2.9 percent and at 3.0 percent for the period 2010 to 2015. Since 2002, the number of Brangus calves recording weaning weights with BREEDPLAN grew at a CAGR of 4.4 percent, including at a rate of 24.2 percent during the period 2010 to 2015. This is illustrated in Figure 43 below.

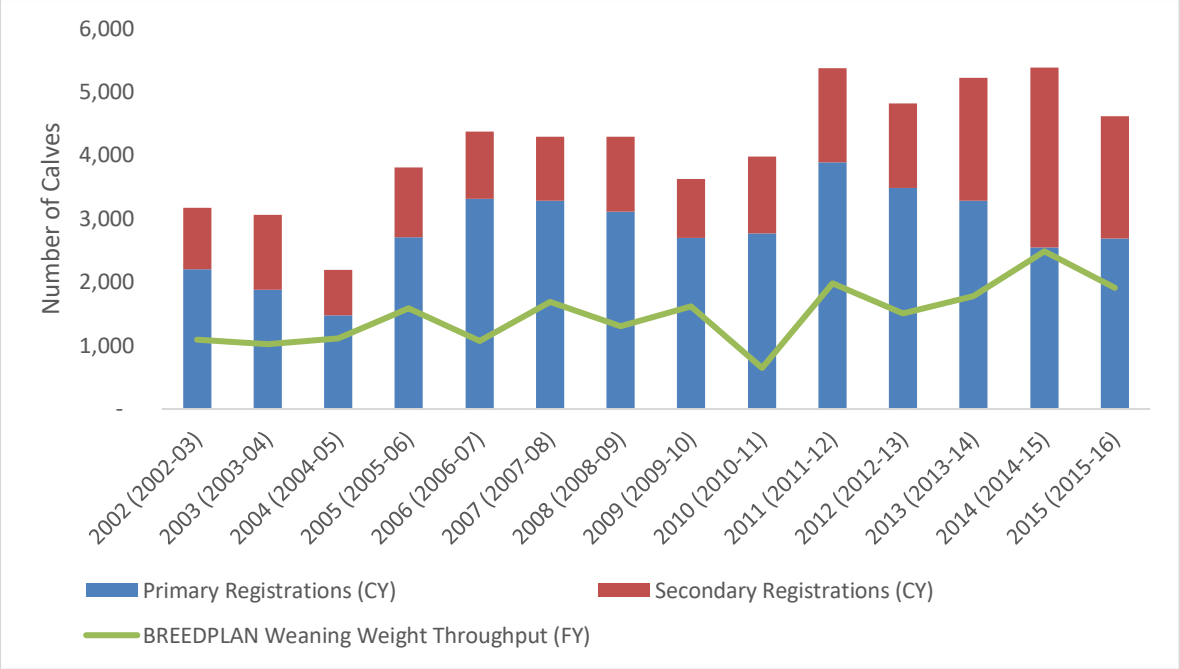

Figure 43 – New Calf Registrations and BREEDPLAN Weaner Weight Throughput – Brangus

Since 2002, the volume of scan records submitted has grown at a CAGR of 39.9 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 1.7 percent of the number of weaning records in 2002 to 78.4 percent in 2015. . This is illustrated in Figure 44 below.

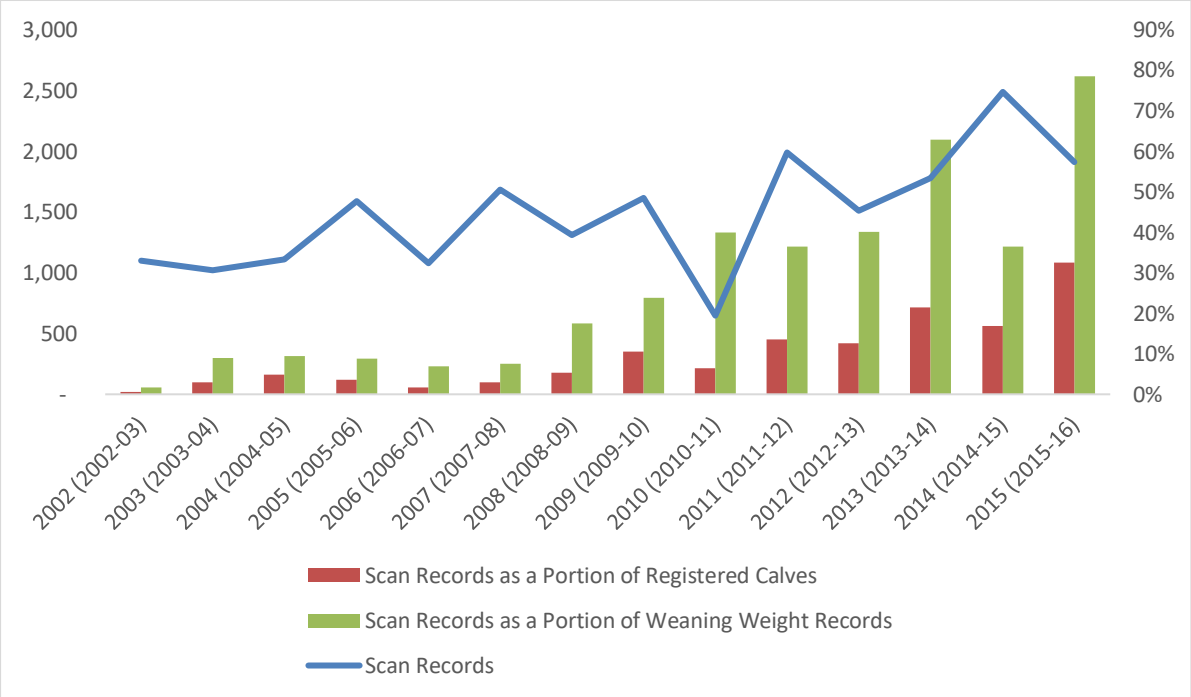

Figure 44 – Scan Records Submitted to BREEDPLAN - Brangus

Figure 45 below illustrates the trend in the Domestic Steer and Export Steer Indices for the Brangus Breed since 1970.

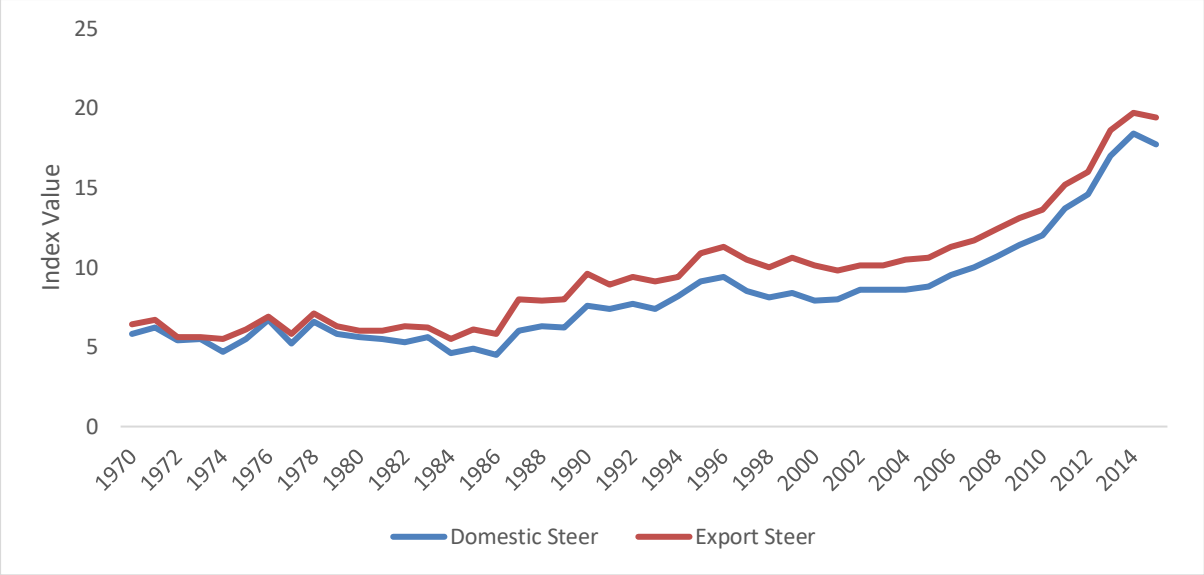

Figure 45 – Domestic Steer and Export Steer Indices – Brangus (1970 to 2014)

Table 20 below compares the CAGR for the period 1970 to 1984 to the CAGR for the period 1985 to 2015 for the Japanese Ox and Live Export indices for the Brahman Breed.

Index	CAGR 1970 to 1984	CAGR 1985 to 2015
Domestic Steer	-1.6%	3.7%
Export	-1.1%	3.5%

Table 20 – Domestic Steer and Export Indices CAGR - Brangus

5.3.4.5 Other Tropical Breeds

Other tropical breeds in the Australian seed stock sector include Charbray, Braford, Belmont Red, Senepol, Nguni, Boran, Bonsmara, Tuli, Sahiwal and Greyman breeds. In 2015, these other tropical breeds collectively accounted for 5.5 percent of new tropical breed calves registered and 1.7 percent of total calves registered.

5.3.5 Trends in European and Derivative Breed Seed Stock Sectors

Generally speaking, European breeds tend to be later maturing than British breeds and require more feed to lay-down fat cover, rendering them more suited to areas of Australia that are characterised by high rainfall. Some European breeds demonstrate strong maternal traits and European breed bulls are often crossed with British breed cows to produce faster growing, higher yielding calves.[45]

As illustrated in Figure 17 above, since 2002, European breeds have accounted for between approximately 9 and 14 percent of all new calves produced by the registered sector and in 2015, accounted for 11.4 percent of new calves.

During the period 2002 to 2015, primary registrations of European breeds grew at a CAGR of 2.5 percent, while secondary registrations decreased at a CAGR of 3.4 percent, resulting in total growth for the period of 1.4 percent. However, during the period 2010 to 2015, primary registrations declined

[45] Cummings, B. (2007), 'Cattle breed types', *Primefacts,* No. 623, New South Wales Department of Primary Industries

at a CAGR of 3.6 percent and secondary registrations at 5.1 percent, resulting in an overall decline in registrations of 3.8 percent. This is illustrated in Figure 46 below.

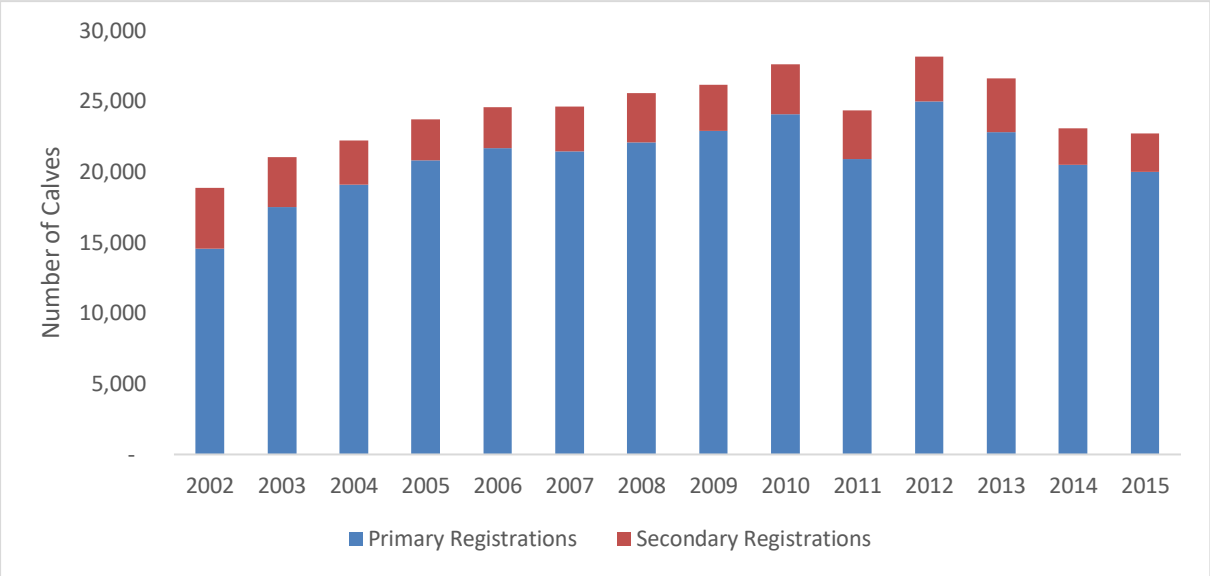

Figure 46 – Number of New Calves Registered – European and Derivative Breeds

The following subsections discuss trends in the market for BREEDPLAN in the main European and derivative breeds that comprise the Australian beef cattle seed-stock sector.

5.3.5.1 Charolais

The Australian breed association for the Charolais breed is the Charolais Society of Australia. BREEDPLAN was first offered to members of the Charolais Society of Australia in the late 1980s. Anecdotally, there is also a relatively large unregistered Charolais sector located primarily in Queensland.

One of the oldest breeds in the French cattle industry, the Charolais breed was introduced to Australia in 1969 and was the first European breed to be established in Australia. They are large framed, long bodied, heavily muscled and late maturing animals. They tend to be a docile breed, with some polled animals now being produced. Charolais steers that are produced on good pasture tend to yield heavy, well-muscled, fine-textured, lean carcases. Crossbred calves from good milking mothers can yield very good carcases at nine to ten months of age and the breed is well suited to bullock production or as a terminal sire in cross breeding programs. In Australia, crossing Charolais with Brahman (see Section 5.3.4.1) genetics is common practice, particularly in Queensland.

Charolais and Charolais crosses can be found in most parts of Australia. In 2002, the Charolais breed accounted for 33.9 percent of European and derivative breed calves and 3.2 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 37.1 percent of new European and derivative breed calves registered and 4.1 percent of all new calves produced by the registered sector.

There are currently 362 full members and 40 intermediate members of the Charolais Society of Australia, 90 of which use BREEDPLAN. In 2015, weaning weight records submitted to BREEDPLAN for the Charolais breed represented 53.1 percent of the new Charolais calves registered.

Approximately four years ago, the Charolais society changed is pricing model for BREEDPLAN, shifting from BREEDPLAN membership being included in the membership fee, to a user pays model on a cost recovery basis. This resulted in approximately one third of BREEDPLAN members discontinuing the service.

During the period 2002 to 2015, the number of Charolais calves registered grew at a CAGR of 2.0 percent. However, this included a period of decline of 6.6 percent per annum since 2010. Since 2002, the number of calves recording weaning weights with BREEDPLAN grew at a CAGR of 2.7 percent but has declined over the past five years. This is illustrated in Figure 47 below.

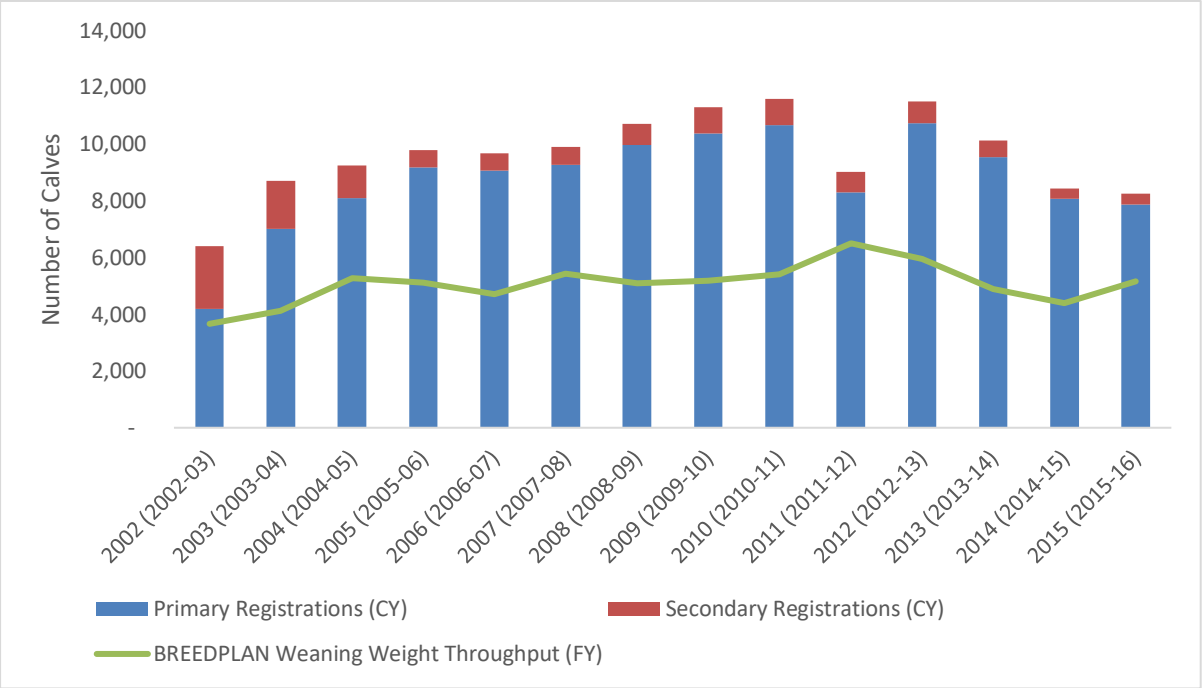

Figure 47 – New Calf Registrations and BREEDPLAN Weaning Weights Processed– Charolais

Since 2002 the volume of scan data submitted to BREEDPLAN has grown at a CAGR of 11.4 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 13.7 percent of the number of weaning records in 2002 to 40.0 percent in 2015. This is illustrated in Figure 48 below.

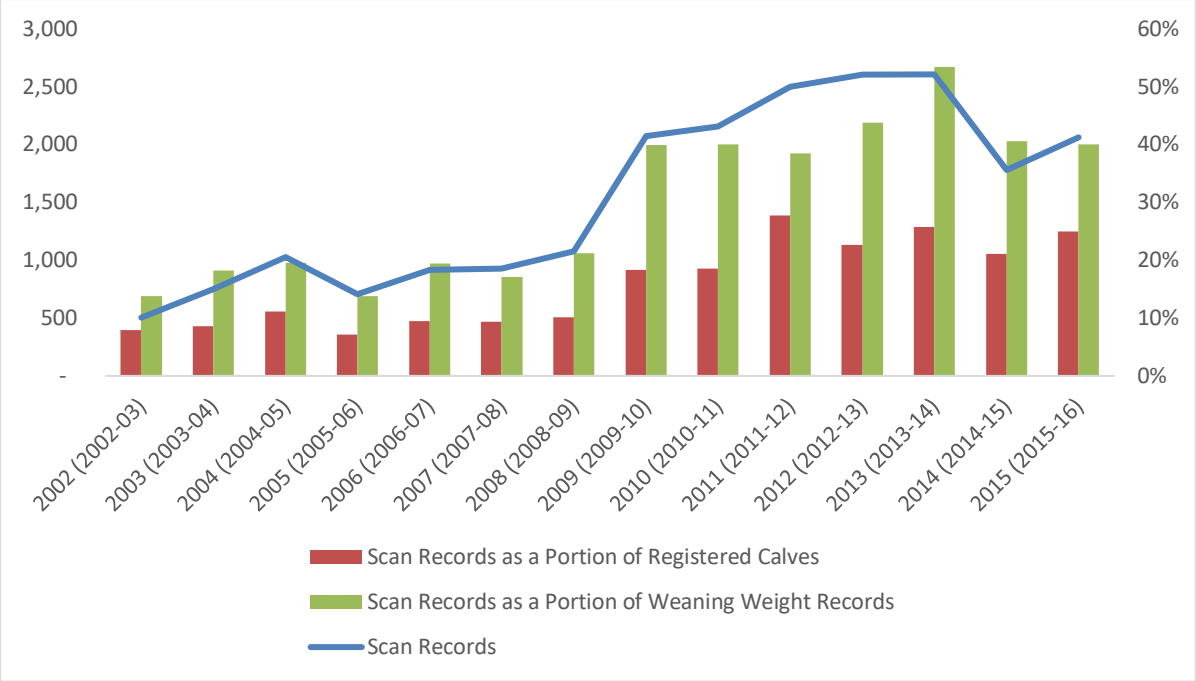

Figure 48 – Scan Records Submitted to BREEDPLAN - Charolais

Figure 49 below illustrates the trend in the domestic, export and northern terminal indices for the Charolais breed since 1970.

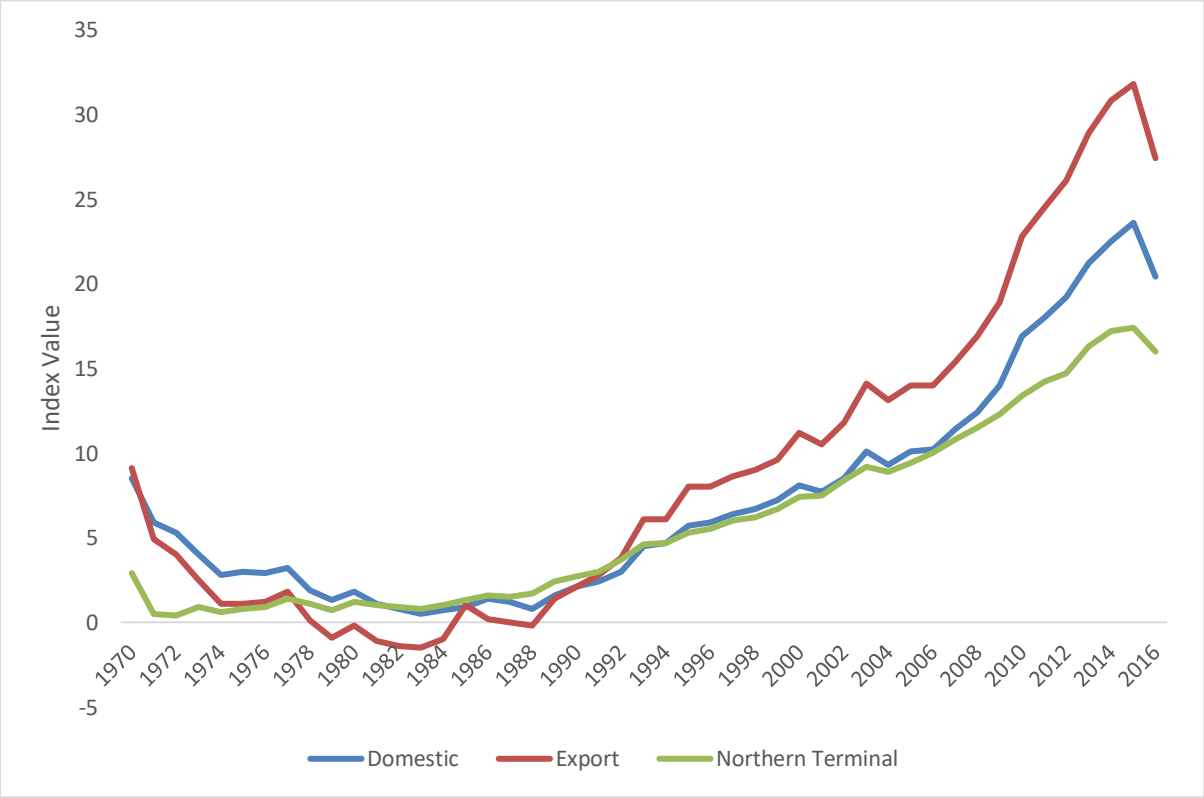

Figure 49 – Domestic, Export and Northern Terminal Index Value – Charolais

Table 21 below compares the CAGR for the period 1970 to 1984 with the CAGR for the period 1985 to 2016 for the domestic, export and northern terminal indices.

Index	CAGR 1970 to 1984	CAGR 1985 to 2016
Domestic	-16.3%	10.6%
Export	-27.5%	11.3%
Northern Terminal	-7.3%	8.4%

Table 21 – Domestic, Export and Northern Terminal Indices - Charolais

5.3.5.2 Limousin

The Australian breed association for the Limousin breed is the Australian Limousin Breeder's Society.

The Limousin breed originates from the central France and today can be found in around seventy countries with production environments as diverse as Finland, Cuba, South Africa and PRC. The breed is the largest breed in the United Kingdom, third largest breed in the United States, fifth largest breed in Canada and seventh largest breed in Australia.

Limousin can be polled or horned and animals are intermediate in size. They adapt to diverse climates and a wide range of management systems and are good foragers. They tend to demonstrate low birth weights resulting in easy calving, particularly when Limousin bulls are used over cows of other breeds. They demonstrate high meat to bone ratios and low fat, resulting in very good yields. The meat is finely textured, tender and low in saturated fats and cholesterol.

Limousin cattle can be found across Australia. In 2002, the Limousin breed accounted for 35.1 percent of European and derivative breed calves and 3.3 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 30.2 percent of new European and derivative breed calves registered and 3.3 percent of all new calves produced by the registered sector.

In 2015, weaning weight records submitted to BREEDPLAN for the Limousin breed represented 49.5 percent of new Limousin calf registrations.

During the period 2002 to 2015, the number of Limousin calves registered was effectively stable, albeit there has been a period of notable decline since 2012. Since 2010, the number of calves recording weaning weights with BREEDPLAN decreased by a CAGR of 4.1 percent. This is illustrated in Figure 50 below.

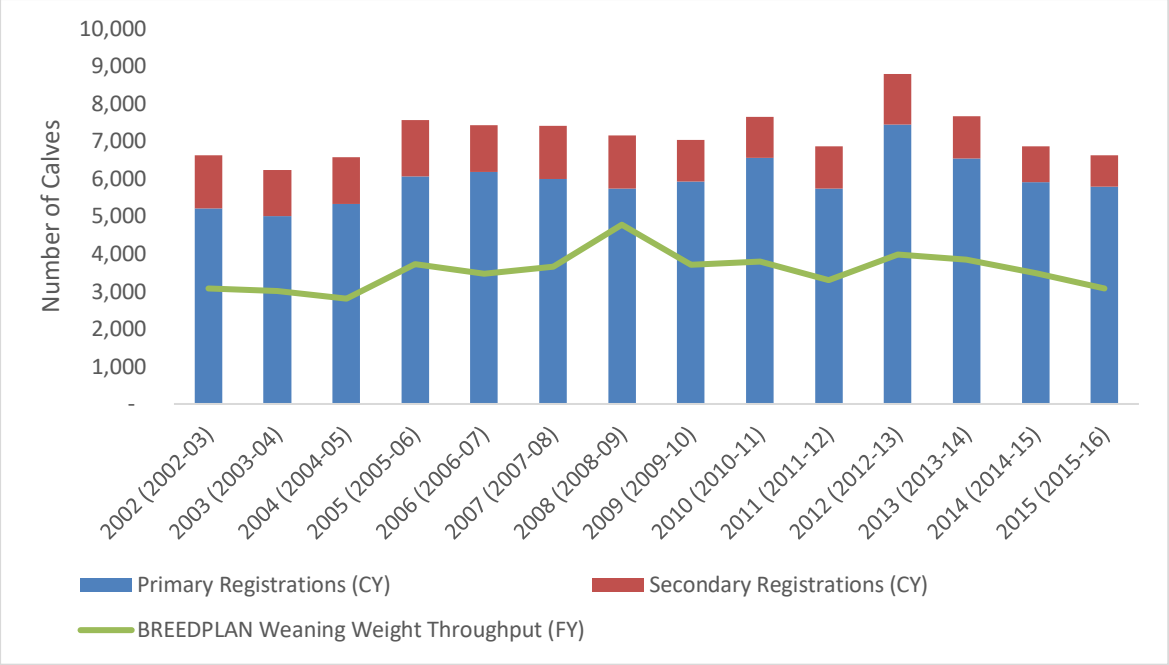

Figure 50 – New Calf Registrations – Limousin

Since 2002, the volume of scan data submitted has increased at a CAGR of 13.5 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 5.4 percent of the number of weaning records in 2002 to 28.3 percent in 2015. This is illustrated in Figure 51 below.

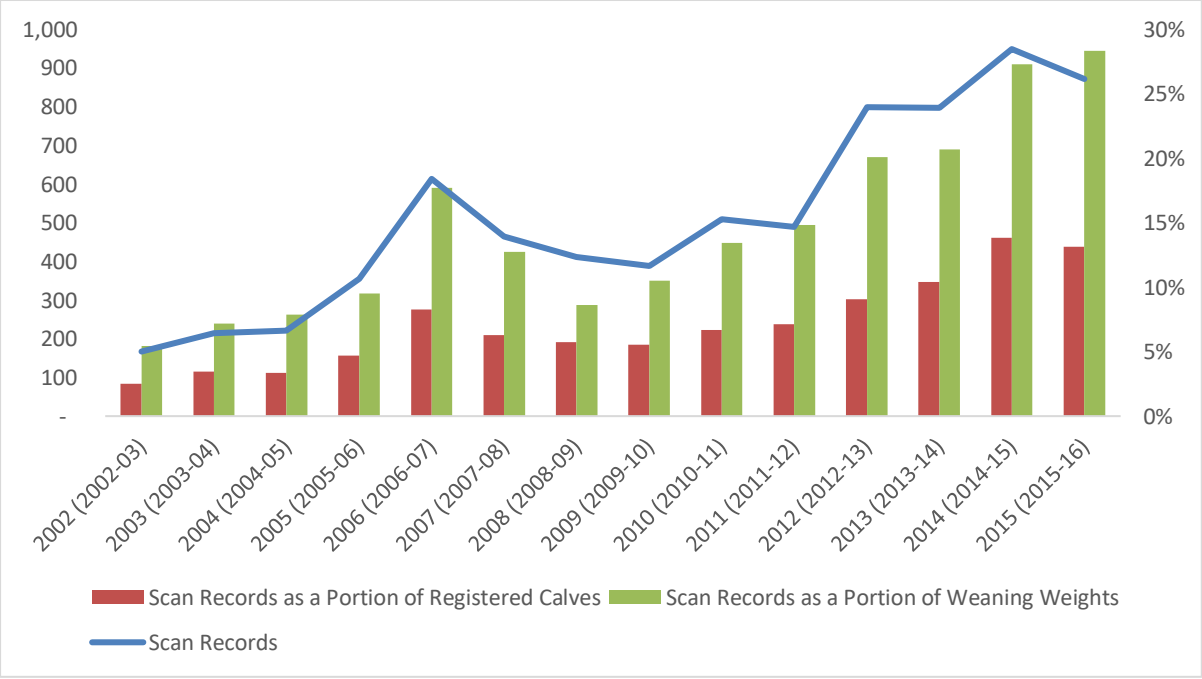

Figure 51 – Scan Records Submitted to BREEDPLAN - Limousin

Figure 52 below illustrates the trend in the Domestic Terminal, Self-replacing, Heavy Steer and Vealer Terminal Indices for the Limousin Breed.

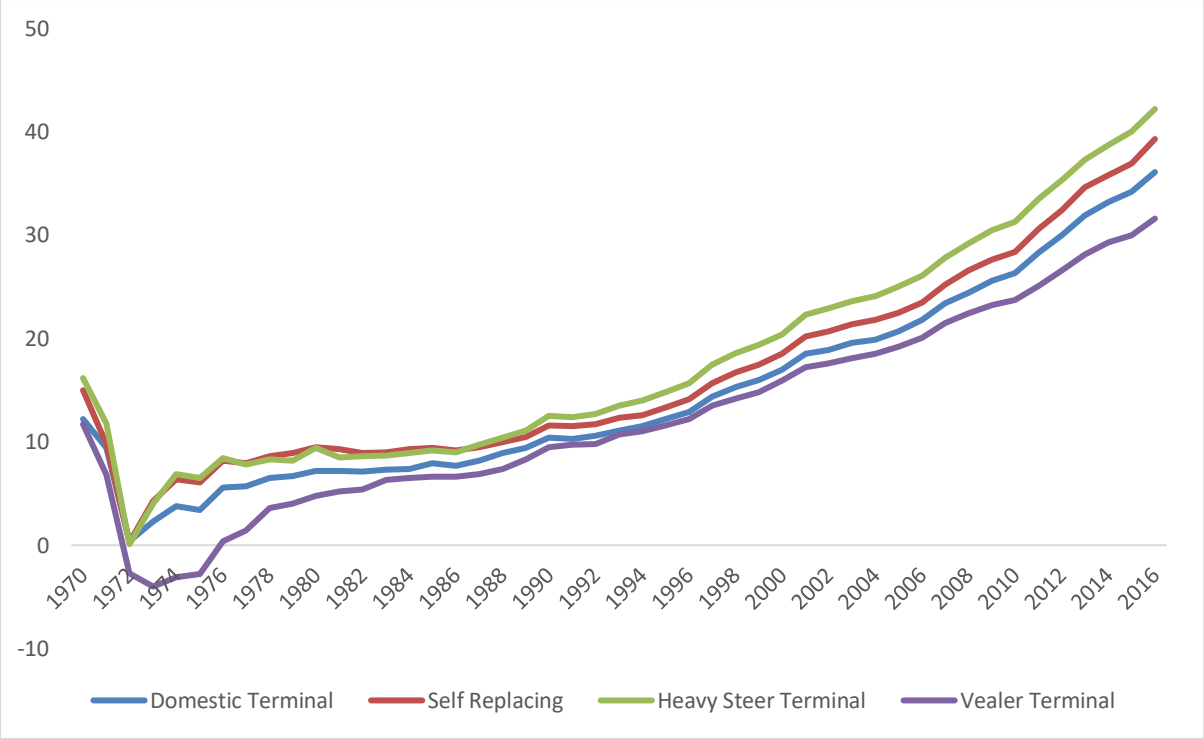

Figure 52 – Domestic Terminal, Self-replacing, Heavy Steer Terminal and Vealer Terminal Indices – Limousin (1970 to 2016)

Table 22 below compares the CAGR for the period 1970 to 1984 with the CAGR for the period 1985 to 2016 for the domestic, export and northern terminal indices.

Index	CAGR 1970 to 1984	CAGR 1985 to 2016
Domestic Terminal	-3.5%	5.0%
Self-replacing	-3.4%	4.7%
Heavy Steer Terminal	-4.2%	5.0%
Vealer Terminal	-4.1%	5.2%

Table 22 – Domestic Terminal, Self-replacing, Heavy Steer Terminal and Vealer Indices CAGR- Limousin

5.3.5.3 Simmental

The Australian breed association for the Simmental breed is Simmental Australia, one of 45 members of the global Royal Simmental Foundation. Administration of Simmental Australia is provided by ABRI under a service agreement arrangement.

The Simmental breed originates from Switzerland and various lines of the breed have been developed across Europe, United Kingdom, countries of the former Soviet Union, South Africa, the Americas and Australasia. Simmental are the second most common domesticated cattle breed in the world. Where in Europe, Simmental are bred primarily as dairy cattle, in Australia they are bred for beef production.

Simmental cattle are long-bodied and well-muscled, demonstrating good milking qualities. They have a good temperament and can be horned or polled animals. Carcases are lean and heavy, delivering high yields. The breed is used extensively in cross breeding, particularly with Herefords (see Section 5.3.3.2). They are suited to vealer, steer and bullock markets, as well as a maternal – rotational – terminal place in crossbreeding

Simmental Australia is the breed association for both black and traditional Simmental. In most other jurisdictions black and traditional Simmental are treated as separate breeds. Combining of the two

pedigrees has caused some conflict within the breed association and a view that the pedigrees should not be compared to each other causes issues with BREEDPLAN. For example, Black Simmental seed-stock producers are primarily concerned with 600 day weight EBVs, whereas Traditional Simmental seed-stock producers are more concerned with 200 day weight EBVs.

Simmental semen was first imported to Australia in 1972 and purebred and Simmental-infused commercial cattle can be found in almost all Australian production environments. In 2002, the Simmental breed accounted for 20.5 percent of European and derivative breed calves and 1.9 percent of all new calves produced by the registered sector. In 2015, the breed accounted for 23.8 percent of new European and derivative breed calves registered and 2.8 percent of all new calves produced by the registered sector.

There are current approximately 156 full members and 88 commercial members of Simmental Australia, 77 of which use BREEDPLAN. In 2015, weaning weight records submitted to BREEDPLAN for the Simmental breed represented 51.9 percent of new Simmental calf registrations.

During the period 2002 to 2015, the number of Simmental calves registered grew at a CAGR of 2.8 percent and for the period 2010 to 2015, at 1.2 percent. Since 2002, the number of registered Simmental calves submitting weaning weight data to BREEDPLAN has increased at a CAGR of 1.8 percent, with a notable decline since 2013. This is illustrated in Figure 53 below.

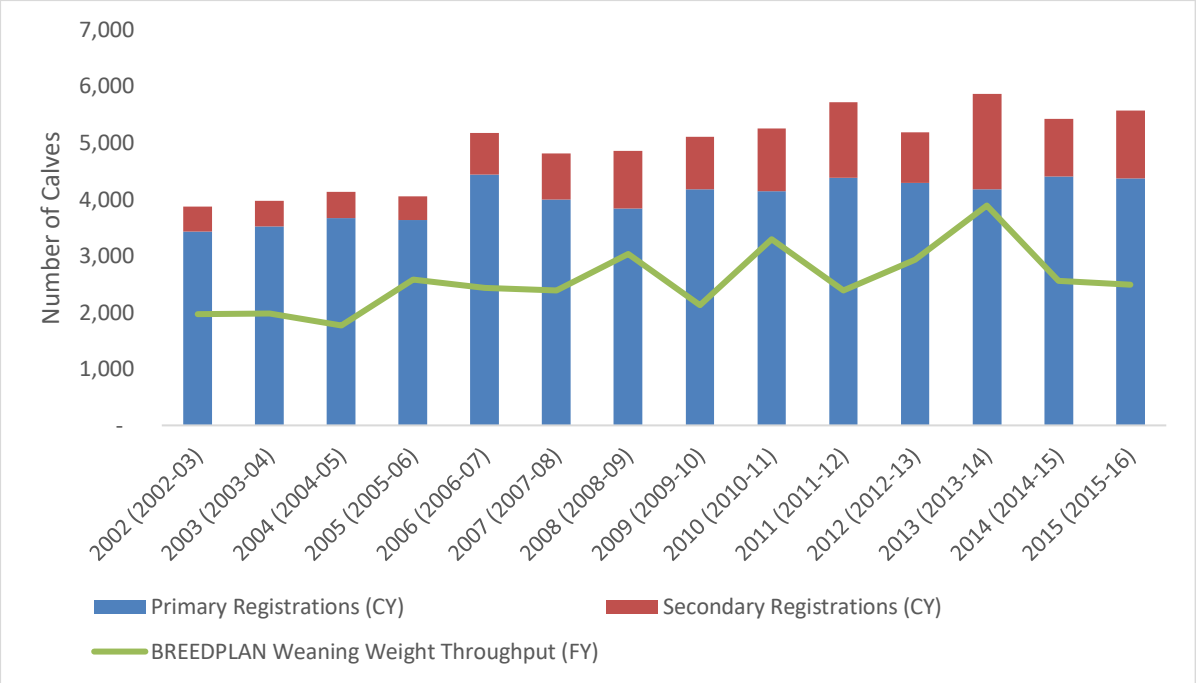

Figure 53 – New Calf Registrations and BREEDPLAN Weaning Weight Throughput – Simmental

Since 2002, the volume of scan records submitted has grown at a CAGR of 5.5 percent. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has increased from 20.6 percent of the number of weaning records in 2002 to 32.6 percent in 2015. This is illustrated in Figure 54 below.

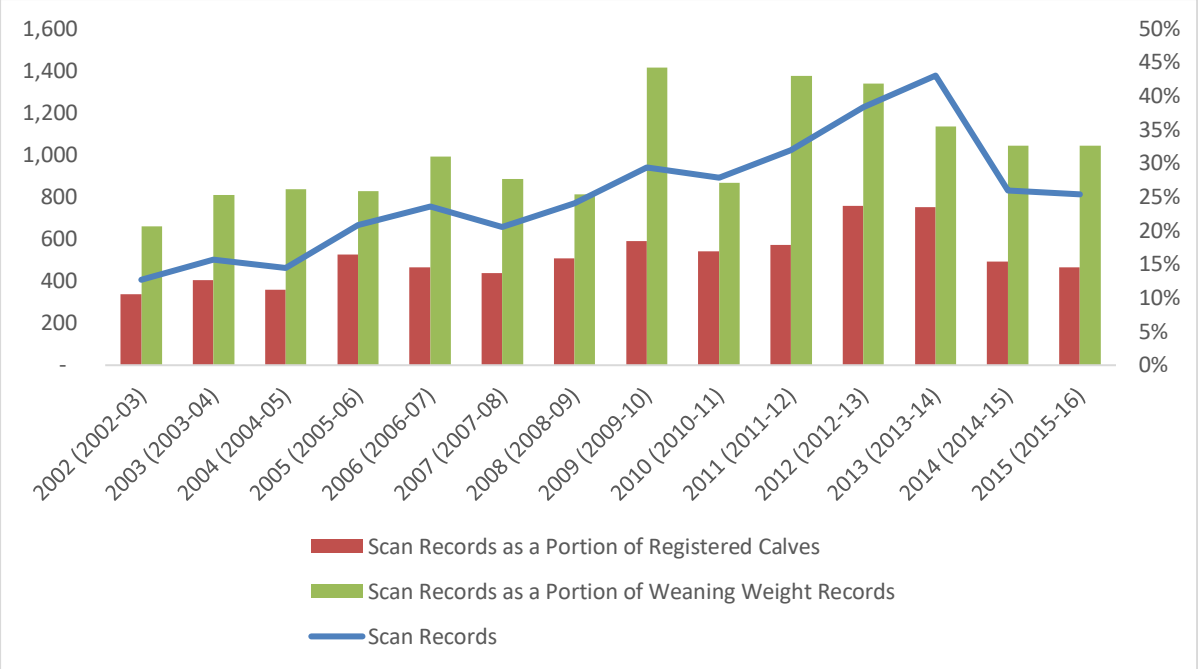

Figure 54 – Scan Records Submitted to BREEDPLAN - Simmental

Figure 55 below illustrates the trend in the Domestic Maternal, Export Maternal, Northern Terminal and Vealer Terminal Indices for the Simmental breed.

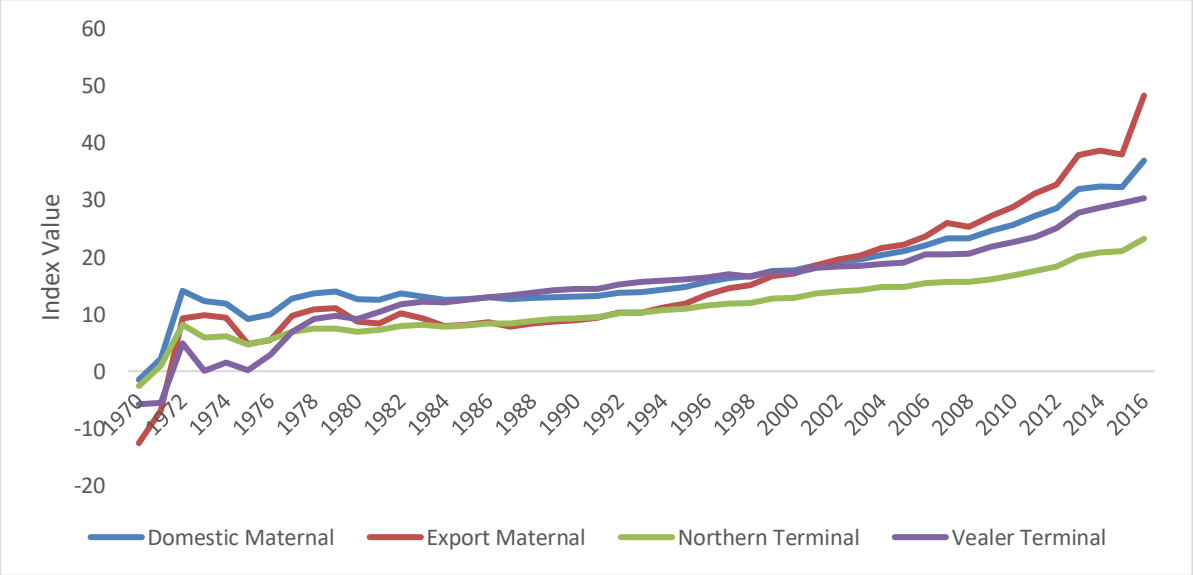

Figure 55 – Domestic Maternal, Export Maternal, Northern Terminal and Vealer Terminal Indices – Simmental (1970 to 2016)

Table 23 below compares the CAGR for the period 1970 to 1984 with the CAGR for the period 1985 to 2016 for the Domestic Maternal, Export Maternal, Northern Terminal and Vealer Terminal Indices.

Index	CAGR 1970 to 1984	CAGR 1985 to 2016
Domestic Maternal	20.7%	3.5%
Export Maternal	24.1%	5.9%
Northern Terminal	18.2%	3.5%
Vealer Terminal	22.8%	2.9%

Table 23 – Domestic Maternal, Export Maternal, Northern Terminal and Vealer Terminal Indices CAGR - Simmental

5.3.5.4 Other European and Derivative Breeds

Other European and derivative breeds found in the Australian beef cattle seed-stock sector include Blonde d'Aquinataine, Fleckvieh, Gelbvieh, Australian Bazadais, Romagnola, Maine Anjou, Salers, Chianina, Piedmontese, Bazadaise, Belgian Blue, Southen He Pinzgauer, Chiangus and Braunvieh. In 2015, collectively these other breeds accounted for 10.0 percent of registered calves from European and derivative breeds and 1.1 percent of all registered calves.

5.3.6 Other Breeds

5.3.6.1 Wagyu

The Australian Wagyu Association was established in 1989 and is the Australian breed association for Wagyu cattle.

Wagyu are a Japanese breed of cattle that is the bred from a range of native Asian cattle breeds. The breed was originally used as a draught animal and therefore animals were selected for their physical endurance. This favoured animals that demonstrated high levels of inter-muscular fat as a source of energy, resulting in the very high levels of marbling that is characteristic of the breed. The breed is also known for easy calving, early female maturation and fertility, quiet temperament, versatile adaptation to environments, good foraging ability and disease resilience in feedlots. Wagyu are used in cross-breeding programs to improve the meat quality of progeny.

The breed was first introduced to Australia in 1990 and frozen semen and embryos have been available in Australia since 1991. In 2002, Wagyu cattle accounted for 0.5 percent of all new calf registrations. In 2015, the breed accounted for 4.2 percent of all new calf registrations.

There are currently 350 full members of the Australian Wagyu Association, 56 of which use BREEDPLAN. In 2015, weaning weight records submitted to BREEDPLAN for the Wagyu breed represented 43.6 percent of new Wagyu registered calves.

Historically, the Wagyu breed has struggled with BREEDPLAN. The key agribusiness metrics for Wagyu are carcase yield and marbling. Initially, BREEDPLAN relied on live animal scanning to identify the extent of marbling in an animal. However, because marbling tends to be very fine with Wagyu cattle, conventional scanning technology was ineffectual in identifying the marbling that is valued by markets. In order to address this issue the Wagyu Association of Australia undertook a research project in conjunction with MLA to develop a new EBV for marbling score and to implement a Japanese developed digital carcase scanner that can accurately measure eye muscle area, marbling and fineness of marbling. While there are still some accuracy issues associated with the new EBVs, there are now approximately 30,000 carcase records and accuracy is improving.

The Association is also running a sire progeny test program to develop a net feed intake, looking at integrating cross breed data into assessments and data integration through the supply chain.

However, the effectiveness of all these developments will ultimately depend on increased performance records that underpin accuracy.

A particular challenge that the breed faces with respect to BREEDPLAN, is that there is currently no diagnostics available for carcase traits. This means that the Association is unable to explain to a member why there has been movement in the member's EBVs and what they can do to address that change with any degree of confidence. The Association is well positioned to implement single-step, which will address the accuracy issue, allow the introduction and performance prediction of commercial animals that do not have sire or dam identification, and provide a basis for improved diagnostics.

During the period 2002 to 2015, the number of new Wagyu calf registrations grew at a CAGR of 18.5 percent. The rate of growth during the period 2010 to 2015 was less at 13.3 percent. Similarly, there has been strong growth in weaning weights recorded with BREEDPLAN, which grew at a CAGR of 32.3 percent since 2002, but have come off their peak in 2012. This is illustrated in Figure 56 below.

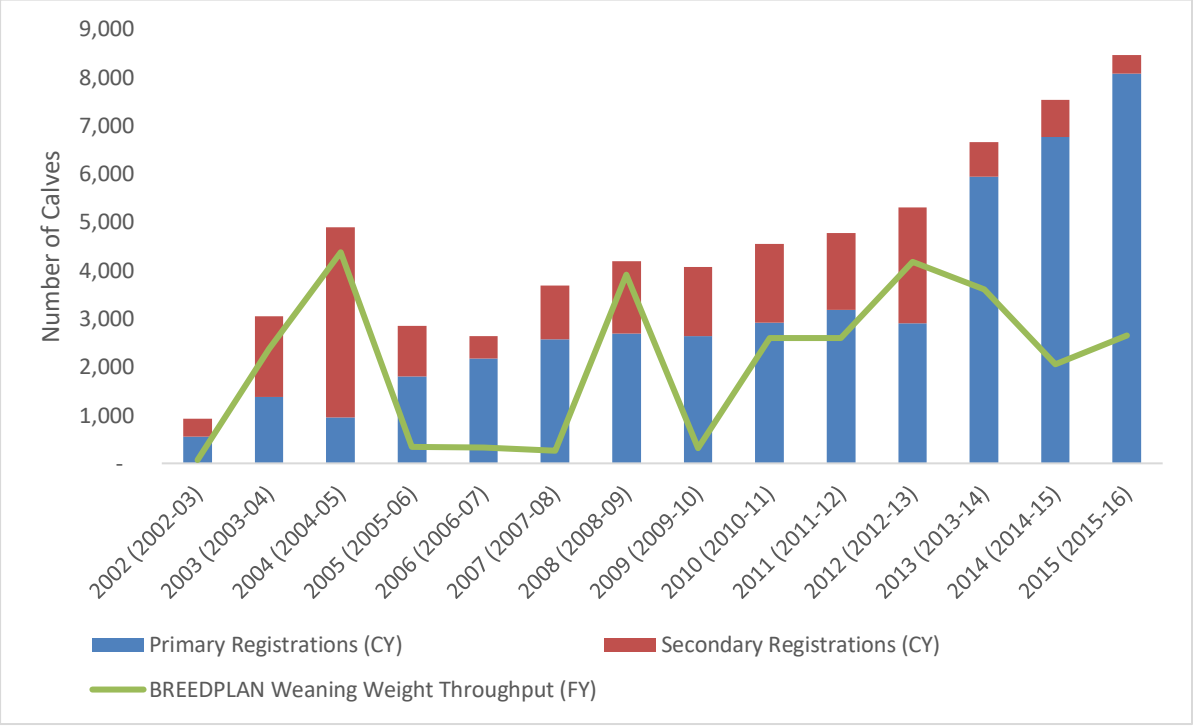

Figure 56 – New Calf Registrations and BREEDPLAN Weaning Weight Throughput – Wagyu (2009-10 to 2015-16)

Since 2002, the number of scan records recorded with BREEDPLAN has grown at a CAGR of 28.7. As an indication of the conversion of weaning weights recorded with BREEDPLAN to subsequent measurements, the volume of scan records submitted to BREEDPLAN has decreased from 27.1 percent of the number of weaning records in 2002 to 19.1 percent in 2015. This is illustrated in Figure 57 below.

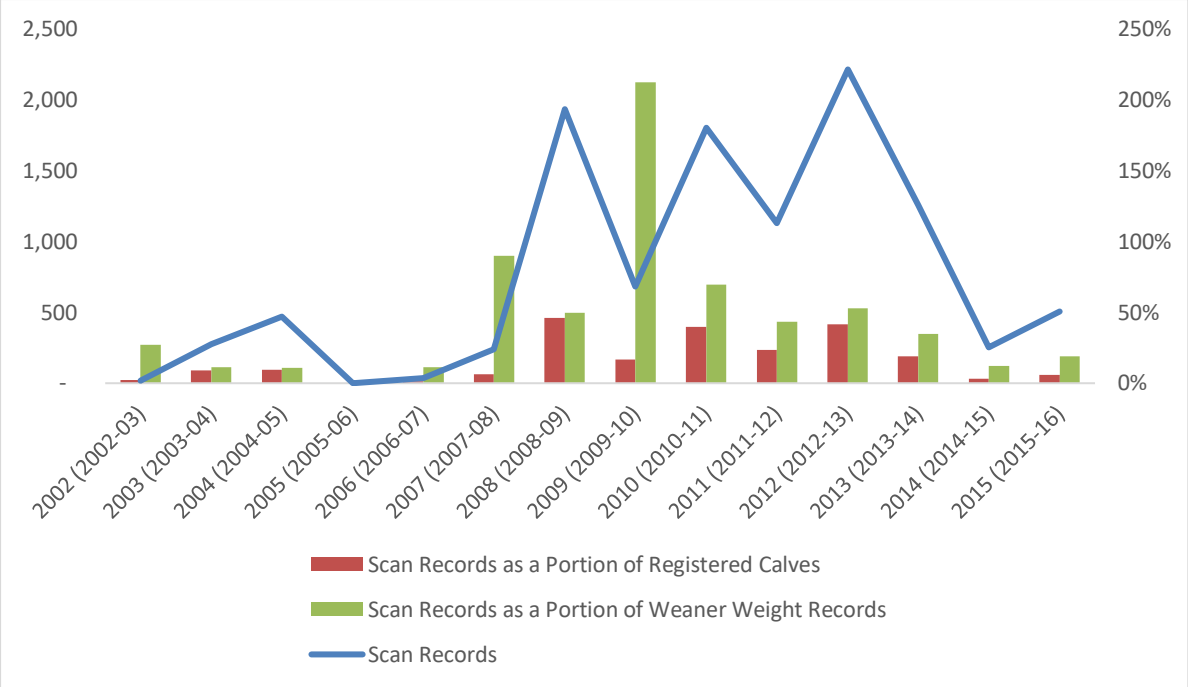

Figure 57 – Scan Records Submitted to BREEDPLAN - Wagyu

Figure 58 below illustrates the trend in the Terminal Feedlot Index for Wagyu from 1970.

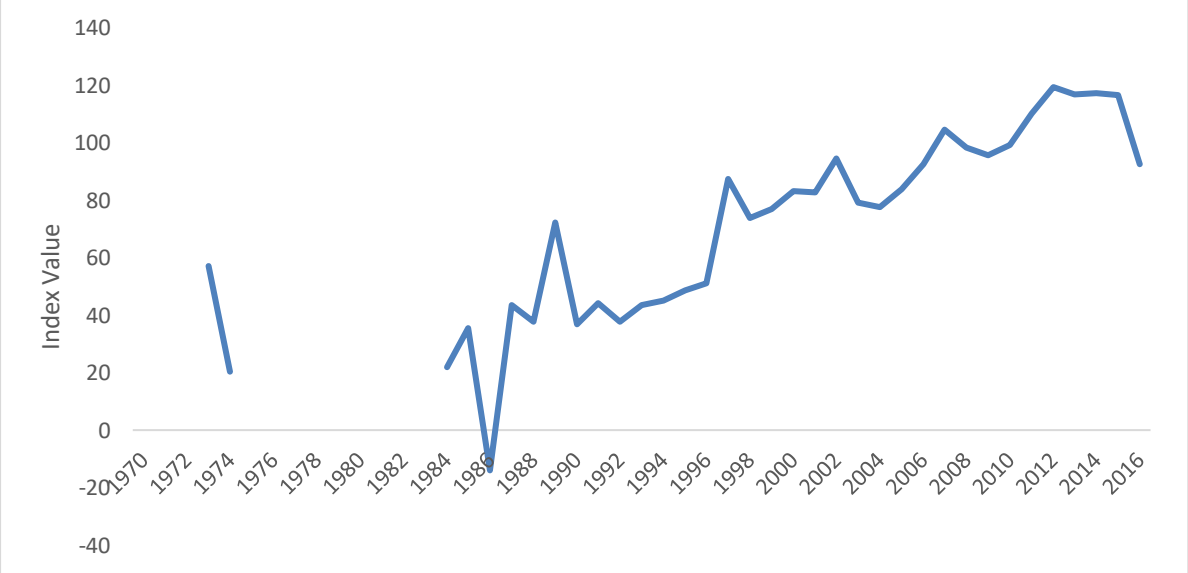

Figure 58 – Terminal Feedlot Index – Wagyu (1970 to 2016)

Table 24 below compares the CAGR for the period 1970 to 1984 with the CAGR for the period 1985 to 2016 for the Domestic Maternal, Export Maternal, Northern Terminal and Vealer Terminal Indices.

Index	CAGR 1970 to 1984	CAGR 1985 to 2016
Terminal Feedlot	-6.7%	3.1%

Table 24 – Terminal Feedlot Index - Wagyu

It is important to note that outside of the registered sector is a large herd of Wagyu cattle (approximately 50,000 head) that is operated by Australian Agricultural Company (AACO) and independently performance measured.

5.3.6.2 Speckle Park and Others

Speckle Park is a Canadian breed of beef cattle that was declared a distinct pure breed in 2006. The breed was introduced to Australia in 2007. They are a moderate sized animal that are able to quickly adapt to cold and hot climates, and rapidly regain condition following periods of challenging grazing conditions.

While Speckle Park calves accounted for only 0.4 percent of new calves registered in 2015, the number of new Speckle Park calves registered has grown at CAGR of 10.8 percent since 2011. This is illustrated in Figure 59 below.

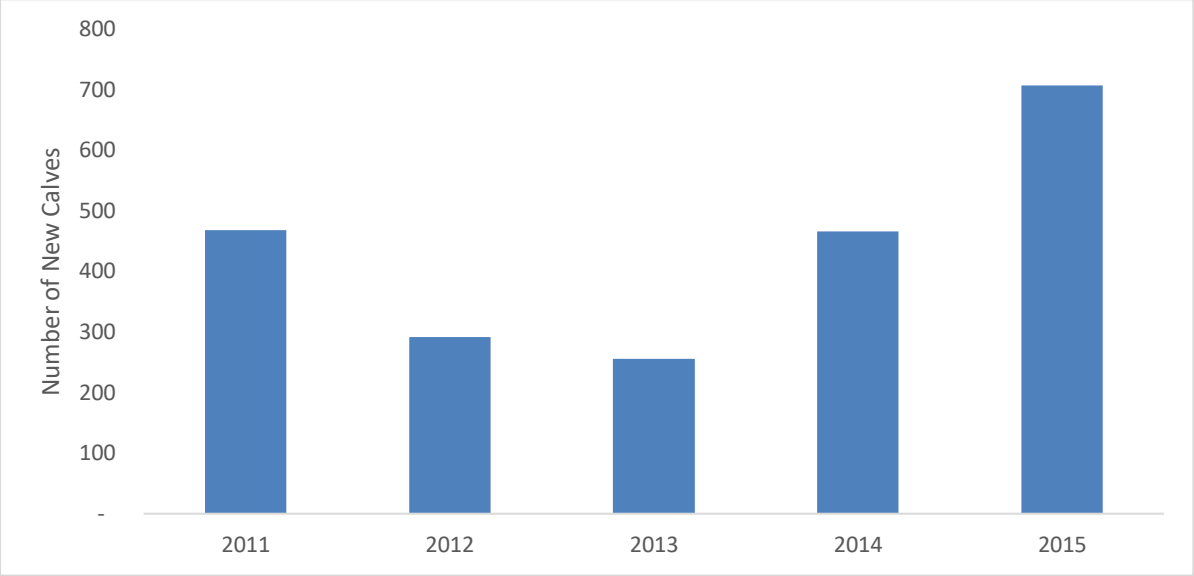

Figure 59 – New Calf Primary Registrations – Speckle Park

Other breeds that comprise these category are Mandalong Specials and Tropicana, which in 2015 accounted for 0.1 percent of all registered calves.

5.4 Perceptions of BREEDPLAN

5.4.1 Recent Market Research

In 2016, MLA commissioned market research firm Ipsos Australia to undertake a survey of primary producers in the Australian beef and sheep industries that was designed to acquire a greater understanding of:

- Decision-making tools used by producers when making genetic selections in their herd and/or flock and how they use those tools;
- Motivations for producers to use genetic decision-making tools;
- Barriers producers face with respect to using genetic decision-making tools;
- Factors that would encourage non-users to adopt greater usage of genetic technologies in their business; and

- Incidence of cited motivators and barriers for using genetic technologies and decision-making tools.[46]

The market research was based on 25 interviews with primary producers and 1,825 survey responses, including 1,031 responses from cattle producers (572 studs and 459 commercial producers). Both the interviews and surveys targeted, among other things, users and non-users of BREEDPLAN. The key observations from the results this market research as far as they pertain to BREEDPLAN are detailed in Appendix 6 and summarised as follows:

- **BREEDPLAN users run larger herds**
  The average size of herds run by both seed-stock and commercial producers that use BREEDPLAN is notably larger than the average herd size of those that do not use BREEDPLAN. This is consistent with the analysis in Section 5.3 that demonstrates that the portion of registered calves in most breeds that have records with BREEDPLAN is significantly larger than the portion of breed association members that use BREEDPLAN.

- **Seed-stock and commercial producers use a wide range of software packages to record animal data**
  The most commonly used software for recording animal data is Microsoft Excel, which is used by approximately 20 percent of seed-stock producers and 20 percent of commercial producers that use BREEDPLAN, and by about 10 percent of commercial producers that do not use BREEDPLAN. HERDMaster is used by approximately 13 percent of seed-stock producers that use BREEDPLAN and 7 percent of those that do not use BREEDPLAN, and only 2 percent of commercial producers that use BREEDPLAN. Over 50 percent of seed-stock producers and 70 percent of commercial producers use some other method of recording animal data, including packages such as Stockbook.

- **Breed associations are an important part of the industry structure**
  Not surprisingly, almost all seed-stock producers that use BREEDPLAN and 80 percent of seed-stock producers that do not use BREEDPLAN are members of a breed association. While breed association membership is substantially lower among commercial producers, with only 10 percent of commercial producers who do not use BREEDPLAN being members of a breed association, 40 percent of commercial producers who use BREEDPLAN are members of a breed association.

- **Most non-users of BREEDPLAN have never used BREEDPLAN**
  The vast majority of seed-stock and commercial producers who do not use BREEDPLAN have never used BREEDPLAN.

- **Most current users of BREEDPLAN are long-term users of BREEDPLAN**
  The vast majority of seed-stock and commercial producer users of BREEDPLAN have been using BREEDPLAN for more than five years and approximately two-thirds of current

[46] Dodd, J., Peeter, D. and Oblitas-Costa, N. (2016), *Understanding the Usage & Perceptions of Genetics & Genomics in the Australian Beef & Sheep Sectors,* Meat and Livestock Australia and Ipsos

BREEDPLAN users have been using BREEDPLAN for more than ten years. This, combined with the fact that most non-users of BREEDPLAN have never used BREEDPLAN, that BREEDPLAN has been promoted to the industry for over three decades and that penetration is stable or declining in most breeds suggests that BREEDPLAN may be approaching market saturation under the current delivery model, or even market saturation of the bull breeding sector altogether.

- **There is significant difference in how BREEDPLAN is used between the tropical and southern beef industries**
  The tropical and southern beef industries place different importance on different traits, with tropical seed-stock and commercial producers placing greater importance on survivability and reproduction, rather than meat production related traits than is the case for the southern industry. This difference in breeding priorities is also reflected in the nature of animal data that is recorded by the tropical and southern beef industries. There is a notably higher level of trust in BREEDPLAN among the southern beef industry and generally speaking, the southern industry faces fewer operational challenges with respect to performance recording. The northern industry has a greater tendency to seek training and guidance on BREEDPLAN from MLA, whereas the southern industry is more likely to seek training and guidance from the breed associations.

- **Establishing clear breeding objectives is commonplace**
  With the exception of commercial producers that do not use BREEDPLAN, the vast majority of all seed-stock producer, as well as commercial producers that use BREEDPLAN not surprisingly have established breeding objectives.

- **The use of Artificial Insemination is limited to the seed-stock sector**
  Artificial Insemination (AI) is only used to any meaningful extent by the seed-stock sector, and users of BREEDPLAN are far more likely to use AI than seed-stock producers that don't use BREEDPLAN.

- **Commercial producers are less satisfied with the genetic gain that has been achieved than seed-stock producers**
  Approximately three quarters of seed-stock producers that use or do not use BREEDPLAN are satisfied with the genetic gain that has been achieved in the industry more generally, whereas less than half of commercial producers that use or do not use BREEDPLAN are satisfied. Dissatisfaction with genetic gain has been attributed to slow rates of change, systems inaccuracies and cost (including the cost associated with collecting and recording animal data). This is an important observation and suggests that the needs of the customers of the end product to which BREEDPLAN contributes are not being met. It is also potentially indicative of a disconnect between seed-stock producers and the downstream beef supply chain with respect to attributing value to BREEDPLAN that is discussed in Section 1.1.5.

- **BREEDPLAN is perceived as a recording and decision-support tool**
  BREEDPLAN is perceived by most industry participants as a database for animal records and as a decision support tool. This observation implies that some users of BREEDPLAN do not fully

understand what it is and that most users of BREEDPLAN see it as one input to a decision, rather than a tool that can be relied on exclusively.

- **Peers and breed associations are the most common source of advice on genetics**
  Both seed-stock and commercial producers tend to seek advice on genetics from other producers or their breed association, and in the case of commercial producers, livestock agents. This observation brings into question how effective SBTS and TBTS are in driving adoption or effective use of BREEDPLAN, particularly with respect to commercial producers.

- **A significant portion of the industry has not received any formal training in BREEDPLAN**
  Only 60 percent of seed-stock producers who use BREEDPLAN and less than half of commercial producers who use BREEDPLAN have received BREEDPLAN training. Less than 20 percent of seed-stock and commercial producers who do not use BREEDPLAN have received BREEDPLAN training. This observation indicates that a significant portion of current BREEDPLAN users have not been instructed how to use it effectively and that STBS and TBTS have not adequately penetrated to existing market of current BREEDPLAN users.

- **Breed associations and MLA are the main sources of training in BREEDPLAN**
  Seed-stock producers expect and receive training in BREEDPLAN primarily from their breed associations. Whereas commercial producers expect and receive the majority of their training from MLA. SBTS is not recognised as a major source of training for BREEDPLAN. This observation combined with the observation that breed associations are a major source of advice for seed-stock producers suggests that training in BREEDPLAN might be better delivered directly from individual breed associations rather than through TBTS and SBTS, albeit generally speaking, the breeds where adoption is lowest tend to be those where the breed association does not actively support or promote BREEDPLAN and which have limited technical capacity to do so. Furthermore, to an extent SBTS and TBTS were established in recognition that most breed associations do not have adequate resources to support BREEDPLAN training internally suggesting that any transfer of BREEDPLAN training responsibility to breed associations would need to be resourced.

5.4.2 Key Observations from Interviews

This analysis has included a series of semi-structured telephone interviews with the Australian beef seed-stock and commercial producers, breed association executives, ABRI executives and the owners of the BREEDPLAN Core Analytical Software. These interviews were designed to ascertain further detail on why BREEDPLAN is used or not used and how it is used, as well as to acquire a better understanding as to the different perspectives of stakeholders in the BREEDPLAN value chain as to how effective that value chain is at delivering on end-user expectations and optimising the rate of genetic gain.

Many of the observations from these interviews are consistent with those from the Ipsos Australian market research discussed in Section 5.4.1. The following summarises the key observations from the interviews undertaken so far:

- **Decision Support Tool**
  BREEDPLAN is not perceived as a stand-alone breeding decisions support tool. It would seem that BREEDPLAN is almost unanimously perceived as tool that supports breeding decisions as one input to those decisions. The weighting that producers prescribe to information provided by BREEDPLAN varies and ranges from simple indication that a trait that cannot be visually assessed will at least possibly be expressed, to quantitative verification as to the likelihood and extent to which are desired trait will be expressed in the animal and its progeny.

- **Opinions on the quality of BREEDPLAN services are mixed**
  There appears to be divergent views on the effectiveness of BREEDPLAN and the quality and effectiveness of its products and services. While some users are totally satisfied with the products and services, others register complaints that revolve around antiquated software platforms and user interfaces, slow reporting and slow customer service response times.

- **Reasons for not using BREEDPLAN are diverse**
  There is a perception that producers who are not using BREEDPLAN do not use the tool because they:
  - Do not believe BREEDPLAN works either because they do not understand the principles that underpin it, have had a bad experience with using the products and services such as unstable EBVs, or resulting EBVs contradict their subjective assessment of an animal;
  - Believe BREEDPLAN works, but don't believe it delivers substantially better results than those attained from breeding decisions that are not informed by BREEDPLAN;
  - Believe BREEDPLAN works but that the majority of genetic gain that is reported is attributable to other factors such as pasture improvement and feed supplements, rather than the use of BREEDPLAN;
  - Determine that BREEDPLAN does not deliver benefits that are adequate to justify the total cost of using BREEDPLAN (BREEDPLAN charges, cost associated with taking measurements and submitting data and opportunity cost of the time allocated to taking measurements and submitting data);
  - Are getting good prices for bull regardless of whether they use BREEDPLAN and therefore don't believe there is a commercial benefit in using BREEDPLAN; and/or
  - Are concerned that bulls from bloodlines that are currently attracting a premium in markets will be assigned EBVs that do not justify that premium, thus devaluing their stock.

- **Value for Money**
  Perceptions as to whether BREEDPLAN represents value for money are also highly variable. For example, some producers:
  - Believe that in the context of the value of the animal and other breeding costs such as veterinary and marketing costs, the cost associated with using BREEDPLAN are not significant and when considered together with genetic gain achieved, BREEDPLAN represents very good value for money.
  - Believe that while the cost of BREEDPLAN is at worst equivalent to other breeding related expenses, the benefits from those other expense are directly attributable to

that expenditure and generally realised in the short-term. Whereas genetic improvement in a herd that flows from the use of BREEDPLAN can take a lot longer to realise and may not be obviously solely attributable to BREEDPLAN.

- Correlate the cost of BREEDPLAN to a perception of any premium in price that is attributable to an animal's EBVs and form a range of views as to its value;
- Compare the cost of BREEDPLAN with the comparative service offered the Australian sheep industry, Sheep Genetics, and form a view that BREEDPLAN is overpriced;
- Believe that BREEDPLAN might be improving the value of bulls, but that this is not translating into additional benefit down the value chain. That is, the industry is not selling more, higher value beef products as a result of BREEDPLAN. The feedback of data pertaining to carcase weight trend and in some breeds, marbling would help address this.

- **Relatively high cost is a result of the long value chain**
  Some that are of the view that BREEDPLAN is too expensive attribute the perceived high cost to the long value chain, whereby additional operating costs and surpluses necessitate a higher price. The counter position to this is that the value chain delivers additional benefits in terms of ease of access and value-adding products.

- **Relatively high cost is the result of monopoly pricing**
  Others attribute a perceived high cost of BREEDPLAN to monopoly pricing by ABRI and in some instances breed associations. The counter argument to this is that the participants in the value chain are not-for-profit organisations and as such surplus should be minimal and reinvested in the product and/or the Australian cattle breeding sector is too small a market to support competitive BREEDPLAN service providers.

- **The optimally effective use of BREEDPLAN is limited to practicality of taking measurements**
  Optimal use of BREEDPLAN requires performing objective measurements of the phenotype of traits at numerous stages over the animals life or before it is sold. The practical logistics of achieving this is limiting meaning that many seed-stock producers don't take measurements properly, take them selectively or don't take them at all. Furthermore, practical logistics of taking some specific measurements vary depending on the production environment.

- **Works well for the big breeds with lots of data**
  There is an observation that for the larger breed associations that have more animal records, EBVs produced by BREEDPLAN are more stable. In the smaller breed associations with small datasets, there is greater inaccuracy in the EBVs and significant changes in an animals EBV can occur year-on-year when new animal records are analysed. These variations undermine the value of EBVs as a marketing tool, as well as the overall perceived credibility of BREEDPLAN.

- **Scepticism over some assumptions used in the calculation of EBVs**
  There is some scepticism that some of the assumptions used to generate EBVs are not realistic practice. For example, it is understood that the measurement used to inform docility EBVs is an assessment of how the animal behaves in a cattle crush. This does not, for example,

measure how an animal behave when a producers gets between it and it's calf in an open paddock.

- **Product innovation delivery is too slow and software platforms are dated**
  There is a view that product innovation associated with BREEDPLAN is too slow and that new BREEDPLAN and BREEDPLAN related products take too long to develop and deliver to market. Examples are the release of Single-step genomic analysis which is available in SHEEPGENTICS and 3D carcase scanning which is available in the United States. There is also a view that software products are based on antiquated architecture and not consistent with contemporary standards of user interface and functionality.

- **Transparency and Proprietorship**
  There is a view that there is too much of a culture of proprietorship over data and transparency with respect to commercial relationships that is inhibiting innovation and the best use of the BREEDPLAN data resource.

- **Focus is on breed associations as individual customers, not on industry as the customer**
  Because of the specific contractual arrangements between ABRI and individual breed associations, there have been cases where innovations and product improvements are developed under commercial terms for a single breed association and not made available to other breed associations.

- **TBTS and SBTS are not working optimally**
  There is a view that the content of TBTS and SBTS extension programs is too generic and too technical. Different breeds and different operators within breed have very different levels of sophistication and experience in using BREEDPLAN and therefore have different training and information needs. Furthermore, TBTS and SBTS are not adequately supported by all of the breed associations and are therefore under-resourced and not adequately promoted or accessible across the industry. In some case, individuals delivering training do not have an adequate mix of technical, commercial and practical farm management expertise to promote BREEDPLAN in a way that is implementable for many potential customers.

- **Perception that genomics will be the game changer, but…**
  There appears to be considerable expectation that products based on genomics technology will render BREEDPLAN significantly more accurate and substantially reduce the cost associated with BREEDPLAN by eliminating the need for performance testing. Conversely, there are concerns that genomics products that are linked to BREEDPLAN databases for breeds that do not have inherent inaccuracy will only exacerbate existing perceived problems. Furthermore, there is concern that the existence of genomic technology based products will demotivate producers to take performance measurements, ultimately undermining the ongoing improvement of the dataset upon which EBVs are based.

- **Incidence of strong disconnect between visual assessment and EBVs can undermine the credibility of BREEDPLAN**

  There are many incidences where an animal will demonstrate a visual phenotype that is inconsistent with its EBVs, undermining the credibility of BREEDPLAN in some customer's eyes. This can be particularly problematic for seed-stock producers who are sophisticated users of BREEDPLAN. Such producers are able to adequately interpret BREEDPLAN EBVs such that they have confidence to run large numbers of younger animals and sell those animals at a younger age, knowing that they will very likely express to the extent that are explained by the EBVs. However, to a customer who does not understand BREEDPLAN, these animals will appear to be poor performing.

- **Market pull is the most important factor in driving adoption of BREEDPLAN**

  It would seem that outside of the Angus breed, most seed-stock producers that use BREEDPLAN report that typically less than 50 percent of their customers ask for BREEDPLAN EBVs or indices. There seems to be a widely held view that irrespective of any promotional or extension activity, BREEDPLAN will ultimately only be used by more seed-stock producers when their customers value it and pay a premium that is clearly attributable to the BREEDPLAN EBVs and indices and that premium delivers the seed-stock producer a compelling economic return. This has been evident over time, when large corporate producers such as S. Kidman & Co and Paraway have sent signals to the market that they will only purchase animals with BREEDPLAN EBVs, resulting in rapid uptake of BREEDPLAN in relevant breeds. Also, customer demand for BREEDPLAN EBVs can be derived from cross-breeding programs. For example, because Santa Gertrudis over Angus breeds is a preferred animal for feed-lot production and purchasers of Angus cattle are accustomed to using BREEDPLAN, those purchasers expect BREEDPLAN numbers on the Santa Gertrudis bulls that they purchase. There are two counter arguments to the notion that only customer demand will drive greater adoption of BREEDPLAN by seed-stock producers. The first is that while customer demand may drive adoption of BREEDPLAN by seed-stock producers, it won't necessarily motivate effective use, therefore undermining the ultimate goal of achieving accelerated genetic gain across the Australian beef industry. Secondly, achieving higher bull prices by using BREEDPLAN may benefit the seed-stock sector, it is pricing that allows more, higher performing bulls to enter production herds that will drive the genetic gain

- **BREEDPLAN has been over-promoted**

  There is a perception that over the course of the past three decades BREEDPLAN has been promoted primarily as a totally reliable stand-alone tool for informing breeding decisions. There is almost consensus that this is not the case, and as a result expectations have been created that have not been met. This, in turn, has resulted in some scepticism toward the effectiveness of BREEDPLAN.

- **The complexity of the product is underplayed**

  It is well understood in the theory of adoption that sustained adoption is more likely if the customer has a basic understanding of how a product works. Promoters of BREEDPLAN often assume that the basic principles by which BREEDPLAN works are simple and easy to understand. However, understanding these principle requires at the very least a senior

secondary school understanding of statistical theory and genetics science. Many primary producers do not have this level of understanding.

- **Getting existing users of BREEDPLAN to use it properly, rather than more users of BREEDPLAN will likely generate a greater return on investment**
  In light of the trends in market penetration, diversity of enterprise types and mix, diversity of breeding practices and philosophies and the fact that BREEDPLAN has been promoted to the Australian beef cattle industry for over three decades, acceleration of genetic gain is more likely to be achieved by focusing resources on getting producers that are already convinced that BREEDPLAN has some merit using it more rigorously and effectively than getting new users who will likely only use it in a rudimentary manner. This observation is perhaps less relevant to the northern (tropical) sector where adoption levels are lower.

- **Future of breed associations**
  There are different perceptions as to the future relevance of breed associations. Some seed-stock producers are of the view that the majority of commercial producers are seeking pure-bred animals for their production or cross-breeding purposes and as such breed associations play an important and fundamental role in maintaining the integrity of breeds and promoting breeds. Whereas others are of the view that the industry is increasingly progressing toward cross-bred animals and the relevance of breed associations is therefore diminishing.

- **Relevance of the unregistered sector**
  Those that argue against the future relevance of breed associations base their argument in part on a perception that there is a large and growing unregistered sector. Others will argue that while there are clearly unregistered animals in the seed-stock sector, particularly in the northern cattle industry, there is no evidence to suggest that the population of unregistered animals in the seed-stock sector is comparable to the number of registered animals, or that it is growing.

- **BREEDPLAN is most effective in the breed associations where the Board and CEO are committed to BREEDPLAN**
  BREEDPLAN appears to achieve the greatest levels of penetration and use most effectively in breeds where the board and executive of the breed association are aligned on the value of BREEDPLAN and promote its use by members, and where the executive has adequate technical and extension skills to successfully promote BREEDPLAN to members. In instances where the leadership of the breed association is divided as to the value of BREEDPLAN, it is difficult for the breed association to allocated adequate resources to promoting and supporting the use of BREEDPLAN.

5.5 BREEDPLAN Value Chain Economics

The term ‘value chain’ refers to a relationship between two or more otherwise independent organisations that, through commercial arrangements, contribute their specific capabilities to the development and delivery of a final product or service to an end-user customer. The fundamental

economic principle that underpins value chain formation is that of comparative advantage. That is, value chains exist because different organisations are able to contribute a product attribute that is valued by a customer at a lower opportunity cost than another organisation, resulting in the more economically efficient production and delivery of a product that is valued by an end-user. However, like many things in economics, the efficacy with respect to the economic theory that underpins a value-chain is not the only factor that is required for an effective value chain. Participation in that value-chain must also provide an adequate commercial financial or strategic benefit to all of the participants in that value chain for the value chain to be sustainable.

The ultimate commercial objective of a value chain is to maximise the overall value generated through the process of converting, in the case of BREEDPLAN, raw animal performance and genetic data, into reliable and usable knowledge products that are purchased by seed-stock producers. The term value chain surplus refers to the difference between the value of the final product to the end customer and the costs that the value chain incurs in filling the customer's product requirements. The extent to which any value chain surplus is generated is a function of the efficiency of the individual organisations that comprise the value chain, as well as the efficiency of the value chain its self. Commercially rational managers of value chains therefore seek to manage the value chain assets, production processes and cash flows such that the value chain surplus is maximised.

Sequential participants in a value chain are counterparties in commercial transactions that are typically the subject of longer-term supply and offtake contractual arrangements between organisations. However, the most effective value chains are characterised by a high level of collaboration and coordination between the organisations that comprise the value chain, with the purpose of ensuring that the value chain continues to deliver a compelling and competitive product to the end-user, and that the organisations that participate in that value chain are adequately commercially motivated to continue to deliver on the product or service attributes that are valued by those end-customers.

The key participants in the BREEDPLAN value chain and their strategic rationale for participating in that value chain is discussed in detail in Section 5.2. However, an assessment of the ongoing viability of that value chain and its ability to deliver on stakeholder expectations also requires an understanding of the economics faced by each of the participants with respect to their participation in the BREEDPLAN value chain.

Developing this understanding with a high level of accuracy is somewhat constrained by:

- The fact that economic value derived by seed-stock and commercial producers from using BREEDPLAN is a function of the full costs associated with using BREEDPLAN and the extra-income derived from price premiums and/or increased production that are the result of having used BREEDPLAN. This varies depending on the enterprise mix, production environment, production systems, decision matrix and process and markets served by individual enterprises. Furthermore, the portion of any price premium that is attributable to BREEDPLAN and the cost incurred in using it are difficult to measure;
- The confidential nature of the commercial relationships between ABRI and individual breed associations that distribute BREEDPLAN;
- The inter-related nature of the ABRI pedigree database product and the BREEDPLAN service; and

- Limited transparency with respect to the internal financial dynamics of some of the breed associations and particularly, ABRI.

Given these challenges, this assessment has endeavoured to provide an indicative estimate of the economics faced by different participants in the BREEDPLAN value chain. Data sources have included information pertaining to revenue and costs of the various participants that is available in the public domain, revenue and cost structures of similar services that are available in the public domain, previous studies that have made estimates, and a limited set of specific commercial arrangements that have been provided under a Non-disclosure Agreement. The fact that some of the information on which this is estimate is based has been provided under contractual confidentiality arrangements, means that in some instances, the outputs noted in this report deliberately lack specificity.

5.5.1 Seed Stock Sector Economics

Arguably, the most important surplus in the value chain that delivers BREEDPLAN with respect to driving adoption of BREEDPLAN is the surplus generated by the seed-stock producer that is a direct result of using BREEDPLAN, as it is this end-user surplus that is a major driver of demand for BREEDPLAN. However, this surplus is a function of derived demand in that seed-stock producers will only generate that surplus so far as there is demand from commercial producers for BREEDPLAN bulls, which in turn requires commercial producers to be generating a compelling surplus by virtue of using those bulls.

At a seed-stock producer level, the economics of using BREEDPLAN is primarily a function of:

- The average price premium that a seed-stock producer receives for bulls that have BREEDPLAN EBVs over bulls that do not have BREEDPLAN EBVs;
- The average cost of taking on-farm measurements and performance recording; and
- The cost of membership to BREEDPLAN and any transaction costs associated with using BREEDPLAN which may be absorbed by the breed association, may be partially or fully passed on at cost or with a price mark-up depending on the individual breed associations commercial relationship with ABRI and its policy with respect to providing access to BREEDPLAN for its members.

For the reasons described in the following subsections, this surplus is very difficult to define.

5.5.1.1 Attributing a Price Premium to BREEDPLAN is Problematic

Determining a price premium that is attributable to BREEDPLAN with any degree of precision is extremely difficult.

As indicated in Figure 60[47] below, the volume of bulls sold across breeds and within breeds from year-to-year is highly variable.

[47] Condon, J. (2015), '2015 Bull Sales: Your complete guide to how each major breed fared', *Beef Central* AND Condon, J (2014), 'How each breed fared for average price and numbers sold' Beef Central

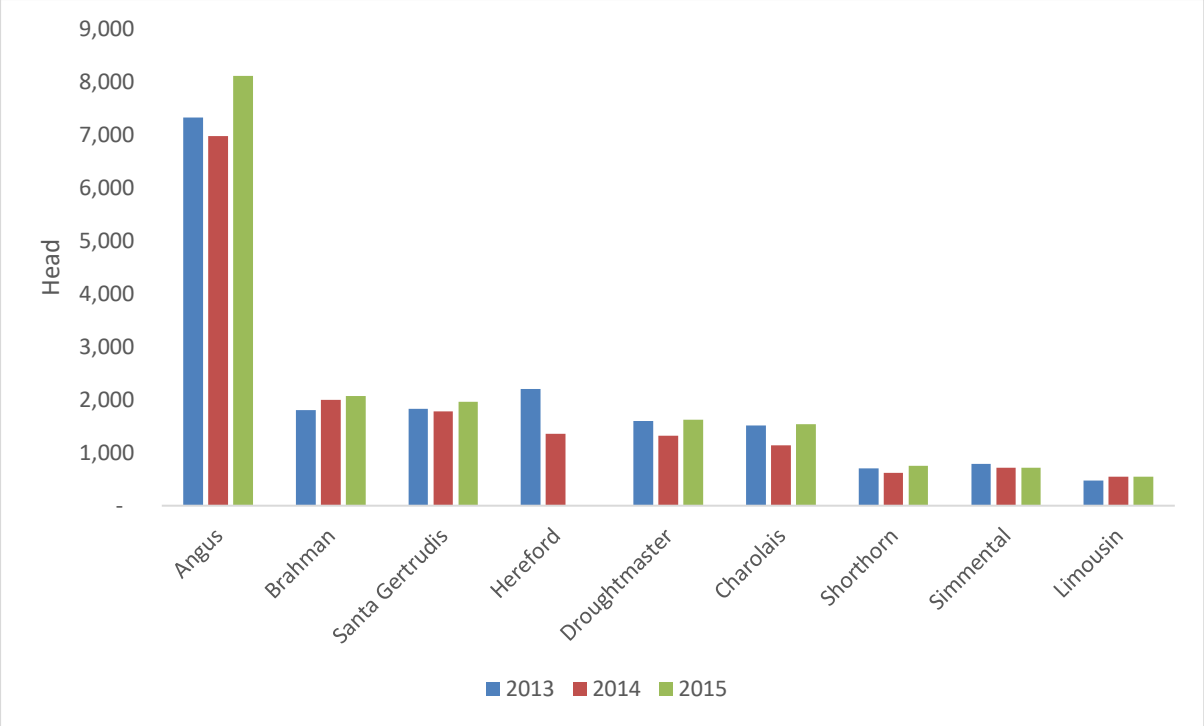

Figure 60 – Number of Bulls Sold at Public Auction 2013 to 2015

As illustrated in Figure 61[48] below, average price is also variable across breeds. However, prices follow the same general trend across the breeds, suggesting they are determined primarily be macro-factors that impact on the wider beef industry.

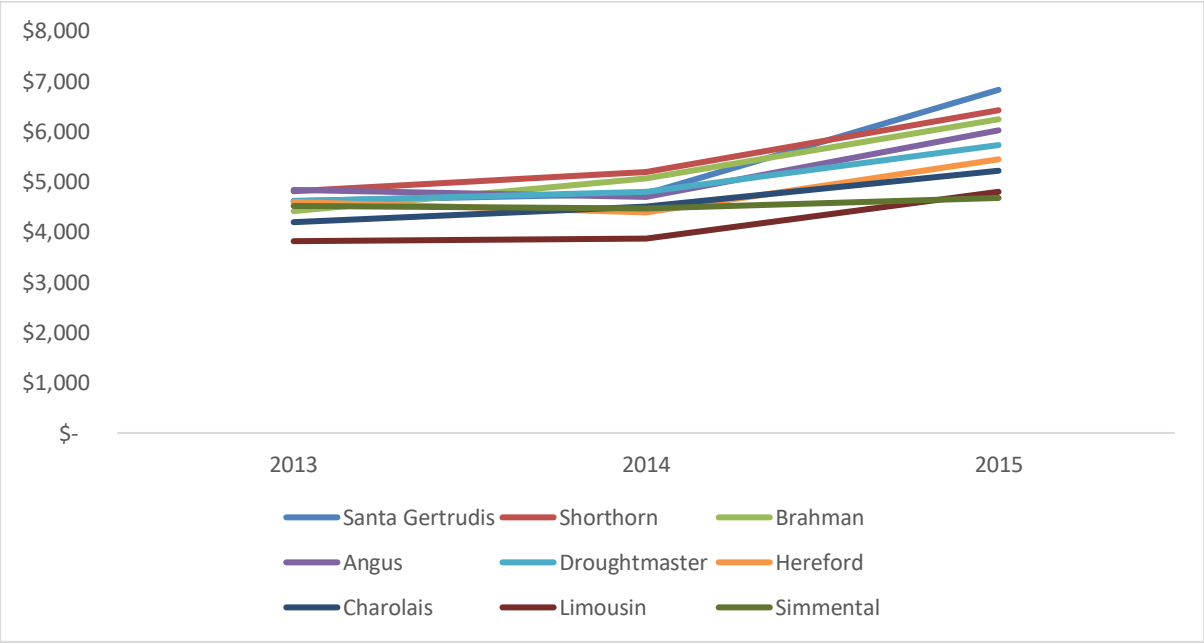

Figure 61 – Average Bull Price at Auction – 2013 to 2015

[48] Condon, J. (2015), '2015 Bull Sales: Your complete guide to how each major breed fared', *Beef Central* AND Condon, J (2014), 'How each breed fared for average price and numbers sold' Beef Central

In particular, there is a strong correlation between bull prices and the Eastern Young Cattle Index (EYCI). This is evident in major breeds such as Angus[49] and across breeds more generally[50]. Figure 62 below illustrates the correlation between average Angus bull price and nominal ECYI. While the correlation between average Angus bull price and real rather than nominal ECYI (0.63 to 0.7), there is still a significant relationship.[51]

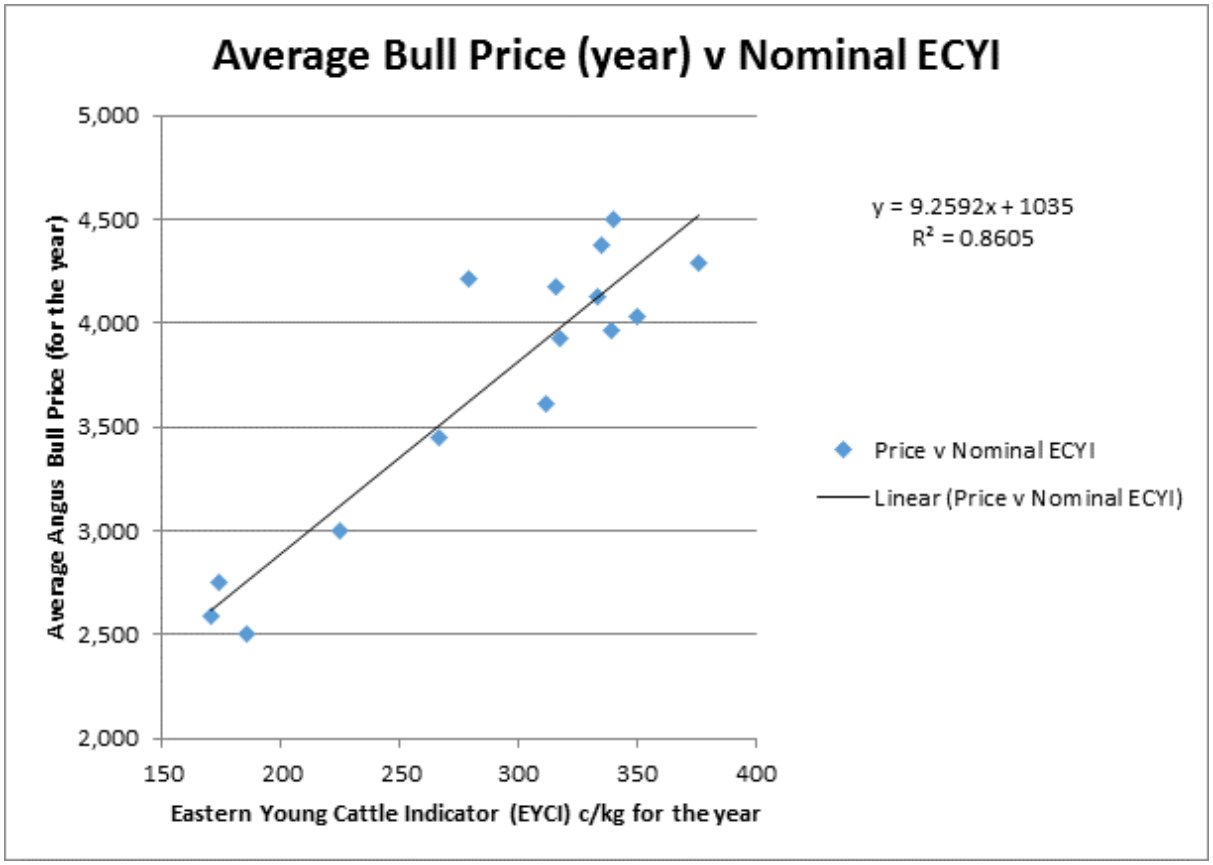

Figure 62 – Average Angus Bull Price and Nominal Eastern Young Cattle Index

Also, as illustrated in Figure 63[52] below record bull prices are highly variable across breeds and the delta between record prices and average prices, suggests that record prices are anomalies and a large volume of bulls are sold at below average prices.

[49] Phillips, G. (2017), 'Weekly genetics review: are recent record bull prices sustainable?', *Beef Central* (https://www.beefcentral.com/genetics/weekly-genetics-review-are-recent-record-bull-sale-prices-sustainable/)
[50] Banks, R. (2017), *Risk and Reward in (Extensive) Livestock Breeding*, Animal Genetics and Breeding Unit
[51] Banks, R. (2017), *Risk and Reward in (Extensive) Livestock Breeding*, Animal Genetics and Breeding Unit
[52] Beef Central (2017), 'Australian stud beef cattle breed record prices at a glance', *Beef Central*

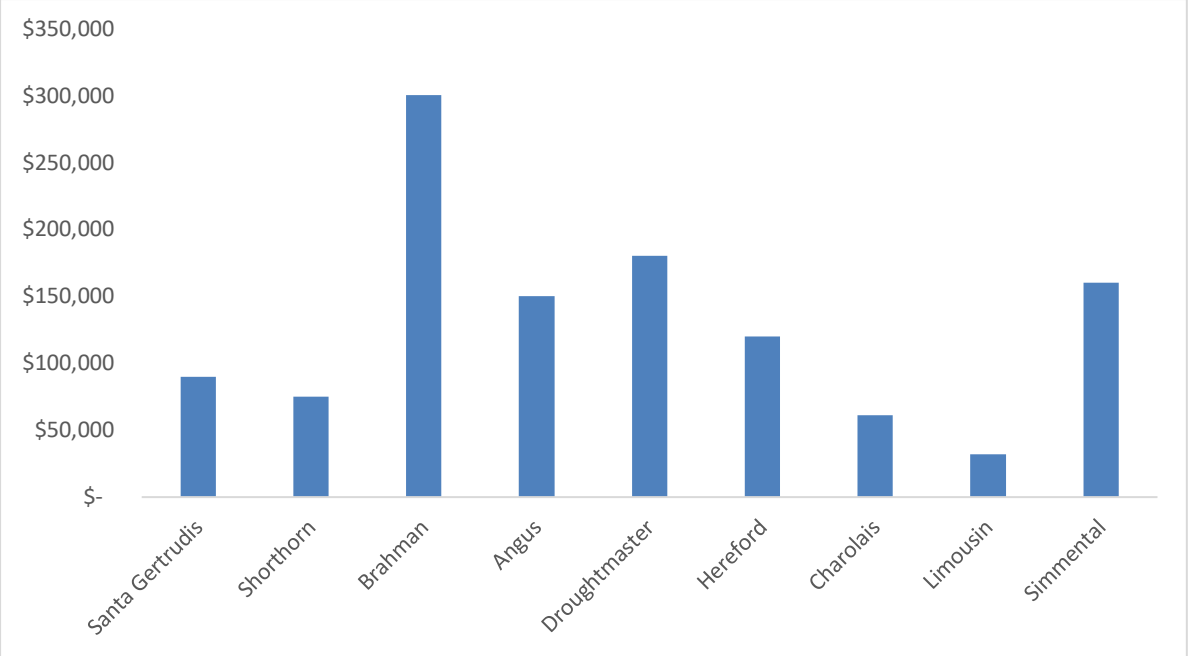

Figure 63 – Record Bull Prices at Auction

Irrespective of this normal volatility in bull prices, actually determining the portion of a premium that is directly attributable to the use of BREEDPLAN is virtually impossible.

5.5.1.2 There is Variation in BREEDPLAN Costs across Producers

In most instances determining the precise cost of BREEDPLAN is also challenging. This is because:

- Different seed-stock producers face different per unit costs depending on the arrangements that their breed association has with ABRI;
- Unless the full membership and transaction costs of using BREEDPLAN are transparently passed onto members by their breed association, it is very difficult for a seed-stock producer to determine the portion of their breed association fees and charges that are covering the cost of BREEDPLAN;
- The cost of taking and recording performance measurements is difficult to assess, and as one estimate suggests, highly variable depending on the measurements that are taken and the operational environment in which they are taken. This estimate suggests that performance measurements and recording typically costs between $25.00 and $150.00 per animal. [53]

5.5.2 Breed Association Economics

As discussed previously, because the commercial arrangements between ABRI and the breed associations are variable and the subject of commercial confidentiality provisions, and the breed associations absorb costs associated with BREEDPLAN across their entire membership to varying degrees, determining breed association economics with respect to the delivery of BREEDPLAN is problematic.

[53] Banks, R.

In order to arrive at an estimate, this analysis was provided, under confidentiality agreement, access to some of the commercial arrangements between ABRI and a subset of breed associations that collectively represent the various arrangements that apply to breed associations. In 2015, the breed associations for which information has been provided collectively accounted for approximately:

- 80 percent of registered calves;
- 79 percent of weaning weight measurements recorded with BREEDPLAN; and
- 83 percent of scanning measurements recorded with BREEDPLAN.

The breed associations used in the modelling demonstrate the average characteristics listed in Table 25below.

Breed Association Characteristics	Average
Total Number of Members	1,082
Number of Full (Stud) Members	503
Number of Commercial Members	434
Number of Members Using BREEDPLAN	167
BREEDPLAN Members as a Portion of Total Full and Commercial Members	16.0%

Table 25 – Average Characteristics of the Breed Associations used in the Modelling

The modelling was based on the inputs summarised in Table 26 below.

Assumption	Description
GST	All revenue and cost data used in the model is GST exclusive.
Core Revenue	Core revenue is defined as estimated breed association revenue that is derived from association memberships, registrations, BREEDPLAN memberships and BREEDPLAN transactions associated with weaning weight and subsequent scan measurements only. Member nomination fees are excluded and where a tiered charging regime is used based on transaction volume, the median charge is used to calculate estimated revenue.
Core Costs	Core Costs are defined as the fixed and variable costs associated with using the ABRI database service and BREEDPLAN. Any one-off costs and charges associated with using Matesel or Geneprob, or data extraction charges or rebates have been excluded.
Other Excluded Revenues or Costs	Revenues and costs associated with all other breed association and ABRI services have been excluded from the modelling, including revenues and costs associated with TBTS and SBTS, catalogue services, any administrative services provided by ABRI to the breed association or any breed association internal FTE allocations to supporting the delivery of BREEDPLAN.

Table 26 – Assumptions used in Breed Association Modelling

For reasons of commercial confidentiality and because the modelling has not been based on a comprehensive dataset, the specific outputs of the modelling are not presented in this public version of the report.

However, this public version of the report notes the following observations from the modelling:

- ABRI reports that the average BREEDPLAN price per weaning weight record across the entire industry was $9.23 in 2015 and $10.27 in 2016. The outputs from the modelling is within this range.

- The modelling indicates that the average incremental cost per registered calf for using the ABRI database system is in the order of $2.00.
- Because different breed associations have difference commercial arrangements with ABRI, operate different internal business models, deliver BREEDPLAN under different terms to their members and face different economies of scale, the economics associated with offering BREEDPLAN to their members is highly variable across breed associations and is not determined primarily by any specific driver of the variability.
- In terms of core revenue, there is significant variability across the sample of breed associations with respect to the degree to which revenues from membership and registration fees contribute to this core revenue base. Similarly, as a result of the different degrees to which breed associations pass on the full costs associated with using BREEDPLAN to their members that use BREEDPLAN, revenue from BREEDPLAN membership and any transaction charges that might apply also vary considerably.
- The fixed and variable costs incurred by breed associations with respect to accessing the ABRI pedigree database system and BREEDPLAN for themselves and their members measured as a portion of total core revenue are similarly highly variable.

It is evident from the modelling that costs incurred by seed-stock and commercial producers with respect to accessing BREEDPLAN is highly variable across the Australian beef industry.

It is also important to stress that the modelling does not account for all of the costs incurred by breed associations with respect to promoting and delivering BREEDPLAN to their members. At the very least, variable amounts of breed association executive time is consumed by tasks associated with the promotion and delivery of BREEDPLAN. This ranges from a negligible amount, to a portion of an executive(s) time, to a dedicated executive resource. Similarly, some breed associations invest in R&D to support BREEDPLAN such as genomics and BIN. This has also not been costed into the analysis.

5.5.3 ABRI Economics

Based on a 2015 BREEDPLAN royalty payment to the Owners of $125,460, it is estimated that total revenue received by ABRI from BREEDPLAN services in that year was $1,672,800. The estimated revenue that ABRI has received delivering BREEDPLAN to the breed associations analysed accounts for approximately 50 percent of the total BREEDPLAN revenue. The balance of revenue is derived from breed associations that have not been included in the analysis, as well as international users of BREEDPLAN.

The modelling that was undertaken by this study to assess ABRI's economics with respect to delivering BREEDPLAN was not provided with detailed ABRI costs data. In order to estimate the cost structure incurred by ABRI with respect to delivering BREEDPLAN, the cost structure associated with delivering Sheep Genetics (see Section 5.6.5) was used as a proxy. This cost structure reflects an approximate fully-costed [54] model for delivering Sheep Genetics. However, it invariably still contains some

[54] This estimate is based on a study that endeavoured to fully-cost the delivery of Sheep Genetics and includes all costs associated with its delivery. It does not include an operating surplus or return on investment.

subsidisation and it is highly likely that ABRI would face significantly higher internal costs with respect to the delivery of BREEDPLAN.

For the purpose of the modelling, the royalty payable to the Owners on BREEDPLAN revenue has been deducted from the BREEDPLAN revenue generated for ABRI from the breed associations analysed. As with the modelling used to assess breed association economics in Section 5.5.2, it is based on information that is incomplete and the subject of commercial confidentiality provisions. As such, the specific outcomes of that modelling are not reported in this public version of the report. However, the following observations from that modelling can be reported:

- Because each breed association has different commercial terms with ABRI, the margins associated with delivering BREEDPLAN to different breed sectors are variable;
- ABRI has disclosed that its total net margin for its BREEDPLAN and database support division was 12.8 percent in 2015 and 4.2 percent in 2016. This is within the range determined by the modelling.

Given that BREEDPLAN has been 'commercialised', it is appropriate for ABRI to receive a return from the 'commercialisation' of BREEDPLAN, albeit any return should be moderate given ABRI is a not-for-profit organisation and BREEDPLAN continues to be supported through taxpayer and levy-payer funded research and development.

By way of comparison, globally, average net margins associated with information technology and software sectors tends to be in the range of 12 to 20 percent, and gross margins typically between 50 and 80 percent.[55, 56, 57] As such, even if ABRI's cost base is considerably higher than that of Sheep Genetics (which it almost certainly is), and the costs associated with delivering and supporting the ABRI database may be substantially higher that estimated, this analysis would suggest that ABRI has at least historically generated returns that are comparable to a commercial rate of return for such a business.

Given ABRI is a not-for-profit organisation the application of any surplus generated from BREEDPLAN is also an important consideration. This analysis has not been provided with any detailed information as to how this surplus is re-invested. However, it is understood that surpluses have historically been reinvested in ongoing software development, as well as building a cash reserve to ensure the ongoing financial sustainability of ABRI.

5.5.4 AGBU Economics

This analysis has not been provided with any information pertaining to the cost structure of AGBU. BREEDPLAN is one of several clients of AGBU. Unlike the case with SHEEP GENETICS, AGBU does not undertake the core processing function for BREEDPLAN. The relationship between AGBU and ABRI is in part prescribed by the Core Analytical Software Licensing Agreement. Under this agreement AGBU

[55] Stern Business School (2017), Margins by Sector, New York University
[56] CIS Market
[57] Ro., S. (2012), 'The Profit Margins for Every Sector in S&P', *Business Insider*, August 2016, Edition

has prescribed technical support role and there are prescribed limitations with respect to ABRI seeking technical services from an entity other than AGBU.

AGBU also receives annual grants from MLA of approximately $800,000 per annum (see Section 5.5.5.2) to undertake research and development that supports the ongoing delivery and development of BREEDPLAN.

5.5.5 Owner Economics

5.5.5.1 Licensing Income

While the royalty income that is generated for the Owners through the licensing agreement is modest, during the period 2003 to 2015 total royalty income grew at a CAGR of 4.5 percent. ABRI forecasts suggest that there will be a decline in revenues in 2016, with revenues returning to current levels in 2018-2019, representing a forecast CAGR out to 2019 of 0.4 percent.

Up until 2010, the royalty income was split among the owners according to their equity interests in the Core Analytical Software. In 2010, a decision was made by the owners to allocate 90 percent of the royalty income to MLA, in recognition of its ongoing substantial investment in research and development that supports BREEDPLAN made primarily through grants to AGBU.

The historical and forecast royalty payments are illustrated in Figure 64 below.

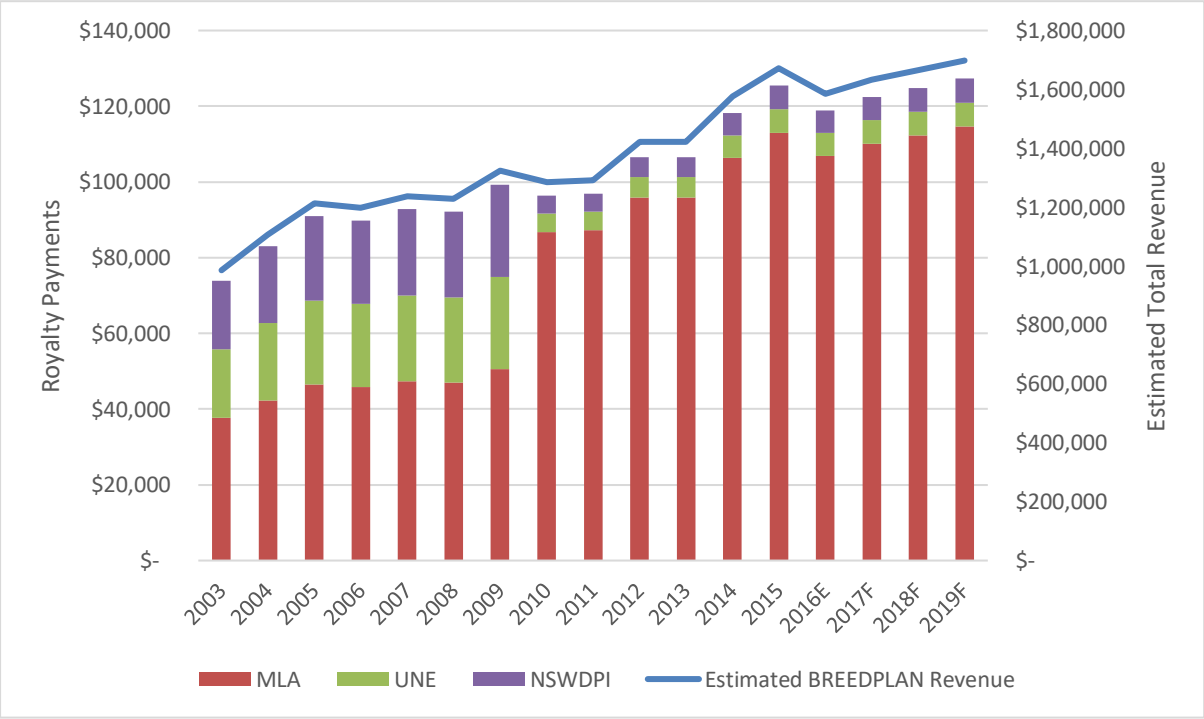

Figure 64 – Historical and Forecast BREEDPLAN Revenue and Royalty Payments

5.5.5.2 Ongoing Costs

UNE and NSWDPI incur some cost associated with the ongoing operations by virtue of financial and in-kind support that they provide AGBU, which in turn provides technical and research and development support for BREEDPLAN to ABRI. The amount of this support has not been quantified,

but it is understood that the majority of cash and in-kind support that the joint venture partners provide to AGBU is provided by UNE. Furthermore, this support covers AGBU's total operations, not just those pertaining to the provision of technical support and research and development services for BREEDPLAN to ABRI.

UNE does not provide any substantive financial or in-kind operational support to ABRI.

It is also understood that the financial and in-kind support provided to AGBU by the joint venture partners, as far as it pertains to services provided by AGBU in respect of BREEDPLAN, is significantly less than the BREEDPLAN related research and development grants that MLA provides AGBU. This was recognised in the decision of the Owners in 2010 to allocate 90 percent of the Owner's total royalty entitlement to MLA in order to part compensate for its ongoing investment in the research and development undertaken by AGBU that supports the ongoing development of BREEDPLAN.

MLA currently invests approximately $770,000 of levy funds in BREEDPLAN related research and development through AGBU. This will increase to almost $900,000 by 2020. This total investment of approximately $4.2 million is part of an overall investment in beef and sheep genetics research and development with AGBU of $8.4 million between 2016 and 2020. As illustrated in Figure 65 below, the vast majority of this investment is in the form of salary support and the royalty stream derived by MLA from BREEDPLAN makes less than 15 percent contribution to this investment.

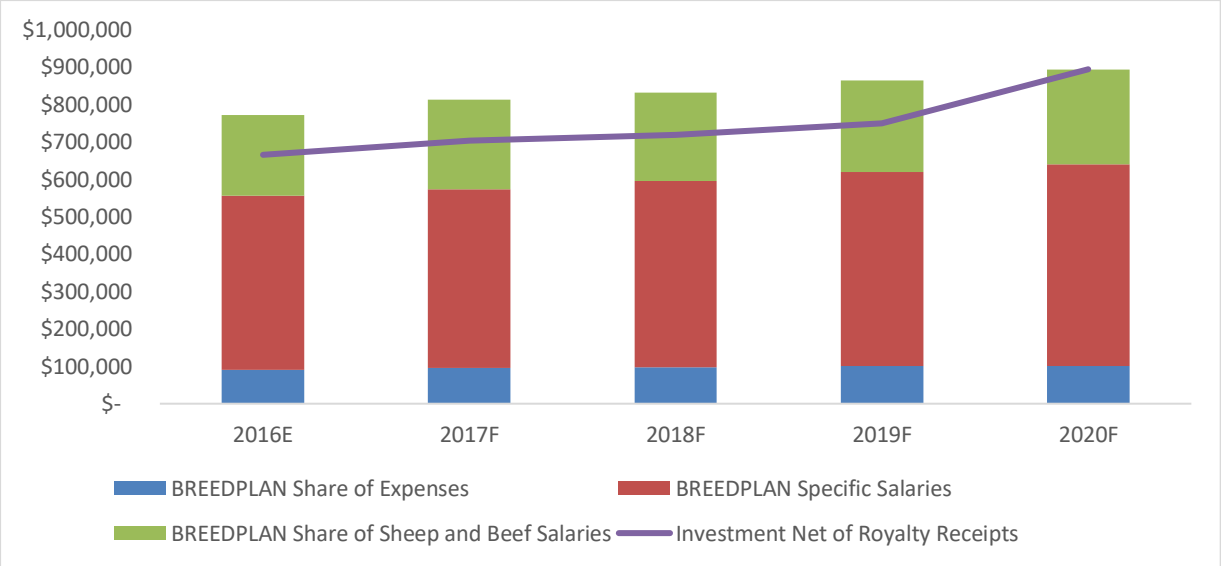

Figure 65 – MLA BREEDPLAN Related Research and Development Investment in AGBU

In addition to the research and development contract with AGBU, the MLA Donor Company also contributes approximately $1.0 million per annum to the operations of TBTS and SBTS.

5.6 The Direct Delivery Model: Sheep Genetics

The Australian sheep industry includes a wool production sector that is based primarily on merino genetics designed to deliver wool specifications and volume and a meat sheep sector that is based on a much wider range of genetics designed to deliver carcase specifications and volume.

Merino genetics are by far the most prominent in the Australian sheep industry, forming not only the basis of the wool sector, but in an increasing number of dual-purpose animals and very importantly, as the predominant ewe used in the meat sheep sector, with an estimated 25 percent of Merino ewes currently mated to terminal sires such as Poll Dorset or White Suffolk for the production of prime lambs.[58]

The BREEDPLAN equivalent industry genetic improvement program targeted at the Australian sheep industry is known as Sheep Genetics. Because BREEDPLAN and Sheep Genetics are targeted at major sectors of the Australian livestock industry and are based on the same fundamental quantitative genetics platform, they are often benchmarked against each other with respect to metrics such as cost and pricing, adoption and attributable genetic gain.

This section discusses Sheep Genetics and compares it to BREEDPLAN with respect to the structure through which it is delivered, level of adoption and business model.

5.6.1 The Australian Sheep Seed-stock Sector

The Australian sheep seed-stock sector is comprised of many breeds, with the 10 breeds listed in Table 27 accounting for the majority of ram and genetic material sales.

[58] Cardellino, R. (2015), *Global Sheep Flock – What Happened and Where to Now?,* Mercado Expert Market Analysis

Breed	Description
Australian Merino	Australian merinos are produced primarily for fine and superfine wool production and formed the 'backbone' of the Australian sheep industry for over a century. They remain the most common breed in Australia and first cross merino ewes are used for prime lamb production. In Australia, merino seed stock flocks are characterised as merino and poll merinos.
Dohne	Dohne merinos were introduced to Australia in 1997-98 and is a plain bodied, polled dual purpose sheep breed developed in South Africa. The breed has the ability to produce merino wool in the 18 to 21 micron range and rear and produce marketable lambs by the age of six to nine months.
Poll Dorset	The Poll Dorset breed was developed in Australia and are a short wool, meat producing breed. They are the most commonly used terminal sire in the Australian prime lamb industry and are capable of rapid growth rates and early maturity, shapely carcase with optimal fat coverage and high lean meat yield.
White Suffolk	The White Suffolk breed was developed in Australia, primarily through a combination of Suffolk and Poll Dorset genetics. The breed is a common terminal sire, particularly in production systems located in the dry, arid pastoral zones.
Dorper	The Dorper was develop in South Africa in the 1930s by crossing Blackhead Persian ewes with a Dorset Horn ram. The breed was introduced to Australia in 1996 and are bred to produce a high quality carcass under extensive agricultural conditions.
Texel	The Texel breed was introduced to Australia from northern Europe stock in 1993. It is a terminal sire, the offspring of which are capable of also producing a heavy cut of bulky wool in the low 30s micron range.
Border Leicester	Border Leicesters are the main maternal sire for the Australian prime lamb production industry. Border Leicester rams are joined with readily available merino ewes to produce a first-cross ewe that exhibits superior maternal and meat producing traits, as well as increased wool production as the result of hybrid vigour.
Suffolk	The Suffolk breed was developed in England in the early nineteenth century by crossing two existing breeds noted for meat quality. It is used as a terminal sire to cross with other breeds in Australia.
Corriedale	The Corriedale breed was progressively developed in Australia and New Zealand over the course of the past 140 years by selectively breeding from pure Merino and Lincoln sheep. They are a dual purpose breed that is used primarily as a terminal sire in prime lamb or live export production.
Southdown	The Southdown breed originated in the United Kingdom and is used as a terminal sire for the production of prime lamb.

Table 27 – Main Australian Sheep Breeds

5.6.2 Overview of Sheep Genetics

Similar to BREEDPLAN, Sheep Genetics is a service that was developed primarily under funding from levy resources that:

- Requires seed-stock producers to submit pedigree and objective measurement data to a centralised database, whereby algorithms based on BLUP are used to calculate estimated breeding values, known as Australian Sheep Breeding Values (ASBVs), as well as indices that seed-stock producers and their customers can use to inform sheep joining and purchase decisions.
- Offers a range of complementary products and services that enhance the usage of Sheep Genetics namely, genomically enhanced EBVs, RAMPOWER, TGRM, Matesel and RAMSELECT[59], Dashboard, Pedigree Master, Resource Flock, advisory service and carcase scanner accreditation; and
- Offers the same services to a range of international markets.

[59] RAMSELECT is a service that was developed by and is delivered by the Sheep CRC, but relies on Sheep Genetics data for its operation.

SHEEP GENETICS is comprised of three broad ASBV and index services:

- LAMBPLAN, which focuses on carcase quality traits associated with terminal sire and reproductive traits associated with maternal sire breeds and composite animals in the meat sheep sector, as well as traits associated with animal health and welfare in that sector;
- MERINOSELECT, which focuses on fleece quality and reproductive traits in the wool sector, as well as animal health and welfare traits in that sector; and
- KIDPLAN, which focuses on carcase and reproductive traits in the goat meat sector, albeit this is a much smaller sector.

5.6.3 Ownership Structure

While each of the owners of BREEDPLAN have strategic and operational interests in Sheep Genetics, the ownership structure of Sheep Genetics is substantially different to that of BREEDPLAN. Up until mid-2016, Sheep Genetics was a joint venture between MLA and Australian Wool Innovation (AWI). AWI is effectively the MLA equivalent for the wool industry. AWI is an RDC that is established by and derives its powers from the *Wool Services Privatisation Act 2000.* As such, AWI, among other things, is responsible for managing and investing the levy funds received from wool growing levy payers, and matching eligible research and development contributions from the Australian Government for the benefit of the Australian wool industry and the public good. In mid-2016, the Sheep Genetics Management Agreement between MLA and AWI was dissolved, leaving MLA as the sole owner of Sheep Genetics.

MLA's ongoing interest in Sheep Genetics is a function of:

- A significant and majority historical and ongoing investment in the R&D that underpins Sheep Genetics, which is driven by MLA's natural interest meat sheep breed genetics, as well as carcase and maternal traits in the merino flock;
- Responsibility for and historical subsidisation of a significant component of Sheep Genetics' operations (see Section 5.6.4); and
- Progressive de-vestment by AWI of its interest in Sheep Genetics.

5.6.4 The Sheep Genetics Value Chain

Unlike BREEDPLAN, SHEEP GENETICS has not been 'commercialised', albeit the service component of the operation (delivering Australian Sheep Breeding Values to sheep seed-stock producers) is operated on a cost recovery basis. The Sheep Genetics service is operated as an internal business unit of MLA, with pedigree and performance data processing, reporting and client support undertaken by the Sheep Genetics/MLA staff and core analysis and calculation of Australian Sheep Breeding Values and Indices undertaken by AGBU. AGBU and the Sheep CRC also provide other research and development services that support Sheep Genetics. The interests of UNE and NSWDPI in Sheep Genetics are solely a function of their equity in the AGBU joint venture (see Section 5.2.2) and as participants in the Sheep CRC, along with MLA.

Another fundamental difference between the value chain that delivers BREEDPLAN and that which delivers Sheep Genetics is the role of breed associations in the respective value chains. For example:

- Breed associations in the sheep industry have not invested in the development of Sheep Genetics anywhere near the same degree as their counterparts in the beef industry have in BREEDPLAN and therefore don't have the same sense of 'equity' in it;
- Whereas breed associations are used as the channel to market for BREEDPLAN, they are not used for this purpose in Sheep Genetics, with sheep seed-stock producers transacting directly with the Sheep Genetics business unit on all elements of service provision, primarily through a Web interface; and
- Because breed associations are not used as a channel to market, the unregistered component of the sheep seed-stock sector has equal access to Sheep Genetics, whereas due to cost and practical limitations, as well as limitations to accessing breed association owned BREEDPLAN databases, the unregistered beef seed-stock sector faces signification restrictions with respect to using BREEDPLAN effectively.

Figure 66 below illustrates the value chain that delivers Sheep Genetics to the Australian sheep seed-stock sector, together with the equity and contractual arrangements that define the relationships in that value chain. Compared to the value chain that delivers BREEDPLAN (see Figure 12), this is a far more compressed value chain. It should be noted that MLA is currently in discussions to determine if and how AWI may continue to contribute to research and development that supports the ongoing development of Sheep Genetics and this is not represented in Figure 66 below.

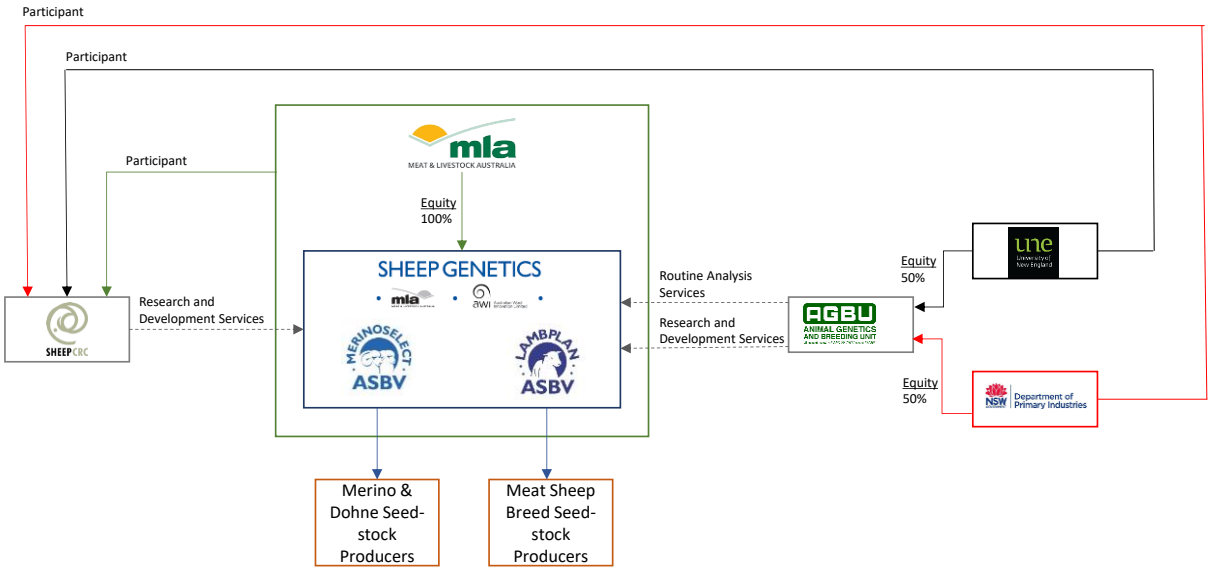

Figure 66 – Sheep Genetics Value Chain

There is a view held by some stakeholders in BREEDPLAN that the achievement of accelerated rates of genetic gain would be more likely accomplished if BREEDPLAN was delivered through a more compressed value chain like Sheep Genetics. The following Table 28 sets out the arguments that support this notion and those that counter it.

Arguments Promoting a Shorter Value Chain	Counter Arguments
Seed-stock producers pay a premium for BREEDPLAN The larger number of participants in the value chain implies that the price paid by seed-stock producers for BREEDPLAN is inflated by the additional operating costs and surpluses realised at the additional stages of the value chain. The resulting higher price serves as a barrier to adoption.	**BREEDPLAN has been 'commercialised'** Unlike Sheep Genetics, BREEDPLAN has been successfully commercialised (albeit by through Not-for-Profit organisations) through arms-length transactions, seed-stock producers are paying the market price for BREEDPLAN and overall adoption of BREEDPLAN has been similar to that of Sheep Genetics. This implies the value-chain adds product and service attributes that are valued by the customer and that all participants have made decadal scale investments in creating that value. Therefore there is no justification to intervene in its operation. Albeit, the fact that the organisations that have commercialised BREEDPLAN are quasi-public sector or NFP organisations and the cross ownership questions the purity of commercialisation.
Access to the unregistered sector The restrictions that non-breed association members face with respect to accessing BREEDPLAN and breed datasets results in suboptimal rates of genetic gain across the industry.	**Pure bred animals are more important in the beef industry** The vast majority of beef producers seek pure-bred animals for their breeding purposes, whereas demand for cross-bred animals is far more common in the sheep meat sector. In any event, while there is most certainly an unregistered sector, particularly in the northern beef industry, there is an absence of empirical evidence with respect to the size of that sector or its rate of growth.
Faster innovation diffused more quickly and widely In Sheep Genetics any product or service innovation that is developed is automatically rolled out to all users. However, in the case of BREEDPLAN, much product development occurs under specific commercial arrangements between ABRI and individual breed associations and are not made widely available.	**BREEDPLAN has been 'commercialised'** BREEDPLAN has been 'commercialised' through a series of negotiated commercial transaction and therefore it is at the discretion of how each entity participating in the value-chain innovates and decides to extract value from that innovation.
Innovation remains focused on key objective of accelerating genetic gain BREEDPLAN is but one aspect of ABRI's business and it delivers BREEDPLAN under commercial arrangements. Alignment of innovation investments with its overall business and commercial arrangements may not necessarily result in the innovation investment that is needed to optimise the rate of genetic gain.	**BREEDPLAN has been 'commercialised' and the Owners approve the ABRI business plan with respect to BREEDPLAN** BREEDPLAN has been 'commercialised' through a series of negotiated commercial transactions and therefore it is at the discretion of how each entity participating in the value-chain innovates and decides to extract value from that innovation. Furthermore, the Owners review and approve an operations plan for the BREEDPLAN aspect of ABRI's business each year, providing opportunity to influence innovation investment direction.

Table 28 – Arguments For and Against Using the Sheep Genetics Delivery Model for BREEDPLAN

5.6.5 Sheep Genetics Business Model

While there are similarities between the business models that deliver BREEDPLAN and Sheep Genetics, there are also some important fundamental differences. Sheep Genetics is a loss making business whose operations have historically been subsidised by the historical joint venture partners, primarily MLA. In both Sheep Genetics and BREEDPLAN, MLA funds the AGBU research and development contract. In the case of data collection, analysis and client support, significant progress toward full cost recovery has been made by Sheep Genetics in recent years and for BREEDPLAN, this is undertaken by ABRI and its commercial arrangements. Extension pertaining to Sheep Genetics is delivered by MLA on a 50 percent cost recovery basis and in the case of BREEDPLAN the MLA Donor Company funds 50 percent of the costs of SBTS and TBTS.

5.6.5.1 Revenue Model

Sheep Genetics operates under a slightly different revenue model and unlike BREEDPLAN the same transparent pricing structure applies to all domestic customers of Sheep Genetics. Total operating revenue for Sheep Genetics has grown from just under $500,000 in 2010-11 to just over $700,000 in 2014-15 and is driven primarily by the number of subscribers and billable animals.

Users of Sheep Genetics with flocks larger than 50 animals pay an annual membership fee on a per flock recorded with BREEDPLAN basis. At $440.00 for the first registered flock and $121.00 for subsequent flock, this membership fee is substantially higher than it is for most users of BREEDPLAN.

The second component of the revenue model for Sheep Genetics is a per animal charge. For small flocks with fewer than 50 animals this charge is $9.50 per animal (but no membership fee). However, for flocks with more than 50 animals, the per animal charge is $2.10. For most flocks, particularly larger flocks the direct costs of using Sheep Genetics is substantially less than is the case for BREEDPLAN. While the market value of the animal does not impact on the cost of undertaking an evaluation, the lower price for Sheep Genetics needs to be considered in the context of the relative market value of rams and bulls, with the average bull typically around three times more expensive than the average ram.

The other significant difference between the BREEDPLAN and Sheep Genetics revenue model is that whereas international BREEDPLAN customers typically pay less that domestic BREEDPLAN customers for access to BREEDPLAN, international Sheep Genetics customers pay a premium on membership and per animal charges.

Overall charges associated with Sheep Genetics have increased over the past five years. This increase has been the result of MLA and AWI transitioning the delivery of Sheep Genetics to an operational cost recovery model. Table 29 below summarise recent trends in Sheep Genetics pricing.

Fee or Charge	2010-11	2011-12	2012-13	2013-14	2014-15	CAGR
Domestic						
Subscription Fee	$385.00	$385.00	$412.50	$412.50	$440.00	3.4%
Additional Flock Fee	$110.00	$110.00	$121.00	$121.00	$121.00	2.4%
Animal Charge (Large Flock)	$1.65	$1.80	$1.80	$2.10	$2.10	6.2%
Animal Charge (Small Flock)	$8.25	$8.50	$8.75	$8.85	$9.10	2.5%
International						
Subscription Fee	$420.00	$420.00	$450.00	$450.00	$480.00	3.4%
Additional Flock Fee	$120.00	$120.00	$120.00	$130.00	$130.00	2.0%
Animal Charge (Large Flock)	$2.00	$2.20	$2.20	$2.50	$2.50	5.7%
Animal Charge (Small Flock)	$9.00	$9.35	$9.65	$9.75	$10.00	2.7%

Table 29 – Sheep Genetics Pricing 2010-11 to 2014-15

5.6.5.2 Cost Structure

As a result of the following, the cost structure of Sheep Genetics also differs significantly from BREEDPLAN:

- The operations and delivery of Sheep Genetics is managed as an internal business unit of MLA. As discussed, in the introduction to this section, while the pricing model for Sheep Genetics has progressed to an operating cost recovery level over the past few years, there will undoubtedly be at least some indirect subsidisation that results from operating as a business unit of MLA.

- The routine processing of pedigree and performance measurements and production of ASBVs and indices is outsourced to AGBU under a service agreement between Sheep Genetics and AGBU and cost recovered in the price paid by Sheep Genetics customers.

The following Table 30 summarises the operating cost of Sheep Genetics on an estimated fully costed basis.

Cost Item	Average (2010-11 to 2014-15)
Core Operating Costs	
Sheep Genetics Salaries and Wages	$363,200
AGBU Processing Contract	$97,573
Other Non-Salary Operating Costs	$131,000
Total Approximate Core Operating Costs	$591,773
Research and Development	
Salaries and Wages	$253,060
Contracted Projects	$140,143
AGBU Research Contract	$385,483
Other Costs	$20,800
Total Research Costs	$799,486
Extension	
Total Extension Costs	$165,657
Other Costs	
Governance and IP Management	$50,000
MLA Overhead Charge	$116,297
Total Other Costs	$166,297
Total Operating Costs	$1,723,213
Core Operating Cost Per Member Flock	$706.17
Core Operating Cost Per Billable Animal	$2.81
Total Operating Cost Per Member Flock	$2,056.34
Total Operating Cost Per Billable Animal	$8.01

Table 30 – Estimated Operating Cost of Sheep Genetics on a Fully Costed Basis

5.6.6 Adoption of Sheep Genetics

Determining the extent of market penetration of Sheep Genetics is challenging primarily because unlike BREEDPLAN, the unregistered sector is able to use Sheep Genetics and there is means of measuring the size of the unregistered sector. However, there is adequate empirical evidence to indicate that adoption of Sheep Genetics has been significant in most meat sheep breeds and is growing in the merino sector.

During the period 2010 to 2015, the number of LAMBPLAN flocks registered with Sheep Genetics remained relatively constant, declining at a rate of approximately 1.0 percent per annum. Whereas, the number of Merino and Dohne flocks registered with MERINOSELECT grew at a rate of 12.0 percent per annum. While there was significant organic growth in the number of merino flocks registered with MERINOSELECT, the rate of growth was somewhat enhanced by the transfer of merinos from a competing service (Advanced Breeding Services) to MERINOSELECT in 2011-12. Figure 67 below illustrates the trend in flocks registered with Sheep Genetics over the period 2010 to 2015.

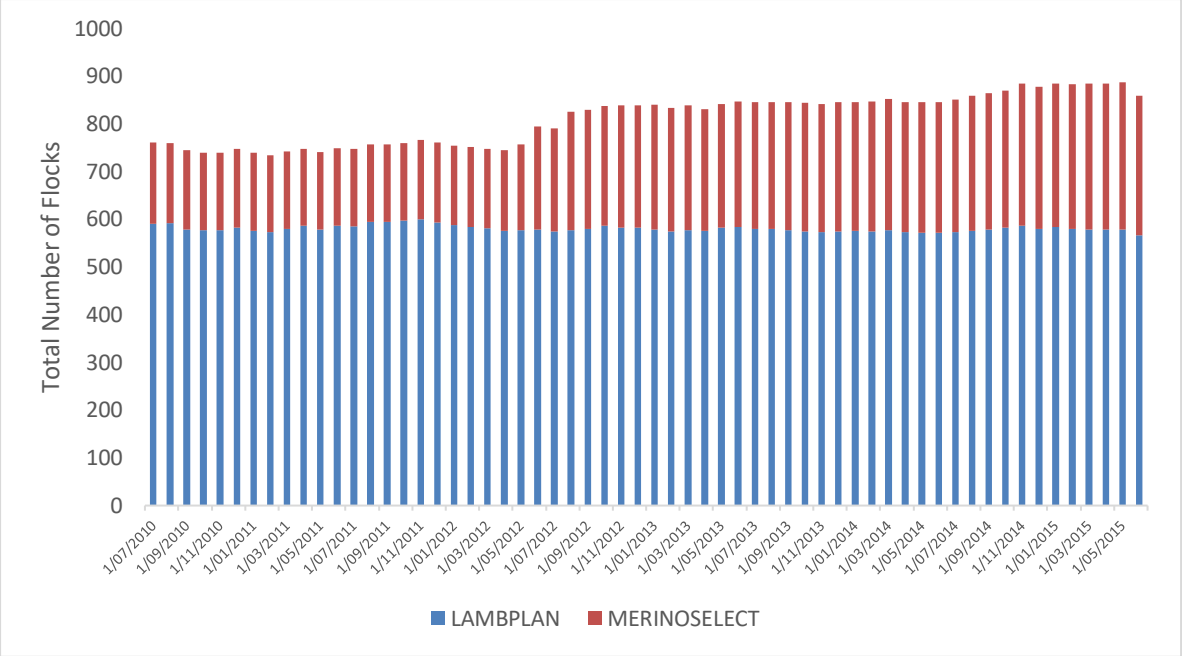

Figure 67 – Flocks Registered with Sheep Genetics (2010 to 2015)

As at 2015, there were 838 Australian sheep flocks registered with Sheep Genetics. The distribution of these registered flocks across the various breeds is illustrated in Figure 68 below.

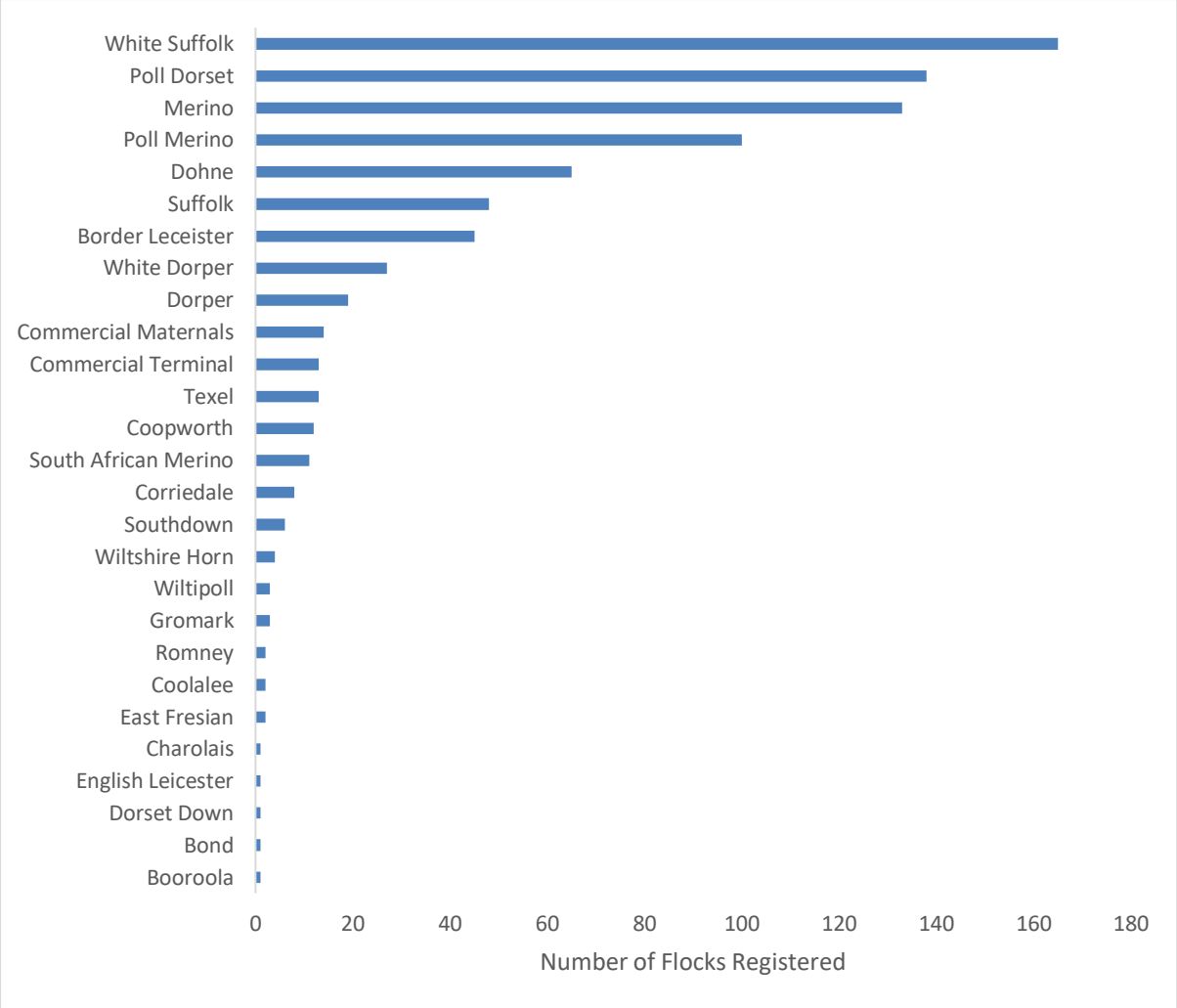

Figure 68 – Number of Flocks Registered with Sheep Genetics – Major Australian Sheep Breeds (2015)

Using breed association membership as the denominator[60], this indicates that the rate of adoption in terms of flocks registered with Sheep Genetics ranges from as low as 11.1 percent in the case of the Corriedale breed and as high as 83.3 percent in the case of the Dohne breed, with an average rate of adoption of 32 percent. This is summarised in Table 31 below.

[60] This excludes the unregistered sector, which in the case of SHEEP GENETICS form part of the total addressable market.

Breed	Estimated Market Penetration Based on Breed Society Membership
Merino and Poll Merino	29.1%
Dohne	83.3%
Poll Dorset	27.4%
White Suffolk	47.8%
Corriedale	11.1%
Suffolk	19.8%
Texel	26.0%
Southdown	17.1%
Border Leicester	22.6%
Dorper	63.9%
Average	31.9%

Table 31 – Estimated Rate of Adoption of SHEEP GENETICS

With the exception of an increase in 2011-12, which was the result of the transfer of merinos from Advance Breeding Services to MERINOSELECT, the total number of billable animals in Sheep Genetics has remained relatively constant. As illustrated in Figure 69 below, the stable number of billable animals has been a function of growth in the number of billable animals in MERINOSELECT being offset by a decline in the number of billable animals with LAMBPLAN.

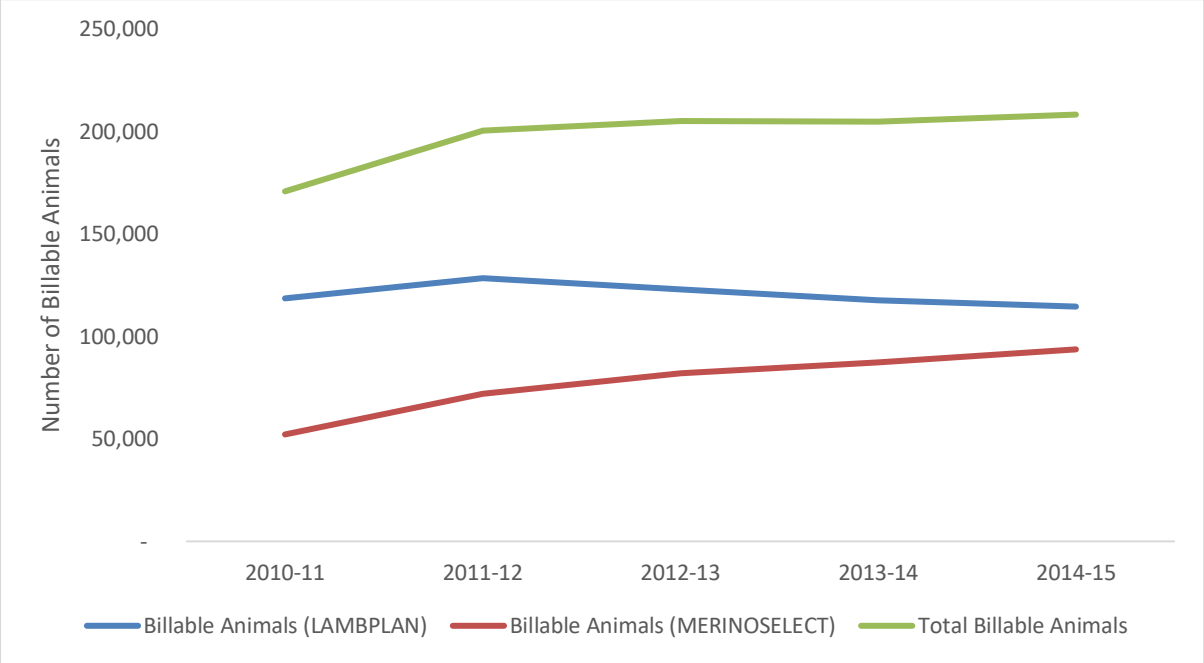

Figure 69 – Trend in the Number of Billable Animals with Sheep Genetics (2010 to 2015)

Determining the portion of total animals that have ASBV is similarly rendered difficult by the fact that the unregistered sector has access to Sheep Genetics. However, all estimates undertaken to date suggested penetration of ASBVs is significant. For example one study estimated that in 2012, seed-stock producers using LAMBPLAN were supplying around 68 percent of terminal sires and 41 percent

of maternal sires, while seed-stock producers using MERINOSELECT were supplying approximately 18 percent of merino sires.[61]

6 Analysis and Synthesis

6.1 The Problem

As discussed in Section 1.1.4, while there has been some improvement over the past couple of years and Japan remains an important export market for Australian beef, exports to this key market have been declining for approximately a decade. The dramatic increase in exports of Australian beef to the United States in the past couple of years has been a function of the United States cattle industry passing through a post liquidation shortage of domestic supply, a lower Australian dollar and drought induced turn-off in Australia. While the United States will remain an important market for Australian beef, it is likely that as domestic stocks begin to rebuild in the United States, demand for Australian beef from the United States will soften.

The transition of emerging economies, particularly the PRC, toward meat based diets represents a very significant opportunity for the Australian beef industry and one that it is well positioned to capitalise on. Australia has some specific advantages with respect to supplying the rapidly growing PRC market, including PRC approved abattoir infrastructure, a trade agreement, PRC approved live export protocol and absence of various diseases that prohibit beef trade with the PRC for many other countries. However, Australia is still a relatively small exporter to the PRC compared to India, Brazil and the United States.

In the global context, Australia is a mid-cost producer. As discussed in Section 1.2, the average cost of Australian beef production is lower than that of European and Asian producers, comparable to African and CIS producers, but significantly higher than producers in north, central and southern America. Australia's cost disadvantage with respect to these major competitors in its export markets is primarily the result of high labour costs, which in the case of Australia account for twice the portion of total beef production cash costs compared to the global average.

Australian labour costs are unlikely to decline. Therefore, the industry's only option with respect to productivity growth is improving the productivity of that labour (i.e. greater output per unit of labour input). As is the case with all livestock industries, accelerating the rate of genetic gain in traits that are commercially valuable is a major initiative of the industry strategy to drive productivity growth. As discussed in Section 1.3.4 and 5.1, as a decision support tool designed to achieve greater certainty in breeding decisions, BREEDPLAN is a major component of industry's efforts to accelerate the rate of genetic gain across the Australian beef cattle herd.

This review of the framework through which BREEDPLAN is current commercialised has been instigated by the Owners primarily because there is mounting concern that while there is a widely-held view that BREEDPLAN has delivered considerable improvement in genetic gain across the Australian beef industry, there is an equally widely-held perception that if BREEDPLAN was more

[61] Fennessy, P. et al (2014), 'Evaluating the impact of Australian genetics and genomics RD&E investment', Meat and Livestock Australia

widely adopted and/or used more rigorously with respect to both performance recording and using it as a breeding decision-support tool, the current rate of genetic gain could be substantially enhanced.

6.1.1 Suboptimal Market Penetration of BREEDPLAN

Section 5.3 of this report provides a detailed analysis of recent historical trends and the current status of adoption of BREEDPLAN across breeds that collectively account for approximately 95 percent of calves in the Australian registered seed-stock sector. As discussed in Section 5.3, for several reasons measuring the level of penetration of BREEDPLAN with accuracy is difficult. Nevertheless, this analysis indicates that the current level of penetration of BREEDPLAN is suboptimal.

No breed association has more than approximately 30 percent of its members using BREEDPLAN. Whereas in the sheep industry equivalent service, Sheep Genetics, some breeds have indicative membership rates as high as 80 percent (see Section 5.6.6). However, as is the case with Sheep Genetics, users of BREEDPLAN tend to be the larger seed-stock herds in most cases, evidenced by the fact that the weaning weight records submitted to BREEDPLAN represent a significantly larger number than the number of members in each breed would suggest. For example the portion of registered calves submitting weaning weight records to BREEDPLAN in 2015 ranged for 92.5 percent in the case of Angus, to 20.3 percent in the case of Droughtmaster (see Section 5.3). This is also consistent with observations discussed in Section 5.4. Nevertheless, the market penetration of BREEDPLAN measured as both the number of members and recorded animals would seem less than is the case in SHEEP GENETICS (see Section 5.6.6)

The analysis in Section 5.3 also suggests that, measured in terms of longer term (2002 to 2015) and shorter term (2010 to 2015), growth in the number of weaning weight measurements recorded with BREEDPLAN is positive in five breeds only that collectively accounted for just under 55 percent of registered calves in 2015. These ‘growth’ BREEDPLAN breed sectors are Angus, Brahman, Wagyu, Brangus and Red Angus.

In the other eight breed sectors analysed, that collectively accounted for approximately 41 percent of registered calves in 2015, the longer and shorter term trends have demonstrated declining registrations and/or declining weaning weight records. These ‘declining’ BREEDPLAN sectors are Simmental, Hereford, Droughtmaster, Charolais, Limousin, Shorthorn, Murray Grey and Santa Gertrudis, albeit Santa Gertrudis has demonstrated some growth in the shorter term.

Table 32 below, summarises these trends.

Breed	Percentage of Registered New Calves (2015)	Percentage of Full and Commercial Members Using BREEDPLAN [62]	BREEDPLAN Weaning Weight Records as Percentage of Registered Calves (2015)	CAGR New Calf Registrations (2002 to 2015)	CAGR New Calf Registrations (2010 to 2015)	CAGR BREEDPLAN Weaning Weight Records (2002 to 2015)	CAGR BREEDPLAN Weaning Weight Records (2010 to 2015)
Growth BREEDPLAN breed sectors							
Angus	33.0%	21.4%	92.5	⇧1.4%	⇧7.7%	⇧1.8%	⇧2.1%
Brahman	13.4%	~10.0%	42.8	⇧1.5%	⇧4.3%	⇧0.2%	⇧7.5%
Wagyu	4.2%	12.2%	43.6	⇧18.5%	⇧13.5%	⇧32.3%	⇧0.4%
Brangus	2.3%	n.a.	36.1	⇧2.9%	⇧3.0%	⇧4.4%	⇧24.2%
Red Angus	1.5%	12.2%	46.3	⇧2.2%	⇧5.1%	⇧4.8%	⇧0.7%
Total	54.4%						
Declining BREEDPLAN breed sectors							
Simmental	2.8%	31.6%	51.9%	⇧2.8%	⇧1.2%	⇧1.8%	⇩5.4%
Hereford	11.7%	30.9%	73.5%	⇩3.8%	⇩3.7%	⇩3.6%	⇩3.8%
Santa Gertrudis	7.5%	6.3%	45.1%	⇧0.2%	⇩2.2%	⇩4.8%	⇧1.3%
Droughtmaster	6.0%	4.7%	20.3%	⇧0.9%	⇩5.8%	⇩1.9%	⇩5.5%
Charolais	4.1%	22.4%	53.1%	⇧2.0%	⇩6.6%	⇧2.7%	⇩0.9%
Limousin	3.3%	n.a.	49.5%	0.0%	⇩2.8%	0.0%	⇩4.1%
Shorthorn	3.1%	17.5%	79.6%	⇩3.2%	⇩2.7%	⇩3.5%	⇩5.5%
Murray Grey	2.2%	n.a.	61.5%	⇩6.0%	⇩6.4%	⇩5.6%	⇩6.5%
Total	40.7%						

Table 32 – Summary of Trends in the Penetration of BREEDPLAN across Major Australian Beef Cattle Breeds

6.1.2 Suboptimal Usage of BREEDPLAN

The ability of BREEDPLAN to accelerate the rate of genetic gain is not only a function of the penetration of BREEDPLAN, but also a function of how rigorously users of BREEDPLAN undertake performance recording and how those users use BREEDPLAN to inform breeding decisions.

As an indication of how rigorously performance recording for BREEDPLAN is undertaken across the breed sectors, the analysis of market penetration of BREEDPLAN in Section 5.3 also discusses longer (2002 to 2015) and shorter (2010 to 2015) term trends in scanning records submitted to BREEDPLAN. Over the longer-term, scanning records submitted to BREEDPLAN ranged from an average of 60 percent of the volume of weaning weight records in the case of Angus, to 12 percent in the case of Brahman, suggesting that in most breeds, BREEDPLAN is not being used rigorously by many users. This is consistent with the perception observations discussed in Section 5.4.

However, the volume of scanning records submitted to BREEDPLAN has been increasing over the longer term in all of the breeds analysed with the exception of Murray Grey and in most cases, the growth in scanning records submitted to BREEDPLAN has been substantially greater than the growth in weaning weight records submitted. Furthermore, in all breeds with the exception of Wagyu, the volume of scanning records as a portion of weaning weight records is greater in 2015 than it was in 2002. This suggests that while BREEDPLAN does not seem to be used as rigorously as it could be, there

[62] Note that in some breed associations only Full Members can register animals with BREEDPLAN and as such, the penetration of BREEDPLAN among the seed-stock sector (Full Members) may be understated in some breeds according to this analysis.

is a minor trend toward improvement in this regard. The trend in BREEDPLAN scanning records is summarised in Table 33 below.

Breed	Scan Records as a Portion of Weaning Weight Records (2002)	Scan Records as a Portion of Weaning Weight Records (2015)		CAGR BREEDPLAN Scanning Records (2002 to 2015)
Growth BREEDPLAN Breed Sectors				
Angus	53.6%	60.4%		⇧2.7%
Brahman	5.6%	24.4%		⇧12.3%
Wagyu	27.1%	19.1%		⇧28.7%
Brangus	1.7%	78.4%		⇧39.9%
Red Angus	22.2%	39.4%		⇧9.6%
Declining BREEDPLAN Breed Sectors				
Simmental	20.6%	32.6%		⇧5.5%
Hereford	31.0%	58.2%		⇧1.2%
Santa Gertrudis	23.3%	53.6%		⇧1.4%
Droughtmaster	0.8%	29.2%		⇧29.1%
Charolais	13.7%	40.0%		⇧11.4%
Limousin	5.4%	28.3%		⇧13.5%
Shorthorn	29.8%	51.5%		⇧0.6%
Murray Grey	33.1%	41.9%		⇩3.9%

Table 33 – Summary of Trends in Scanning Records Submitted to BREEDPLAN by Breed

6.1.3 An Evolving Industry Structure

It would seem that the structure of the Australian beef cattle seed stock sector is evolving in three ways. Firstly, there is increasing concentration of the sector into several key breeds. Secondly, there is some anecdotal evidence of a growing unregistered sector. Thirdly, there is some anecdotal evidence that, while the industry is still dominated by pure-bred animals, there is an increasing prevalence of cross-bred and composite animals, particularly in the northern sector.

6.1.3.1 Concentration in the Key Breeds

There has been strong growth in some breeds at the expense of others. For example, as discussed in Section 5.3 and summarised in Table 32 above, new calf registrations for the Angus breed have continued to grow at the expense of some other southern sector breeds such as Hereford. There has also been relatively strong growth in the main northern sector breed of Brahman, as well as Wagyu in both the northern and southern sectors. These trends have resulted in significant concentration in the Australian beef seed-stock sector. Table 34 below summarises the extent to which new registered calf production is concentrated among the main breeds.

60 percent of new registered calves	80 percent of new registered calves	90 percent of new registered calves	95 percent of new registered calves
Angus (33.0%) Brahman (13.4%) Hereford (11.7%)	Angus (33.0%) Brahman (13.4%) Hereford (11.7%) Santa Gertrudis (7.5%) Droughtmaster (6.0%) Wagyu (4.2%) Charolais (4.1%)	Angus (33.0%) Brahman (13.4%) Hereford (11.7%) Santa Gertrudis (7.5%) Droughtmaster (6.0%) Wagyu (4.2%) Charolais (4.1%) Limousin (3.3%) Shorthorn (3.1%) Simmental (2.8%)	Angus (33.0%) Brahman (13.4%) Hereford (11.7%) Santa Gertrudis (7.5%) Droughtmaster (6.0%) Wagyu (4.2%) Charolais (4.1%) Limousin (3.3%) Shorthorn (3.1%) Simmental (2.8%) Brangus (2.3%) Murray Grey (2.2%) Red Angus (1.5%)

Table 34 – Concentration of the Australian Beef Cattle Seed-stock Sector

This implies that considerable improvement in the rate of genetic gain could be gained by focusing on initiatives designed to improve BREEDPLAN adoption and usage among these limited number of breed sectors.

6.1.3.2 The Unregistered Sector

As discussed in Section 5.4, there is a view held by some that there is a significant and growing unregistered component of the Australian beef cattle seed-stock sector. While there is an absence of empirical data to support this, there are some anecdotal evidence to suggest that there is at least some merit to this claim. For example, as discussed in Section 5.3.5.1, there is a reasonably well identified unregistered sector among the Charolais breed and as discussed in Section 5.3.6.1, there is a known large herd of unregistered Wagyu seed-stock cattle operated by the Australian Agricultural Company.

This implies that if there is a trend toward a larger unregistered sector, the ability of BREEDPLAN to positively impact the rate of genetic gain will be limited by virtue of the fact that under current systems arrangements, it can only be accessed with optimal effectiveness through a breed association.

6.1.3.3 Increased Prevalence of Composites and Cross Breeds

As noted in Section 1.1.1.1 there is an increased prevalence of cross-bred and composite animals, particularly in the northern sector. Obviously, these animals exist in the unregistered sector and give credence to the observation that the unregistered sector is growing.

In most cases, composites and cross bred animals cannot be registered with a breed association. The exceptions to this are the Australian Brangus Cattle Association and Belmont Australia that both accept composite animals, the Angus Australia Multi-breed Register (Brahman-Angus and Gelbvieh-Angus) and the ABRI Tropical Composite database that is based on Belmont genetics and which seed-stock and commercial producers can access directly through ABRI.

As such, if there is growth in composite and cross-bred animals, the ability of BREEDPLAN to positively impact the rate of genetic gain will be limited by virtue of the fact that under current systems arrangements, it can only be accessed with optimal effectiveness through a breed association.

6.1.4 Perceptions of High Cost

As discussed in Section 5.5.1, 5.5.2 and 5.6.5.1 the price paid for BREEDPLAN by breed associations and/or their members is by virtue of commercial arrangements between ABRI and individual breed association and terms of membership of individual breed associations, variable across the breeds. Nevertheless, BREEDPLAN is generally more expensive than its counterpart in Australian sheep seed stock sector, Sheep Genetics.

As discussed in Section 5.9.2, the perceptions as to whether BREEDPLAN represents value for money are varied. However, there seems to be two common perspectives. The first is that users believe that, in the context of the overall value of the animal and compared to other costs, BREEDPLAN represents very good value given what it delivers. The second, common alternate view compares the cost of using BREEDPLAN to the cost of using Sheep Genetics (see Section 5.6.5.1) and determines it is too expensive.

Furthermore, as discussed in Section 5.5.1.1, irrespective of any view formed through contextual pricing, actually attributing value to the use of BREEDPLAN is challenging for any seed-stock producer.

For BREEDPLAN to be more widely adopted it must clearly present value for money for seed-stock producers.

6.1.5 Some Evidence of User Dissatisfaction

As discussed in Section 5.4.2, opinions on the effectiveness of BREEDPLAN, as well as the usability of its various associated products and services are divergent. Underpinning this, is the observation that reasons cited for not using BREEDPLAN typically revolve around a bad experience with BREEDPLAN, results from BREEDPLAN that contradict the user's assessment of an animal, a perception that the benefit from BREEDPLAN does not justify the cost, or users are simply getting good prices for bulls irrespective of using BREEDPLAN.

Obviously, genuine user dissatisfaction with BREEDPLAN products and services is problematic with respect to driving greater adoption. However, even divergent views on the products and services can challenge higher levels of adoption by the confusion that it causes in the marketplace.

6.1.6 Perception of Slow and Selective Innovation Cycle

As discussed in Section 5.4.2, there is a perception held by some that the current value chain that delivers BREEDPLAN is slow at delivering new innovation and products, and that by virtue of the individual commercial arrangements between ABRI and the breed associations, development is undertaken contractually for one breed and not made more widely available.

This assessment seems based on a comparison to Sheep Genetics (see Section 5.6.2) where anecdotally, product development and innovation appears to happen more quickly and by virtue of the absence of individual agreements with breed associations, any product improvement or innovation is made immediately available to all users across the industry.

Obviously, rapid delivery of customer-valued products and product improvements to all users of BREEDPLAN is in the interests of optimising both adoption and usage of BREEDPLAN. However, the impact of this is somewhat mitigated by the concentration of the sector among the key breeds as discussed in Section 6.1.3.1.

6.1.7 Perception that the Value Chain is Inefficient

As discussed in Section 5.4, there is a perception that a major cause of the inability of BREEDPLAN to adapt to a perceived evolving industry structure, the perceived high costs, user dissatisfaction and slow and selective innovation cycle is the multi-level and relatively complex value chain that delivers BREEDPLAN to market, as well as the commercial arrangement which define the relationships along that value chain (see Section 5.2).

There is no question that the current value chain is adding cost to the end product (see Section 5.5) and that the restrictions that non-breed association members face with respect to accessing BREEDPLAN, particularly with respect to an across breed evaluation, limits BREEDPLAN's ability to cater to a potentially evolving industry structure and in some circumstances, limits the ability of ABRI

to innovate for the entire industry. However, it is folly to assume that the length and relative complexity of the value chain is the only cause of these issues. The following Section 6.2 discusses this in more detail.

6.2 Issues Analysis

6.2.1 Nature of Demand for BREEDPLAN

One of the main challenges with respect to driving greater adoption and usage of BREEDPLAN is the relatively complex nature of the demand profile for BREEDPLAN. Theoretically, demand for BREEDPLAN should be driven by a seed-stock and commercial producer felt need to use BREEDPLAN as a basis for making better and more certain breeding decisions that lead to better production outcomes. As identified in Section 5.4, there is most certainly a component of the BREEDPLAN demand profile that is based on precisely this notion. However, as discussed in Section 6.2.1.1 below, establishing an environment where it is clear that BREEDPLAN tangibly addresses this felt need can be challenging.

There appears to be two other major components of the BREEDPLAN demand profile. There is a component of demand that is determined by the general conditions in the market for Australian beef (see Section 6.2.1.2)and then related to this determinant of demand, is demand from commercial producers that is based on the fact an animal has EBVs, rather than any sophisticated usage of those EBVs (see Section 6.2.1.3)

The challenge presented by this demand profile is that the latter two sources of demand do not necessarily make an optimal contribution to accelerating the rate of genetic gain, primarily because they do not ensure the rigorous use of BREEDPLAN.

Furthermore, the challenges presented by the demand profile for BREEDPLAN have little to do with the value chain that delivers BREEDPLAN to market *per se*, and are more a function of the product itself. There is, however, a role for the value chain ensuring that the product is adequately promoted and its users supported to ensure that BREEDPLAN is used as rigorously as possible across these various components of the demand profile.

Finally, demand for BREEDPLAN that is derived from demand from commercial producer customers of seed-stock producers paying premiums for bulls with BREEDPLAN EBVs in its self has the potential to be problematic with respect to achieving the goal of optimising the rate of genetic gain across the industry. This is discussed further in Section 6.2.1.4 below.

6.2.1.1 The Challenge of Identifying How BREEDPLAN Addresses a Felt Need

As discussed in Section 5.5.1.1, it is almost impossible for a seed-stock producer to assign the portion of any premium received for a bull that might be the result of having used BREEDPLAN. Furthermore, as discussed in Section 5.5.1.2, assigning specific costs to the use of BREEDPLAN is challenged by the difficulties in determining the costs associated with taking and recording performance measurements. This means that determining the portion of a margin that is attributable to the use of BREEDPLAN is problematic.

Furthermore, these dynamics, combined with the fact that, as a result of facing different costs that are a function of the specific commercial arrangements between ABRI and individual breed

associations, differences in the extent to which BREEDPLAN usage costs are subsidised by different breed associations, and that performance measurement costs vary with production environment, it is very difficult for promoters of BREEDPLAN to establish metrics to demonstrate how BREEDPLAN addresses a felt need that are universally relevant.

Most seed-stock producers that value BREEDPLAN, create that perception of value by making an assessment of the genetic improvement they are achieving over their personal perception of the counter-factual. To an extent this can be informed by the delta between historical rates of genetic gain and those that have been achieved since using BREEDPLAN, but this is by its nature a subjective assessment based largely on tacit knowledge that is very difficult to quantify with certainty.

6.2.1.2 Demand for BREEDPLAN Driven by Market Conditions for Australian Beef

As discussed in Section 1.1, demand for BREEDPLAN and the extent to which it is used rigorously by many of its customers in the seed-stock and commercial sectors is at least in part a function of prevailing market conditions for Australian beef. Generally speaking, when demand for Australian beef is high, producers tend to be motivated to produce and turn-off as many market ready cattle as is sustainably possible. In such an environment demand for bulls is also generally high, and seed-stock producers tend to get higher prices for bulls irrespective of whether or not an animal has BREEDPLAN records. This can translate to lower demand for BREEDPLAN from the seed-stock sector.

Conversely, when demand for Australian beef is soft, and particularly if the industry is passing through a phase where producers are endeavouring to rebuild herds to sustainable levels, producers tend to have a greater focus on their breeding objectives and demonstrate greater discretion with respect to bull purchases. This results in more producers requiring bulls with BREEDPLAN records and as a result, greater demand for BREEDPLAN from the seed-stock sector.

As discussed, in Section 1.1.2, following an extensive drought period, the Australian cattle industry went through a period of herd build-up from a recent low of 24 million head in 2010 to a peak of approximately 26.5 million head in 2013. As discussed in Section 1.1.3, during the period 2013 to 2015, the Eastern Young Cattle Indicator increased from approximately $3.00 to over $6.00 per kilogram cwt, resulting in dramatic turn-off and a corresponding decline in the national herd to approximately 24.5 million head in 2015. This recent event may explain recent declines in the throughput of weaner weight records associated with some breeds as discussed in Section 5.3.

The inconsistent use of BREEDPLAN over-time that is associated with this source of demand is counter-productive with respect to the intention of optimising the rate of genetic gain.

6.2.1.3 Demand for BREEDPLAN that is derived from a Nominal Customer Request

As discussed in Section 5.4.2, there appears to be significant, sometimes intermittent, demand for BREEDPLAN that is derived from the fact that some commercial producer customers that want the bulls they buy to have BREEDPLAN EBVs on a nominal basis, either simply to identify a trait is present or as an almost quality assurance on the animal.

There is anecdotal evidence that this can cause intermittent spikes in demand for BREEDPLAN. For example, as discussed in Section 5.4.2, there have been incidences when large corporate commercial producers have entered the bull market on a condition that they will only look at animals with EBVs. This has resulted in a spike in demand for BREEDPLAN from the relevant seed-stock sectors, but this

spike in demand for BREEDPLAN has not necessarily coincided with increased sophisticated use of BREEDPLAN and once demand for BREEDPLAN animals from the corporate purchaser declines, so typically does demand for BREEDPLAN. Similarly it has been observed, that because Santa Gertrudis - Black Angus cross a preferred cross-breed for feed-lotting operations and commercial producers of Black Angus are accustomed to buying animals with BREEDPLAN EBVs, increased demand for Santa Gertrudis from these producers drove an increased demand for BREEDPLAN among Santa Gertrudis seed-stock producers.

This source of demand for BREEDPLAN that is more nominal in nature is not contributing to the objective of achieving optimal rates of genetic gain in the Australian beef industry.

6.2.1.4 The Demand Pull Dilemma

It is reasonable to assume that a primary motivation for using BREEDPLAN for most seed-stock producers is that through one or more of the mechanisms discussed in the previous subsections they receive premiums for BREEDPLAN bulls because they have BREEDPLAN records, are perceived as better performing bulls by customers or because they can deliver a greater degree of certainty to a breeding or production program.

There is a risk that if premiums associated with BREEDPLAN bulls become significant, they will be purchased by a smaller number of commercial producers. However, it is the interest of accelerating the rate of genetic gains to have as many bulls that can deliver higher guarantees of progeny performance with respect to valued traits operating in the seed-stock and production environment.

In this sense a market that pays unusually high prices for BREEDPLAN bulls is not in the interests of the objective of optimising the rate of genetic gain across the Australian beef industry.

6.2.2 Product Issues that Impact on Demand for BREEDPLAN

In addition to the complex nature of the demand profile for BREEDPLAN, there are also a number of characteristics that are inherent to the nature of the BREEDPLAN product that present challenges to higher rates of adoption.

6.2.2.1 Quantifying the Value of BREEDPLAN at the Seed-stock Producer Level is Problematic

Perhaps the single most significant challenge facing accelerated adoption of BREEDPLAN is the challenge that the primary customer, the seed-stock producer, faces with assigning the level of profitability that is directly attributable to the use of BREEDPLAN. As discussed in Section 5.5.1 and summarised in Section 6.2.1.1 above, this difficulty exists because it is very difficult, if not impossible, to assign the portion of any premium received for a bull that is directly attributable to BREEDPLAN, difficult to measure the costs associated with performance recording and in cases where BREEDPLAN costs are totally or partially absorbed by a breed association, determine the portion of breed association membership fees that are attributable to having access to BREEDPLAN. Of course, only animals that have desirable EBVs would be expected to attract a premium and as such, a significant portion of BREEDPLAN registered animals would have EBVs for specific traits that are below the average, and therefore would not be expected to attract a premium.

Certainly seed-stock producers in the Australian sheep industry face similar difficulties with respect to Sheep Genetics. However, this is at least party mitigated by the shorter production cycle associated with sheep, which means returns are realisable in a shorter timeframe.

6.2.2.2 Rigour in Performance Measurement Restricted by Practicalities

The extent and rigour to which seed-stock producers undertake performance measurements is function of the different breeding philosophies and associated practices that exist across the Australian beef seed-stock sector. These are determined by individual skill, tradition, specific structure of the enterprise and emotive factors.

It is also determined by the cost and practicality of taking various measurements, which is variable across enterprises. At the most basic level, taking many measurements is far more difficult on the larger properties that comprise the northern industry. However, even in the more intensive southern industry taking birth weight for example, can represent a major logistical challenge.

6.2.2.3 Instability of EBVs in the Smaller Breeds

As discussed in Section 5.4.2, there is a perception that BREEDPLAN works well for the larger breeds that have large data sets for most traits and therefore relatively stable EBVs. In the smaller breeds, smaller datasets can result in significant changes to an animal's EBVs year on year, undermining its usefulness as both a decision-support and marketing tool. While the accuracy factors discussed in Section 5.1.2.4, are designed to partially address this issue, they do little to mitigate the negative impact EBV instability has on product perception in the smaller breeds.

6.2.2.4 Validation of Assumptions used in the Calculation of EBVs

As discussed in Section 5.4.2, there is some scepticism over the assumptions used in the calculation of some EBVs, particularly with respect to how accurately they reflect the production environment. This undermines the credibility of BREEDPLAN.

6.2.2.5 Measurement of the Counter-factual

As discussed in Section 5.4.2, there is some scepticism as to how well the counter-factual is accounted for in estimates of the contribution that BREEDPLAN makes to genetic gain. This is a common issue across most industry genetic improvement programs that are based on quantitative genetics.

6.2.2.6 BREEDPLAN Treatment of Sub-breeds

The fact that separate BREEDPLAN databases are maintained for individual breeds is problematic with respect to facilitating an across-breed evaluation (see Section 5.1.2.3) similar to the evaluation that is undertaken for the sheep industry in Sheep Genetics (see Section 5.6.2) and ensuring stability of EBVs across the industry (see Section 6.2.2.3). However, the segregation and in some cases aggregation of breed databases, also causes problems when breeds on which breed associations are based are very similar.

The issue associated with segregation of databases for breeds that are very similar is exemplified in the case of Red Angus. As discussed in Section 5.3.3.5, with the exception of the homozygous red coat, Red Angus and Black Angus are for all intent and purpose the same breed. However, because they have different breed associations, performance records are recorded on separate BREEDPLAN databases. Because there are far fewer records for Red Angus, Red Angus animals that are otherwise comparable to Angus animals will typically demonstrate poorer BREEDPLAN figures and higher

degrees of inaccuracy. This renders BREEDPLAN a less effective marketing tool for Red Angus seed-stock producers who are targeting purchasers of Angus cattle more generally.

The issue associated with aggregation of databases for similar breeds is best demonstrated in the case of Simmental. As discussed in Section 5.3.5.3 in most other cattle industries, black and traditional Simmental animals are treated as separate breeds. However, because Simmental Australia is the breed association for both black and traditional Simmental animals they share the same BREEDPLAN database. Combining of the two pedigrees has caused some conflict within the breed association with respect to the use of BREEDPLAN. For example, Black Simmental seed-stock producers are primarily concerned with 600 day weight EBVs, whereas Traditional Simmental seed-stock producers are more concerned with 200 day weight EBVs. This conflict renders it challenging for Simmental Australia to effectively promote BREEDPLAN to its members and results in a lack of critical mass of data in some performance record categories.

6.2.2.7 ABRI Product Integration

To effectively use BREEDPLAN, breed associations must also use the ABRI pedigree database system for animal registrations. While this is not a contractual requirement it is a practical reality as very few breed associations have adequate internal resources to develop a proprietary pedigree database system, or integrate third party software with ABRI's BREEDPLAN data import system. The observation in Section 5.4.1 that seed-stock and commercial producers use a very wide range of software for recording animal data suggests that it is the breed associations that face the integration problem rather than the end-customer.

In the case of some smaller breed associations, ABRI also provides a range of services pertaining to the administration of the breed association business. These services range from simple accounting support to full administrative function, including employment of an executive officer function for the breed association.

There is a perception that this product integration has two implications. Firstly, there is a view that it results in high costs associated with using BREEDPLAN, simply because it is necessary to incur the cost of using the ABRI database when using BREEDPLAN (see Section 5.5.2), albeit many breed association clients were using ABRI database services prior to using BREEDPLAN and they are not compelled to use the ABRI database service. Secondly, there is a view that as a commercial entity, ABRI places more focus on the customers that deliver it the greater portion of revenue, which is a function of the terms on which they acquire BREEDPLAN and the ABRI database, as well as the portfolio of other ABRI products and services that they acquire.

6.2.2.8 BREEDPLAN is Complex Product

It is a well understood tenet of adoption theory that adoption is more likely to occur and be sustained when the adopter understands how a product works.

As discussed in Section 5.4.2, it is perceived by some that critiques of the extent of adoption of BREEDPLAN often overlook that fact that it is relatively complex product to understand. While selecting animals on the basis of EBVs and indices is reasonably easily understood, understanding how BREEDPLAN works at even a rudimentary level requires a senior secondary school level of understanding of principles of genetic science and statistical mathematics. Many producers do not possess this understanding and therefore perceive the workings of BREEDPLAN as a 'black box'.

6.2.2.9 Expectations of Genomics

The emergence of genomic technologies in the past decade and their commercial application in livestock industries over the past few years, has bought an even greater degree of certainty in the application of genetic science to breeding and animal purchase decisions. As discussed, in Section 5.4.2, there is a perception that genomics will be a game changer for BREEDPLAN by decreasing risk and labour.

The introduction of genomics to BREEDPLAN brings with it the following benefits:

- Improving the accuracy of EBVs by validating the statistical assessment on which they are based;
- Totally de-risking pedigree identification; and
- Reducing the labour involved in assessing an animal.

Producers will be able to access a GEBV simply by acquiring a DNA test on an animal. However, this risks demotivating producers to undertake labour intensive performance measurements, ultimately diluting the performance measurement database and undermining the effectiveness of the system.

There is also the possibility that genomics will challenge part of the value proposition of breed association membership. A DNA test that can provide information on the breed composition of an animal and many of its characteristics, the value of pedigree recording with a breed association is perhaps diminished.

6.2.2.10 Limitations of SBTS and TBTS

SBTS and TBTS were set up primarily because most individual breed associations are unable to resource internal technical genetics and BREEDPLAN advisory and training capability to service their members. While there is certainly some support for SBTS and TBTS, there have also been a number of concerns raised.

Individual breeds have different histories and usage patterns with respect to BREEDPLAN, which as discussed in section 5.4.2 is often a function of the degree to which the individual breed association supports and promotes BREEDPLAN. Because SBTS and TBTS programs are designed to be delivered across multiple breeds, differentiating programs only the basis of the different production environments and BREEDPLAN needs of the southern and northern industry, the programs do not seem to take into account the unique needs of individual breeds. In the extreme case, this paradigm has caused one breed association, Angus Australia, to withdraw from SBTS (see Section 5.3.3.1).

As noted in Section 5.4.2, both SBTS and TBTS also suffer from the usual criticism of agricultural extension programs that they are delivered primarily by technical staff who do not understand the practical realities of farming and therefore much of the program content is not realistically implementable. At the very least, programs are not tailored to an individual producer's needs

These possible deficiencies with SBTS and TBTS may be rendering it an ineffective mechanism for promoting BREEDPLAN and its rigorous use. In light of the observation in Section 5.4.1 that most seed-stock and many commercial producers view breed associations as the main trusted source of advice, as well as the fact that breed associations have a much deeper relationship with their members, promotion and training in the use of BREEDPLAN may be more effectively delivered directly through the breed associations, provided the breed association is an advocate for the use of BREEDPLAN by its

members. Such an initiative would most likely need to be resourced externally and considered in the context of the fact that SBTS and TBTS were in part established as a response to declining public sector investment in extension and an apparent succession management challenge.

6.2.3 Structural Issues that Impact on Demand for BREEDPLAN

In addition to the complex nature of the demand profile for BREEDPLAN and inherent product characteristics, there are a number of structural issues that impact on how extensively and rigorously BREEDPLAN is used.

These structural issues are the long and complex product feedback loop that is the result of a long and complex downstream beef production supply chain, a degree of evident promotion fatigue in the market for BREEDPLAN, the limited relevance to industry of an across-breed BREEDPLAN evaluation and the fact that because most of the industry still revolves primarily around pure bred animals, the breed associations remain an important channel to market.

6.2.3.1 Long and Complex Product Feedback Loop

As detailed in Section 1.1.5, the Australian beef supply chain that services both the domestic and international market, is long and complex. This lengthy and complex supply chain means that while seed-stock producers bear the entire cost of using BREEDPLAN, either through direct payments and/or through the cost of their breed association membership, any benefit in terms of increased value of the animal and its produce is shared along this value chain. While it can be theoretically argued that this is captured in any premium that the seed-stock producer receives for BREEDPLAN bulls, as discussed in Section 5.5.1.1, it is nearly impossible for a seed-stock producer to determine the portion of any premium that is attributable to the use of BREEDPLAN.

The length and complexity of the supply-chain also means that it is difficult for seed-stock producers to assess the impact of the breeding decisions they are making using BREEDPLAN on end-customer perceptions as this information is typically not adequately measured or delivered back to the seed-stock producer.

The observation in Section 5.4.1 that the commercial sector is less satisfied with the genetic gain that is being achieved than seed-stock sector is, as well as the observation in Section 5.4.2 that some believe that BREEDPLAN may be improving the value of bulls, but that this is not translating into additional benefits down the value chain, indicates that at the very least, the complexity and length of this value chain, together with an absence of effective information feedback is problematic with respect to demonstrating the value of BREEDPLAN.

As discussed in Section 1.2 a series of data oriented initiatives have been undertaken by industry to provide improved information linkages along the supply chain. Underpinning this is a world best practice product traceability system that distinguishes Australian beef produce in international markets that for biosecurity, food safety or culinary reasons, require traceability back to the primary producer. It would appear that while these initiatives have no doubt improved information flow along the value chain, they are yet to address the fundamental product quality feedback gap that seed-stock producers face with respect to using BREEDPLAN.

6.2.3.2 Promotion Fatigue and Possible Market Saturation

The following observations suggest that the market for BREEDPLAN is in a state of promotion fatigue and has potentially reached market saturation:

- BREEDPLAN has been heavily promoted to the beef cattle seed-stock sector for over three decades;
- As noted in Section 5.4.1, it would seem that most non-users of BREEDPLAN in the seed-stock and commercial sector have never used BREEDPLAN, and most current users of BREEDPLAN are long-term users; and
- As discussed in detail in Section 5.3 and summarised in Section 6.1.1, the market penetration of BREEDPLAN and in the case of some breeds, the market for BREEDPLAN itself, has plateaued or is declining.

As discussed in Section 5.4.2, there is a view that this being the case, combined with the observation that a large portion of BREEDPLAN users do not use BREEDPLAN rigorously, greater impact on the rate of genetic gain would more likely be achieved by focusing promotional, training and support activities on getting existing users of BREEDPLAN to use it more rigorously than by trying to get more users, many of which are not likely to use it rigorously. This is further validated by the fact that adoption and rigorous use is more common in breeds where the breed association values BREEDPLAN and invests in the promotion of BREEDPLAN to its members and supports its members in using BREEDPLAN. Having said this, there are specific breed sectors where current levels of adoption and recent adoption trends indicate that is opportunity to drive wider adoption of BREEDPLAN, implying a need for more targeted promotional efforts.

6.2.3.3 Relevance of Across Breed Analysis

As discussed, in Section 5.1.2.3, the widest scope that an evaluation is undertaken for BREEDPLAN is within-breed. There have been some calls for BREEDPLAN to transition to an across-breed analysis, similar to that which is conducted under Sheep Genetics (see Section 5.6.2). This would have three main advantages:

- It would provide seed-stock producers and their customers with information on an animal that is relative to all other animals, leading to arguably more informed animal selection and joining decisions;
- If animal selection and joining decisions were consistent with this information, the rate of genetic gain across the Australian beef industry would likely increase; and
- It would reduce the current instability of EBVs in the smaller breeds that is the result of inadequate performance records to underpin accuracy in the EBVs (see Section 5.4.2 and Section 6.2.2.3).

There is significant resistance to transitioning BREEDPLAN to an across breed analysis that is founded in:

- The fact that compared to the sheep industry, the Australian beef industry is more pure-bred focused. Commercial producers, particularly in the southern beef sector, tend to seek-out pure-bred animals that they then use to produce pure-bred commercial product or in their own cross breeding programs; and

- While some seed-stock producers note that there might be some benefit to being able to benchmark performance across breeds, the fact that the industry revolves primarily around pure-bred animals means that this is not a priority. There would need to be a considerable investment in research and development to create the cross-breed linkages in BREEDPLAN and most would consider there to be other research and development priorities.

Conversely, some argue that the resistance to cross-breed evaluation is a function of smaller breeds not wanting their animals compared to the larger breeds. However, it would seem there is a similar level of resistance from the larger breeds, and in reality, because of the pure-bred structure of the industry, each breed has its own niche market of sorts, limiting the level of competition between breeds.

Furthermore, there is a risk that the contribution that across breed analysis might make to the rate of genetic gain is overstated. The primary benefit of an effective across breed analysis is that it allows breeders and purchasers of composite animals to select the best genetics. While it is a plausible hypothesis that this might lead to faster genetic gain across the industry, the seemingly persistent pure-bred structure of particularly the southern beef industry calls into question the extent to which this might occur.

6.2.3.4 Breed Associations Remain an Important Channel to Market

While there is some anecdotal evidence of a growing unregistered sector, particularly in the northern beef industry (see Section 6.1.3.2), the analysis in Section 5.3, clearly demonstrates that breed associations are a critical component of the industry structure. This is validated by the observations in Section 5.4 pertaining to the importance and trust seed-stock producers and some commercial producers place on the breed associations and the fact that as discussed in the previous section 6.2.3.3, the industry still revolves around pure-bred animals.

Most certainly, it would appear that the BREEDPLAN delivery model must evolve over time to cater for the unregistered sector. However, for the reasons outlined in the previous paragraph, breed associations will remain an important channel to market for BREEDPLAN and could potentially play a greater role in promotion and delivery of training for BREEDPLAN.

6.2.4 Issues Associated with the BREEDPLAN Value Chain

Because the value chain that delivers BREEDPLAN to market is substantially different to that which delivers Sheep Genetics, there is a tendency to associate perceptions of high cost and suboptimal product development and market penetration with this distinguishing feature. As demonstrated by the analysis in Sections 6.2.1, 6.2.2 and 6.2.3, while the structure of the value chain that delivers BREEDPLAN to market has the ability to determine and influence some issues associated with the demand profile, product characteristics and structural nature of the industry and market, it is clearly not the sole determinant of challenges faced by BREEDPLAN with respect to optimising the rate of genetic gain across the industry.

Nevertheless, there appears to be some issues associated with the BREEDPLAN value chain that require attention if the objective of optimising genetic gain across the industry is to be achieved.

The commentary in this section should not be construed as being critical of any participant in the BREEDPLAN value chain. There is no evidence to suggest that any participant has behaved in a manner that is inconsistent with its strategic intent, fiduciary and/or legislative obligations and/or contractual rights and obligations.

The key issues associated with the BREEDPLAN value chain are:

- The delivery of BREEDPLAN has not really been commercialised, rather its delivery has been outsourced to a series of not-for-profit organisations;
- While the participants in the BREEDPLAN value chain are operationally aligned with respect to the delivery of BREEDPLAN, their strategic and fiduciary alignment is less so;
- There appears to be no formal agreement that governs the relationship between the owners, or the objectives they are seeking with respect to the outsourcing of the delivery of BREEDPLAN;
- There are equity and licensing arrangements along the value chain that cause conflicts of interest in the management of the value chain;
- Exclusivity arrangements along the value chain may be resulting in inefficient service delivery and monopoly style pricing; and
- A transactional approach to managing the value chain, combined with the lack of strategic and fiduciary or legislative alignment among the participants is resulting in different terms of usage for seed-stock producers across the industry and a concentration of value-chain surplus.

These issues are discussed in the following subsections.

6.2.4.1 Has BREEDPLAN Really Been Commercialised?

The transaction that delivers BREEDPLAN to market might better be described as an outsourcing arrangement between public, quasi-public and not-for profit organisations whereby revenue and costs associated with the delivery of the service are shared across those organisations, rather than commercialisation.

The term 'commercialisation' generally refers to, or at least implies, that a new product or service is being delivered to the market for commercial or financial gain. While there are some elements of commercial behaviour along the value-chain that delivers BREEDPLAN, the key distinguishing factor is that the value-chain is not designed to produce financial investment style returns for the shareholders or members of the organisations that are participating in that value-chain. Rather, it is expected that any surplus generated is modest and is invested in improvements to BREEDPLAN and its delivery or in BREEDPLAN price reduction for the seed-stock sector. In such a context, the existence of a surplus above beyond these reinvestment requirements represents a productivity penalty with respect to the objective of optimising the rate of genetic gain.

This is an important distinction from two perspectives. Firstly, if the financial dynamics of BREEDPLAN as a 'whole business' are such that it has the ability to produce commercial style returns or returns being generated by partial privatisation are extraordinary, then there is little evidence of market failure, which raises the question as to why it is still being delivered by government and quasi-government organisations and reliant on research and development that is supported by levy funds. Secondly, the fact that BREEDPLAN has not been genuinely commercialised but rather delivered

through a series of government, quasi-government and not-for-profit organisations defines the extent to which any surplus should exist and how that surplus should be treated.

6.2.4.2 How well are the BREEDPAN Value Chain Partners Aligned?

Prima facie, the participants in the BREEDPLAN value chain would seem to be strongly operationally aligned with respect to the purpose of delivering an information technology product to the Australian beef cattle seed-stock sector. The Owners have progressed the translation of the outcomes of the research and development they have supported in the form of the BREEDPLAN Core Analytical Software by licensing it to ABRI, a service provider that specialises in developing and delivering information technology products to the Australian livestock, particularly the beef, sector. ABRI has then entered into what are effectively distribution agreements the breed associations that are a direct channel to a key market, the registered beef cattle breeding sector. However, the strategic and fiduciary alignment between the organisations that comprise the BREEDPLAN value chain is a different matter.

As discussed in detail in Section 5.2.1.2.1, MLA is a RDC that is the subject of Commonwealth Legislation and a Funding Agreement with the Commonwealth, which places a range of obligations on MLA designed to align its activities with policy objectives of the Commonwealth and interests of the Australian beef industry. The basic logic underpinning MLA ongoing substantial investment in the research and development that underpins BREEDPLAN is that there is market failure with respect to this investment. Unlike the case of Sheep Genetics, where MLA has determined there is market-failure in the delivery of the Sheep Genetics service, MLA has 'commercialised' the delivery of BREEDPLAN. This ongoing investment and structure for delivery seems to be basically aligned with the various documents that MLA uses to guide its investments and activities namely, MLA Memorandum and Articles, MLA Strategic Plan, Meat Industry Strategic Plan, Australian Government Science and Research Priorities, Rural Research, Development and Extension Priorities and the Levy Principles and Guidelines. The principle objective of MLA's investment in the BREEDPLAN value chain is to optimise the rate of genetic gain in traits that are determined by industry to be valuable across the Australian beef industry.

Furthermore, MLA's intent to optimise the benefits of its investments in the interests of the Australian beef industry is articulated in the objectives of the licensing agreement – '*The objective of the licensing agreement is to commercialise and distribute the software for the purpose of maximising the rate of genetic progress toward breeding objectives that are relevant to industry.*' Because of the lack of strategic and fiduciary alignment (including any hard KPIs or incentives to motivate alignment) of the other participants with this objective, it is questionable as to whether current value chain is achieving this.

UNE has very significant equity interest in the value chain and service providers to the value chain. As discussed in Section 5.2.1.2.2, the University of New England is a teaching and research university whose performance in important academic league tables that ultimately serve to attract quality researchers and students, as well as a very significant portion of external research funding is dependent on livestock genetics and related disciplines. The maintenance of UNE's equity holding in the BREEDPLAN core analytical software, the AGBU joint venture and ABRI is strategically consistent with its focus on research excellence and dependence on research income in the area of livestock genetics. Its participation in the BREEDPLAN value chain adds value to its research focus, provides a

direct linkage to the ultimate beneficiaries of its research and provides a channel for translation of research outcomes to end users. However, it is not in UNE's strategic framework, nor is its fiduciary responsibility to optimise the rate of genetic gain for the Australian beef industry.

Other than its equity in the BREEDPLAN Core Analytical Software, NSWDPI only has equity interest in a service provider to the value chain, AGBU. As discussed in Section 5.2.1.2.3, arguably NSWDPI has the weakest strategic and fiduciary alignment with BREEDPLAN. While BREEDPLAN is a national initiative rather than just focused on New South Wales, the objectives of BREEDPLAN align with the New South Wales' government's objectives for its beef industry (which is a very significant component of the national industry) and the New South Wales government is a supporter of and participant in the livestock innovation system that revolves around the UNE campus in Armidale. However, as a State Government agency, the NSWDPI's fiduciary duty is to the government of New South Wales. While this does not conflict with the objective of optimising the rate of genetic gain in the Australian beef industry, NSWDPI does not have a fiduciary duty to endeavour to do so.

AGBU benefits from ABRI being obligated to enter into a service contract with it under the Licensing Agreement as well as substantial grants it receives from MLA to undertake ongoing research and development that supports BREEDPLAN. AGBU has also performed a very significant role in the development of BREEDPLAN, providing it with a sense of 'equity' in BREEDPLAN. AGBU undertakes industry focused applied research, application development and training in livestock genetics. While most of AGBU's activity in these areas revolves around the Australian beef cattle and sheep industries, it also undertakes such activity in the Australian pig, dairy, poultry, aquaculture, tree and honeybee industries. It also provides services to international livestock industries. BREEDPLAN is not necessarily a priority for AGBU and it does not have a fiduciary obligation to optimise the rate of genetic gain in the Australian beef industry. Rather, its fiduciary obligation is to its owners, UNE and NSWDPI.

As discussed in Section 5.2.3, ABRI is a not-for-profit business that is wholly owned by UNE. ABRI certainly has a significant strategic alignment with BREEDPLAN as it provides a number of information technology products that are integrated with or complementary to BREEDPLAN functionality. Furthermore, beef sector information services, including BREEDPLAN and its integrated and complementary products account for a significant portion of its income. However, its fiduciary duty is to its owner, UNE, and it does not have a fiduciary obligation to optimise genetic gain in the Australian beef industry.

Finally, as discussed in Section 5.2.4, breed associations owe their fiduciary duty to their members. This has two implications with respect to their alignment with the purpose of the BREEDPLAN value chain. Firstly, breed associations have a primary obligation to protect and promote the breed. This can result in resistance to initiatives such as potential cross-breed BREEDPLAN evaluation or allowing BREEDPLAN access to the non-registered sector, which may be counter to optimising the rate of genetic gain. Secondly, the extent to which any breed association is strategically aligned with BREEDPLAN, depends on the degree to which the individual breed association's members value BREEDPLAN and this is variable across the breeds. This is variable across the breeds and over time as individual breed association politics change.

Obviously, the strategic and fiduciary misalignment that is evident has not prohibited BREEDPLAN from being delivered to market through this value chain. Indeed it has resulted in penetration that is as high as a quantitative genetics service in any beef industry globally. However, it is clear that the

strategic and fiduciary misalignment is adequate to act as a barrier to optimal penetration and usage of BREEDPLAN.

6.2.4.3 Absence of a Joint Venture or Shareholders Agreement among the Owners

There does not appear to be a formal agreement in place between MLA, UNE and NSWDPI that transfers the equity holdings to each of the parties and governs their relationship. Such an agreement would normally take the form of a joint venture agreement or shareholder's agreement depending on the structure that holds the assets in which they have interest. While this is probably not entirely uncommon, it would seem that the following circumstances would necessitate such an agreement:

- The intellectual property in which MLA, UNE and NSWDPI have an agreed interest has been developed by levy-payer and taxpayer resources and continues to be supported through these resources via the research and development agreement between MLA and AGBU;
- MLA, UNE and NSWDPI are quasi-public entities, indicating a need for more robust management of equity interests;
- The fact that since 2010, MLA has received preferential royalty payments suggests that its equity instrument is of a different class than that of UNE and NSWDPI and the rights and obligations associated with this different class of instrument should be clearly documented, at least so that the additional royalty income that MLA receives cannot be construed as anything other than royalty income and that MLA has an obligation to continue to fund research and development that underpins BREEDPLAN; and
- Most importantly, the Owners have material equity and contractual interests in other organisations in the value chain, including those that are counter-party to, or benefit from the exclusive licensing agreement pertaining to the BREEDPLAN Core Analytical Software. A process for managing these conflicts between the Owners should be established and clearly documented.

6.2.4.4 Are the University of New England's Interests along the Value Chain Dis-functional?

While NSWDPI has 50 percent interest in AGBU, which by virtue of the clause in the licensing agreement that requires ABRI to enter into a service agreement with AGBU, is a beneficiary of the licensing agreement, this is probably manageable. The conflict that has the potential to be substantially more problematic is that of UNE. This conflict is as follows:

- UNE holds a 24.5 percent interest in the BREEDPLAN core analytical software;
- UNE holds a 100 percent interest in ABRI, the counterparty to the exclusive licensing agreement for the BREEDPLAN core analytical software;
- While the constitution of ABRI prevents a dividend of any kind being paid to UNE, in the case of ABRI winding-up any remaining assets must be transferred to a (preferably) UNE controlled entity, incorporated or otherwise, with the same basic purpose as ABRI, which is not necessarily just about advancing BREEDPLAN and genetic gain in the Australian beef industry; and
- While there are triggers for the Owners to terminate the licensing agreement between themselves and ABRI, the agreement can only be terminated by the unanimous consent of all parties, including UNE, the ultimate beneficiary of the licensing agreement.

While there is no evidence of this conflict having ever been an issue, if a major dispute along the value chain was to arise it would very rapidly become a major issue. This is a particular concern given the value chain is the result of and continues to be supported by taxpayer and levy-payer funds.

6.2.4.5 Are the Exclusive Arrangements Resulting in Monopoly Power?

There are single-party exclusive arrangements along the entire BREEDPLAN value-chain. For example:

- As discussed in Section 5.2.1.1, the Owners have granted ABRI a world-wide exclusive license to 'commercialise' the BREEDPLAN Core Analytical software;

- As discussed in Section 5.2.4, to effectively use BREEDPLAN, breed associations must also use the ABRI pedigree database system for animal registrations. While this is not a contractual requirement it is a practical reality as very few breed associations have adequate internal resources to develop a proprietary pedigree database system, or integrate third party software with ABRI's system. As discussed in Sections 5.1.3.2 and 5.2.3, ABRI offers a range of other complementary software products, but these are not essential to the effective use of BREEDPLAN.

- As discussed in Section 5.2.1.1, while there is nothing in the BREEDPLAN Core Analytical software licensing agreement that prohibits ABRI from sourcing additional technical services from a third party, the licensing agreement compels ABRI to enter into a service arrangement with AGBU.

- As discussed in Section 5.2.4, the service arrangements between ABRI and the breed associations effectively mean that it is very difficult for a seed-stock or commercial producer who is not a member of a breed association to access BREEDPLAN, and in any event not possible for them to participate in an extensive across-breed BREEDPLAN evaluation.

As observed in Section 5.4.2, this exclusivity along the value chain has created a perception among some that the extensive exclusivity is resulting in a lack of competition in the development and delivery of BREEDPLAN, leading to monopoly-style pricing. Again, this perception is reinforced by an observation that BREEDPLAN is more expensive that its counterpart in the sheep seed-stock industry, Sheep Genetics.

However, there is also a counter-view that, because the Australian beef cattle seed-stock sector is relatively small, the exclusivity is necessary from the following perspectives:

- The small market could not sustain competitive deliverers of BREEDPLAN; and
- Because of the small market, parties require exclusivity to be adequately 'commercially; motivated to participate in the value-chain.

Furthermore, as far as the exclusivity that applies to the BREEDPLAN core analytical licensing software between the owners and ABRI is concerned means that multiple providers of EBVs could emerge, resulting in multiple, non-comparable analysis and multiple market information 'languages' that is not in the interests of optimising genetic gain across the industry.

6.2.4.6 Inconsistent Terms of Use for End-users

As discussed in Section 5.2.4, the terms through which breed associations are able to provide their members with access to BREEDPLAN are the subject of exclusive commercial arrangements between ABRI and the individual breed association. These arrangements vary across breed associations, and as demonstrated in Section 5.5.2 mean that different breed associations face different financial dynamics

with respect to the delivery of BREEDPLAN in terms of both quantum of cost and ratio of fixed to variable costs. The specific terms of each agreement seem to be more of function of what has been negotiated between ABRI and the breed association, including negotiations pertaining to the total ABRI service package, rather than any set formula basic on a metric like volume.

Furthermore, as discussed in Sections 5.3 and 5.5.2, the breed associations themselves deliver BREEDPLAN to their members under different terms, ranging from full cost-recovery to almost full subsidisation.

The net result of this is that, seed-stock and commercial producers across the Australian beef industry pay different rates for BREEDPLAN depending on which breed they are producing (and therefore which breed association they belong to). Obviously higher levels of adoption and greater rigour of use is more likely in the breeds that face lower BREEDPLAN costs.

6.2.4.7 Concentration of Value Chain Surplus

Even though the analysis in Section 5.5 is only an estimate and as noted in the introduction to that section has some significant limitations, it is reasonably evident that:

- As has been discussed throughout this analysis, it is very difficult for seed-stock or commercial producers to identify the extent of any surplus that is attributable to using BREEDPLAN;
- Breed associations face varying financial dynamics with respect to the delivery of BREEDPLAN to their members, but in the vast majority of cases, this activity is at least partially subsidised by the breed association;
- MLA receives the vast majority of the royalty that is payable to the Owners, but this revenue does not cover the annual investment that MLA makes in research and development grants that support the ongoing development of BREEDPLAN and its investment in TBTS and SBTS; and
- All of the value-chain surplus is concentrated with ABRI and this surplus is possibly at a rate that is comparable to commercial entities operating in similar industries.

If the estimate in Section 5.5 is broadly accurate, this raises the following three key questions:

- Is the full surplus being reinvested in the development of BREEDPLAN and improvement in BREEDPLAN service delivery;
- Should the surplus be redistributed along the value chain, so that it is shared more equitably with other value-chain participants; or
- Should the surplus be used to deliver price relief to the end-customer (seed-stock and commercial producers who use BREEDPLAN)?

7 Options Analysis

The issues discussed in Section 6 can be wholly are partly addressed through two principle mechanisms.

- The current value chain that delivers BREEDPLAN to market could be collapsed by the Owners using the triggers in the BREEDPLAN Core Analytical Software license to cancel that license, effectively removing ABRI's ability to continue to offer BREEDPLAN. The Owners could then

seek to either commercialise BREEDPLAN through another party, or internalise the delivery of BREEDPLAN in MLA under a model similar to which Sheep Genetics is delivered to market.

- The value chain can work collaboratively, to adopt a more strategic rather than transactional approach to delivering BREEDPLAN that better aligns the value chain participants' interests and addresses most of the issues identified in Section 6.

Each option and its merits and challenges are discussed in the following subsections. It should be noted that this section only identifies and briefly discusses the options. Once the Owners have determined the appropriate pathway, a deeper examination of the option and an implementation plan will be developed for the Owners' consideration.

7.1 Termination of Current Licensing Agreement

Terminating the exclusive licensing agreement between the Owners and ABRI would have the effect of prohibiting ABRI from continuing to offer BREEDPLAN products and services, effective collapsing the existing value chain. The mechanism for doing this is prescribed in Clause 12 of the Licensing Agreement (see Appendix 2 in Section 9.2) that provides the Owners with the power to terminate if they cannot reach an agreement of the annual operating plan pertaining to the delivery and development of BREEDPLAN as prepared by ABRI. This review process commences in October of each year and would presumably take several months to effect after the prescribed review process of one month and adequate time for negotiations in good faith.

However, this process is not without some potential legal obstacle. As discussed in Section 6.2.4.4, UNE is an Owner of BREEDPLAN and the owner of the licensee, ABRI. Clause 22 of the Licensing Agreement requires termination of the Licensing Agreement to be by consent of all three owners. Obviously, UNE has a significant conflict of interest in this decision, but could substantially frustrate, if not prevent termination if it so desired.

In any event, for the following reasons, collapsing the existing value chain that delivers BREEDPLAN to market would be expensive and represent a significant risk of service disruption, if not catastrophic service failure:

- The existing value chain has been operating for three decades. As a result there are established product and service delivery systems and protocols that the market is accustomed to and transitioning these systems and protocols to a new structure, or transitioning the market to adopt new systems and protocols under a new delivery mechanism would take considerable time, require considerable investment and present significant continuity of service risk.

- The equity and licensing arrangements that exist along the value chain are complex and their reconfiguring to accommodate a new delivery model would absorb both financial and time resource and in some cases may not be achievable, potentially resulting in a compromised product.

- Data ownership along the value-chain is complex and its use outside of the value-chain would require the consent of the different owners, which in some case is unlikely to be forthcoming.

- AGBU, ABRI and many of the breed associations have invested significantly in developing and promoting BREEDPLAN over the course of three decades. As a result, these organisations justifiably have a sense of equity in BREEDPLAN and would likely react adversely to the value-chain being totally dismantled. This would cause further problems for BREEDPLAN's credibility in the market-place.

Furthermore, the fact that despite some of the perceived deficiencies associated with the current value chain that have been discussed in this analysis, the fact is that the current value chain has delivered BREEDPLAN to market and has achieved reasonable market penetration. While there is a widely-held perception that penetration is not optimal, BREEDPLAN is not being used as rigorously as it could be and therefore the rate of genetic gain is not being optimised, the fact is that the value chain has delivered BREEDPLAN to market.

Nevertheless, given that collapsing the current value chain is an option, this analysis would be remiss not to discuss the two main alternative delivery mechanisms. These are to tender out delivery of BREEDPLAN to a commercial entity, or to internalise the operation of BREEDPLAN within MLA and deliver BREEDPLAN under a similar model to SHEEP GENETICS. These options are discussed in the following subsections.

7.1.1 Tender Out for Commercialisation

The natural acquirer of the BREEDPLAN business is a company operating in the livestock genetics industry. As discussed in Section 1.3.2, there has been considerable growth in the livestock genetics industry over the past decade, driven by:

- The significant advances in livestock genetics technology;
- Increased demand for products and services designed to help producers profitably produce larger volumes of animals that meet very specific market specifications that is derived from the increasing global market demand for animal based food; and
- A greater awareness among livestock producers of the genetic influences on veterinary diseases and disorders.

The macro-trends in the global livestock genetics industry appear prima facie to be favourable to the genuine commercialisation of BREEDPLAN. For example:

- The live animal segment is the largest and fastest growing segment of the global livestock genetics industry;
- The Asia Pacific region is the fastest growing region; and
- Products and services targeting bovine species is a major focus of the industry more generally.

However, much of the focus of these firms is the development of proprietary lines of breeding animals or genetic testing services. BREEDPLAN is a service provider to proprietary lines of breeding animals and a user of genetic testing services. As such, while BREEDPLAN is part of the 'ecosystem' of an attractive segment of the livestock genetics industry, it is not operating in the space where the most attractive returns are being generated.

Also, while the analysis in Section 5.5.3 suggests that ABRI may be generating a surplus that is consistent with commercial returns, for the following reasons, the ABRI surplus would not necessarily translate to a financial investment style return:

- The full enterprise of BREEDPLAN is still reasonably subsidised by virtue of MLA's investment in research and development that supports the ongoing development and delivery of BREEDPLAN, as well as MLA's investment in marketing and training that supports the delivery of BREEDPLAN (SBTS and TBTS)

- Because ABRI is a not-for-profit organisation, it does not pay taxation and therefore its returns are pre-tax. In a commercial setting, and assuming there is not an inventory of R&D taxation credits or other deductions, that margin would be reduced by around 30 percent, rendering it less attractive.

- The Australian beef cattle seed-stock sector is a relatively small total addressable market. Therefore, even if good margins could be achieved, the actual quantum of the margin would unlikely be attractive to a major player in the global livestock genetics industry.

As such, it is highly likely that in order to generate an adequate financial return, a commercial enterprise operating BREEDPLAN would need to increase prices, which is not in the interests of optimising the rate of genetic gain.

While BREEDPLAN's delivery and profitability may be able to enhanced by a large global company who can integrated BREEDPLAN with its own operating systems, products and global market channels, these factors limit the attractiveness of BREEDPLAN as a commercial investment. BREEDPLAN may also represent an attractive strategic investment, but this has not been assessed as part of this analysis.

The other main limitation to this option is that by commercialising BREEDPLAN, the Owners' control over how and to who BREEDPLAN is offered will almost certainly be limited and its ongoing delivery will face uncertainty associated with potential failure of the enterprise delivering BREEDPLAN or a decision by that enterprise to not invest in the ongoing development and delivery of BREEDPLAN. Any conditions in a licensing agreement that try to prescribe this are likely to be perceived as uncommercial, given the existing limitations BREEDPLAN has with respect to producing financial investment style returns.

Commercialising BREEDPLAN is unlikely to be in the best interests of optimising the rate of genetic gain across the Australian beef industry.

7.1.2 Internalise Delivery within MLA

If the current Licensing Agreement was to be terminated, BREEDPLAN could theoretically be delivered by MLA under an arrangement similar to which Sheep Genetics is delivered. At the most basic level, this would involve MLA operating the service delivery component of BREEDPLAN as an internal business unit and outsourcing the core processing to AGBU.

Some would see this as an attractive option, primarily, because it would:

- Allow BREEDPLAN to be accessed by any commercial or seed-stock producer, allowing penetration in the unregistered sector;
- Give MLA control over the innovation and product development agenda, potentially resulting in more timely innovation and product development that is better aligned with the objective of accelerating the rate of genetic gain across the industry; and
- Potentially result in a cheaper BREEDPLAN product for the seed-stock and commercial producer end-users.

However, for the reasons cited in the introduction of this section, transitioning the delivery of BREEDPLAN to this model would be complex and consume considerable resource. It would involve negotiating access to breed association databases and developing a new set of value chain relationships. Given the volume of data, the transaction cost associated with combining registered and non-registered data under a new delivery model would likely prove prohibitive and contra-out any productivity divided that might be accrued by the shorter value chain.

It would also likely cause resentment among the existing value-chain participants and possibly many customers whose primary customer loyalty and trust resides with their breed association.

Furthermore, while BREEDPLAN could be delivered on a cost recovery basis by MLA and there is case precedence for this model in the form of SHEEP GENETICS, many MLA stakeholders would argue that levy payer or Donor Company funds should not be invested in the cost of transition and that in any event, operating BREEDPLAN is not MLA's core business.

7.2 BREEDPLAN Value Chain Re-invigoration Program

As discussed in Section 7.1, the option of terminating the current Licensing Agreement carries significant risk. Furthermore, if the Licensing Agreement was terminated, the drawbacks and risks associated with the alternative delivery mechanisms seem to outweigh any potential benefits. However, this doesn't by any means imply that the default action is business as usual.

There is adequate evidence that the current value chain is not delivering optimally with respect to maximising the rate of genetic gain. Furthermore, while the structure of the existing value chain is not the cause of all of the factors that limit BREEDPLAN's ability to optimise the rate of genetic gain, it contributes to some and can be modified to address others.

As such it is recommended that a BREEDPLAN value chain reinvigoration program be designed and implemented. This program would be underpinned a strategic approach to managing the value chain and consist of the key elements discussed in the following subsections. If the Owners determine that this the best course of action, the elements will be further explored and elaborated on, and an implementation plan designed in the next, final stage of this project.

7.2.1 Strategic Approach to Managing the BREEDPLAN Value Chain

The BREEDPLAN value-chain currently operates primarily on a transactional basis, where BREEDPLAN is delivered to the market through a series of transactional arrangements that cascade along the value-chain from the licensing agreement between ABRI and the Owners. A strategic approach would involve

all the participants agreeing to the strategic intent of the value chain and aligning their interests with that strategic intent. Transactional agreements between value-chain participants then articulate terms, including performance criteria and incentives that reinforce that alignment.

It is important to note that by virtue of their ability to terminate the BREEDPLAN Core Analytical Software Licensing Agreement, the Owners' hold the 'stick' with respect to driving this change. However, the change is unlikely to be successful unless the specific initiative designed to give effect to the change are adequately resourced and there are incentives for the downstream value chain participants to embrace the changes.

7.2.2 Owners Agreement

As discussed in Section 6.2.4.3, there is no evidence of a formal agreement between MLA, UNE and NSWDPI that governs their relationship as the Owners of BREEDPLAN. If the BREEDPLAN Core Analytical Software intellectual property was to be vested in a company in which MLA, UNE and NSWDPI were issued shares according to their current equity interests, this agreement would take the form of a shareholder's agreement. If the interests of the Owners were to remain as they are, a joint venture agreement would be the most appropriate instrument.

This agreement is necessary for the following reasons:

- As discussed in Section 6.2.4.2, the fiduciary and strategic interests of the Owners are not necessarily aligned. As such, the specific objectives of 'commercialising' BREEDPLAN and the priorities among those objectives should be formally agreed between the Owners in an overarching agreement that governs their relationship at the asset level, not merely as the objects of a licensing agreement;
- By virtue of an agreement to accrue a greater portion of the pro rata royalty entitlement to MLA, royalty payments are not proportional to the equity holdings. This arrangement needs to be formally documented;
- By virtue of interests along the value chain, NSWDPI and UNE have conflicts of interest in Owner decisions pertaining to the Licensing Agreement. This is particularly problematic for UNE who has a 24.5 percent equity interest in the BREEDPLAN Core Analytical Software, 100 percent equity interest in the licensee (ABRI) and a 50 percent interest in a service provider to ABRI that is prescribed in the licensing agreement (AGBU). NSWDPI has a 50 percent interest in AGBU. In lieu of UNE divesting its interests in either the BREEDPLAN Core Analytical Software or ABRI, there should be documented processes for managing the conflicts faced by NSWDPI and UNE in decision-making pertaining to the Licensing Agreement;
- There should be documented agreement on the normal conditions pertaining to the potential disposal of equity interests in the BREEDPLAN Core Analytical Software such as pre-emptive rights, rights of first refusal and tag-along and drag-along rights; and
- Processes and rights with respect to various areas of decision-making should be agreed and documented.

The existence of such an agreement clearly articulates to the value chain the Owner's intent with respect to allowing use of the Core Analytical Software and removes owner action uncertainty with respect to the reinvigoration process.

7.2.3 Financial Transparency

As highlighted in Section 5.5, other than the licensing agreement between the Owners and ABRI, all other transactions that govern the relationship between participants in the BREEDPLAN value chain are strictly confidential. Furthermore, the financial dynamics of each participant is kept confidential.

This confidential, transaction approach to managing the value chain has resulted in a concentration of the value-chain surplus with a single value-chain participant, significant distrust and along the value-chain and terms of BREEDPLAN usage that are inconsistent across the industry and not in the best interest of optimising the rate of genetic gain across the industry. As discussed in Section 5.5, for value chains to be sustainable, participants must be adequately motivated to remain part of the value-chain.

A more strategic approach to managing the BREEDPLAN value-chain would see a higher degree of financial transparency along the value chain. This does not necessarily mean full financial disclosure to counter-parties along the value-chain. But certainly a set of standardised financial reporting metrics would go a long way to addressing the current absence of financial transparency and the problems that causes.

7.2.4 Consistent pricing to breed associations

The optimisation of adoption of BREEDPLAN requires, consistent cost of using BREEDPLAN across the breeds. This should be the starting point and its level determined by working back up the value chain based on operating costs and required surplus at each stage of the value-chain.

7.2.5 Accessing the Unregistered Sector

While the size and trajectory of the unregistered sector is unknown, there is ample evidence to suggest that it may become an increasingly important market for BREEDPLAN to access, particularly in the northern sector. The value-chain needs to determine how it will achieve this. In the absence of a true cross-breed evaluation, establishing a direct service based on a database for all unregistered animals would seem to have limited value. It may be that breed associations will need to evolve their business models to cater for unregistered, cross-bred and composite animals by establishing different databases, and allowing an evaluation system to interrogate their registered animal database and through formal arrangements, the databases of other relevant breeds so that cross bred and composite animals can be compared with the appropriate pure bred animals.

This involves the consideration of two issues with respect to broadening an evaluation beyond the pedigree databases of individual breed associations. The first is the inclusion of unregistered animals that may or may not be purebred and the other is the ability to compare EBVs of animals of different breeds. As discussed throughout this analysis, both are contentious and giving effect to either will involve further investment in research and development.

7.2.6 Develop and Invest in a Value Chain Owned Innovation and Product Development Plan

The perception of a slow and selective innovation and product development cycle associated with BREEDPLAN can be addressed by the value chain participants collectively agreeing on the priorities

and making sure those priorities are addressed in the interests of all BREEDPLAN users and in the interests of optimising the rate of genetic gain across the industry.

Giving effect to this, may require a resetting of the current intellectual property arrangements along the value-chain so that the opportunity for innovation is optimised, as well as agreements between ABRI and individual breed associations. It is also further complicated by different breed associations having different capacity to pay and indeed, different innovation and product development priorities.

7.2.7 Resourcing of Breed Associations to Promote and Support BREEDPLAN Usage

While most of the main breed associations have an interest in SBTS or TBTS, the fact that SBTS and TBTS are the subject of some criticism and market research suggests that breed associations are the most trusted source of advice for seed-stock producers and some commercial producers, indicates that if they were adequately resourced to do so, breed associations would be a more effective mechanism for promoting BREEDPLAN and encouraging and supporting their members to use BREEDPLAN rigorously.

However, the effectiveness of such a proposal is dependent on the degree to which an individual breed association is supportive of its members using BREEDPLAN. The fact that some breed associations have mixed views on the usefulness of BREEDPLAN means that any funding would need to be conditional on the degree of support for BREEDPLAN and an alternative source of training might need to be made available for members of breed associations that want to use BREEDPLAN, but their breed association does not demonstrate the degree of support for BREEDPLAN that is necessary to attract the proposed training and promotional funding.

7.2.8 Responsibly introduce competition along the value chain

Once the value chain has been reset according to the initiatives described in Section 7.2.1 to 7.2.7, a project to identify if competition can be introduced to various levels of the value chain such that it does not disrupt or reduce the quality of the product delivered by the value chain, but improves value for money for the end-user should be undertaken. However, this should not be contemplated until the reinvigoration program is completed, as to do so prematurely would only increase uncertainty for existing participants in the BREEDPLAN value chain. For the purposes of clarity, competition would only be considered with respect to elements of service delivery that comprise the BREEDPLAN value chain, not to the BREEDPLAN service itself, as a single evaluation and evaluation language is critically important to maximising the rate of genetic gain.

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9 Appendices

9.1 Appendix 1 - BREEDPLAN Estimated Breeding Values

The following Table 35 summarises the individual Estimated Breeding Values (EBVs) that are available through BREEDPLAN.

Breeding Value	Description
	Weight
Birth Weight	Calf birthweight is the largest genetic contributing factor causing calving difficulties in heifers. However, lower birthweight is also generally associated with lower overall growth potential. Birthweight EBVs are expressed in kilograms and are calculated based on weights of calves taken at birth. Small or moderate birthweight EBVs are favourable.
200 Day Milk	200 Day Milk EBVs are estimates of an animal's maternal effect on the 200 day weight of its calf. In the case of sires, this estimates the maternal effect that his daughters will have on the 200 day weight of their progeny. The 200 Day Milk EBV is expressed as kilograms of live weight at 200 day (i.e. the expected difference in the weight of the calf at 200 days due to maternal effect – milk – of the cow) and is calculated by portioning the difference in 200 day weigh of calves into growth and milk components. Larger, more positive, 200 Day Milk EBVs are generally more favourable, depending on the environment. The optimum level of milk production potential among beef cows is dependent upon the production system and environment in which the cows are run. Selection for increased milk production may be warranted when cows are run under good nutritional conditions and calves are sold as weaners. However, some environments may not support high milking cows.
200 Day Growth	Generally speaking, all other things being equal, higher growth rates will lead to higher profitability. 200 Day Growth Rate EBVs are estimates of genetic differences between animals in live weight at 200 days of age dues to their genetics for growth. The 200 Day Growth EBVs are expressed in kilograms and are calculated from the weights of calves taken between 80 and 300 days of age. It is a measure of an animal's early growth to weaning and is an important trait for breeders turning off animals as vealers or weaners. Larger, more positive, 200 Day Growth EBVs are generally more favourable.
400 Day Growth	400 Day Growth EBVs are estimates of the genetic differences between animals in live weight at 400 days of age. 400 Day Weight EBVs are expressed in kilograms and are calculated from the weights of calves taken between 301 and 500 days of age. This is an important EBV for breeders turning off animals as yearlings. Larger, more positive, 400 Day Weight EBVs are generally more favourable.
600 Day Growth	600 Day Weight EBVs are estimates of the genetic difference between animals in live weight at 600 days of age. The EBV is expressed in kilograms and is calculated from the weights of calves taken between 501 and 900 days of age. This is an important EBV for breeders targeting the production of animals suited for heavy weight grass or grain fed markets. Larger, more positive, 600 Day Weight EBVs are generally more favourable.
Mature Cow Weight	Mature Cow Weight EBVs are estimates of the genetic difference between cows in live weight at 5 years of age. The EBV is expressed in kilograms and is calculated from weights taken on the cow when her calf's 200 day (weaning) weight is being measured. Mature Cow Weight EBVs are an indicator of: ▪ Cow Feed Requirements whereby in general, lighter cows will tend to eat less and consequently have lower feed requirements and be less expensive to maintain. ▪ Cull Cow Values whereby the major determinant in the value of cull cows in a commercial herd will be live weight. Consequently, heavier cows may provide higher returns from the sale of cull cows.
	Fertility/Calving
Scrotal Size	Scrotal size EBVs are estimates of the genetic difference between animals in scrotal circumference at 400 days of age. Scrotal Size EBVs are expressed in centimetres and are calculated from scrotal circumference measurements taken on bulls between 300 and 700 days of age. Increased scrotal circumference is associated with increased semen production in bulls and earlier age at puberty of bull and heifer progeny. It also has favourable relationship with days to calving, such that bulls with larger scrotal circumferences tend to have daughters with shorter days to calving.
Days to Calving	Days to Calving EBVs are estimates of genetic differences between animals in time from the start of the joining period (i.e. when the female is introduced to the bull) until the subsequent calving. Days to Calving EBVs are expressed in days and are calculated from the joining records submitted for females. The Days to Calving EBV promotes those cows that calve earlier in the season compared to those that calve later, while penalising those cows that do not calve. Variation in days to calving is mainly due to differences

Breeding Value	Description
	in the time taken for female to conceive after the commencement of the joining period. Lower, or more negative, Days to Calving EBVs are generally more favourable.
Calving Ease	Calving difficulty has a significant impact on the profitability of a herd through increased calf and heifer mortality, slower re-breeding performance and considerable additional labour and veterinary expense. Calving Ease EBVs are calculated from data pertaining to calving difficulty score, birth weight and gestation length.
Gestation Length	Shorter gestation length is generally associated with lighter birth weight, improved calving ease and improved re-breeding performance among dams. Calves born with a shorter gestation length are often heavier at weaning due to more days of growth. Gestation Length EBVs are estimates of genetic differences between animals in the number of days from the date of conception to the calf birth date. They are expressed in days and are calculated from the joining date and bird date records for calves conceived by either AI or Hand Mating.
	Carcase
Carcase Weight	Carcase Weight EBVs are estimates of the genetic differences between animals in hot standard carcase weight (as defined by AUSMEAT) at 650 days of age (it is not a measure of yield). Carcase Weight EBVs are expressed in kilograms. Larger, more positive, Carcase Weight EBVs are generally more favourable.
Eye Muscle Area (EMA)	EMA EBVs are estimates of the genetic difference between animals in eye muscle area at the 12/13th rib site in a standard weight steer carcase. EMA EBVs are expressed in square centimetres. Larger, more positive, EMA EBVs are generally more favourable. For example, a bull with an EMA EBV of +4cm^2 would be expected to produce steer progeny with a greater degree of muscle expression than a bull with an EMA EBV of +1cm^2, relative to carcase weight.
Rib Fat	Rib Fat EBVs are estimates of the genetic differences between animals in fat depth at the 12/13th rib site in a standard weight steer carcase. Rib Fat EBVs are expressed in millimetres. More positive or more negative Rib Fat EBVs may be more favourable, depending on your breeding goals relating to the finishing ability of your animals. A bull with a Rib Fat EBV of -0.4mm would be expected to produce leaner calves than a bull with a Rib Fat EBV of +0.4mm, relative to carcase weight.
Rump Fat	Rump Fat EBVs are estimates of the genetic difference between animals in fat depth at the P8 rump site in a standard weight steer carcase. Rump Fat EBVs are expressed in millimetres. More positive or more negative Rump Fat EBVs may be more favourable depending on the breeding goals related to the finishing ability of the animals. A bull with a Rump Fat EBV of -0.6mm would be expected to produce leaner calves than a bull with a Rump Fat EBV of +0.6mm, relative to carcase weight. Stock with positive fat EBVs are likely to produce progeny that are fatter, or more early maturing on average that stock with lower or negative fat EBVs. Increasing fat depth leads to a decrease in retail beef yield, however, most market specifications require a minimum fat depth. Breeders aiming to breed leaner, higher yielding cattle may select for lower fat EBVs. Breeders wishing to finish their animals earlier may tend to select animals with moderate fat EBVs. Caution should be placed on selecting for extremely low fat EBVs for replacement females as they may indicate females that are more difficult to get in calf. Differences between Rib Fat EBVs and Rump Fat EBVs can indicate differences in fat distribution among animals.
Retail Beef Yield (RBY)	RBY EBVs are estimates of genetic differences between animals in boned out retail beef yield in a standard weight steer carcase. RBY EBVs are reported as differences in percentage yield. Larger, more positive RBY EBVs are generally more favourable.
Intramuscular Fat (IMF)	Intramuscular Fat (IMF) EBVs are estimates of genetic differences between animals in intramuscular fat (marbling) at the 12/13th rib site in a standard weight carcase. IMF EBVs are reported as differences in percentage IMF. Larger, more positive, IMG EBVs are generally more favourable. For markets where marbling is important such as Japanese B2/B3 market, restaurant trade and MSA, higher IMF EBVs can contribute significantly to carcase value.
Shear Force	Shear Force EBVs are estimates of genetic differences between animals in meat tenderness. Shear Force EBVs are expressed as differences in the kilograms of shear force that are required to pull a mechanical blade through a piece of cooked meat and are calculated from shear force measurements (i.e. objective abattoir measures of meat tenderness), gene information and flight time records. Lower, more negative shear force EBVs are more favourable.
	Other
Docility	Docility EBVs are estimates of genetic differences between animals in temperament. Docility EBVs are expressed as differences in the percentage of progeny that will be scored with acceptable temperament (i.e. either docile or restless) and are calculated from temperament scores recorded on animals using a crush or yard test when the animals are between 60 and 400 days of age (preferably at weaning). Docility in cattle is the way cattle behave when being handled by humans or put in an unusual environment such as being separated from the mob in a small yard. Poor docility in the wild is a survival trait – fear of anything unusual and the desire to escape. In domesticated cattle it is exhibited in flightiness. It is a highly heritable trait and so can be improved genetically. Higher, more positive, Docility EBVs are more favourable.
Flight Time	Flight Time EBVs are estimates of the genetic differences between animals in temperament. Flight Time EBVs are expressed as differences in the number of seconds taken for an animal to travel approximately 2.0 metres after leaving the crush and are calculated from flight time measurements that have been recorded on animals using specialised flight time equipment.

Breeding Value	Description
	Flight time is a simple, cost effective and easy to record objective measurement of temperament. Longer fight time implies ease of handling and management and animals with longer flight time also demonstrate superior meat quality. Higher (longer) flight times are preferable.
Net Feed Intake (Post Weaning)	Feed efficiency is recognised as one of the most economically important production traits, both in grazing enterprises and feedlot operations. Net Feed Intake (Post Weaning) (NFI-P) EBVs are estimates of genetic difference between animals in feed intake at a standard weight and rate of weight gain when animals are in the growing phase. For example, animals placed in a feedlot post weaning. They are expressed in kilograms of feed intake per day. Lower, or more negative, NFI-P EBVs are more favourable.
Net Feed Intake (Feedlot Finishing)	NFI EBVs are estimates of genetic differences between animals in feed intake at a standard weight and rate of weight gain when animals are in a feedlot finishing phase. NFI-F EBVs are expressed as kilograms of feed intake per day. Lower, more negative, NFI-F EBVs are more favourable.
Structural Soundness	Since cattle were first domesticated, it has been recognised that animals should conform to certain structure requirements to ensure high levels of production and adaptability to the environment. If structural integrity is not maintained, substantial financial loss can occur from issues such as bulls not being able to cover the allocated cows resulting in low conception rates, steers being unable to finish a long feeding program, or cows with badly structured udders being unable to rear their calves properly. Structural Soundness EBVS are provided for five important structural traits: ▪ Front Feet Angle (FA) ▪ Front Feet Claw (FC) ▪ Rear Feet Angle (RA) ▪ Rear Leg Hind View (RH) ▪ Rear Leg Side View (RS) Structural Soundness EBVs are reported as an estimate of genetic difference between animals in the percentage of progeny that will have a desirable score for a particular trait and are calculated from structural scores recorded on animals by an accredited scorer when the animals are younger than 750 days of age. Higher Structural Soundness EBVs are more favourable.

Table 35 – BREEDPLAN Estimated Breeding Values

9.2 Appendix 2 – Key Terms and Conditions of the Core Analytical Software Licensing Agreement

The following Table 36 summarises the key terms and conditions of the BREEDPLAN Core Analytical Licensing Agreement.

Term	Description
Clause 2: Objective	The objective of the licensing agreement is to (a) ensure that the software is commercialised, exploited and distributed to the Australian beef industry for the purpose of maximising the rate of genetic progress towards breeding objectives that are relevant to the needs of the industry; and (b) maximise the commercialisation, exploitation and distribution of the software in the beef industry outside of Australia.
Clause 3: License	ABRI is granted an exclusive, worldwide license to use, commercialise, exploit and distribute the software and all upgrades to that software. The owners may use the software for R&D purposes.
Clause 4: Use, Commercialisation, exploitation and distribution of software	ABRI must use best efforts to commercialise, exploit and distribute the software in accordance with the Operational Plan, as well as all upgrades.
Clause 5: Royalties	ABRI must pay to the owners a royalty of 7.5 percent of the revenue in the proportions of MLA (51%), NSWDPI (24.5%) and UNE (24.5%). These equity stakes have since changed. This royalty is to be paid on a quarterly basis in arrears. ABRI must spend at least 2.5 percent of revenue each year on co-ordination of national extension initiatives aimed at promoting a better understanding of BREEDPLAN, BREEDObject and increasing their usage. The way in which ABRI spends this must be detailed in the Operational Plan.
Clause 8: Deliverables	The owners, through AGBU, must provide ABRI the following: ▪ Operationally robust and tested software that can use data in the databases agreed by the parties and provided by the applications software in an interface format agreed by ABRI and AGBU ▪ Operationally robust and tested software that is capable of calculating EBVs, accuracy of EBVs and genetic trends for various traits to be included in BREEDPLAN and GROUP BREEDPLAN evaluations and performs these calculations in a reasonable time on contemporary hardware.

Term	Description
	▪ Operationally robust and tested files of heritabilities, variances, co-variances and any other genetic parameters that are reasonably required for the BREEDPLAN and GROUP BREEDPLAN evaluations of each beed analysed by ABRI in a format that can be used by the software. ▪ The output of EBVs, accuracies and genetic trends in a format that is compatible with the interface format agreed to by ABRI and AGBU for passing results to the application software. ▪ Analytical software which is capable of running efficiently in the hardware/operating system environment agreed by ABRI and AGBU ▪ Command procedures that describe how the software is to be run ▪ Diagnostic software that allows ABRI to determine how particular results have been calculated for all EBVs ▪ Software that can produce data files that allow ABRI to undertake diagnostic work ▪ Up to date documentation that describes the individual components of the software and how they interact, the definition of traits, editing ranges and procedures, software limitations on the traits being analysed, data files used internally by the analytical software, definitions and meanings of parameters used in the software command procedures ▪ Software to provide results that are consistent with the immediate previous run of the analytical software on the dataset of a particular end user.
Clause 9: Improvements	ABRI may make improvements to the software that are additional to upgrades provided by AGBU. AGBU has the first right of refusal to quote on any external software services required by ABRI and ABRI may not engage any other person to perform the work on terms that are more favourable than those quoted by AGBU. ABRI grants a perpetual royalty-free worldwide non-exclusive license to the owners to use or permit others to use any improvements made by ABRI
Clause 12: Operational Plan	In October each year ABRI must provide the owners with an Operation Plan for the next three years that sets out the following information for each module of the analytical software: ▪ The target audience and performance criteria (including adoption rates for the modules) for the commercialisation, exploitation and distribution of the module; ▪ A description of the manner in which the commercialisation, exploitation and delivery of the module will relate to the delivery of other genetic improvement technologies or other technologies of interest to the Australian beef industry; ▪ The marketing strategy for the module, including proposed expenditure on marketing related activities; and ▪ Any other information reasonably requested by the owners. If ABRI fails to submit an operational plan by 15 October or fails to provide information reasonably requested by the owners, the owners may render the license non-exclusive. ABRI must carry out its operations in accordance with the accepted operational plan. Following the submission of the plan, the owners must within one month of its delivery either accept or reject the plan. They may only reject the plan if in their reasonable opinion, the projected revenue is less that what is reasonable given the market conditions. If rejected, the parties must negotiate in good faith to update the operational plan. If they cannot agree the owners may terminate the license or accept the updated plan last offered by ABRI and render the license non-exclusive.
Clause 13: Reports	By 28 February (or within two calendar months after the Licensors notify the Licensee of the following protocols) in each year of the term of this agreement, the Licensee must provide to the Licensors a report of the Licensees progress measured against the previous year's Operational Plan, including: ▪ Adoption rates of the Analytical Software in the previous year for Australia as a whole and for New South Wales; ▪ Genetic progress across all BREEDPLAN traits in all breeds in Australia on a breed by breed basis (and, when available, on a cross-breed basis); ▪ Improvements to the Analytical Software made by or on behalf of the Licensee in the previous year; ▪ Activities undertaken in the previous year to commercialise, exploit and distribute the Analytical Software in the beef industry and other industries overseas; and ▪ Such other information as the Licensors may, from time to time, reasonably request provided that such information does not require the Licensee to breach its contractual obligations to End Users.
Clause 22: Actions by the Licensors	The owners do not have the power to terminate the licensing agreement, convert the licensee's rights from exclusive to non-exclusive, or purchase the Improvements unless they do so jointly.

Table 36 – Key Terms and Conditions of the BREEDPLAN Core Analytical Licensing Agreement

9.3 Appendix 3: MLA Memorandum and Articles of Association, Investment Guidelines and Strategic Plan

9.3.1 Memorandum and Articles of Association

Section 2 Clause 1 of MLA's Memorandum and Articles of Association sets out its objectives as follows:

a) To market and promote the industry in Australia and overseas;
b) To improve the production and quality of meat and livestock in Australia
c) To improve the methods of production, handling, storage, transport and marketing of Australian meat and livestock and to encourage the production of livestock and the marketing of meat and livestock to be more efficient;
d) To represent, promote, protect and further the interests of the industry overseas in relation to the export of meat and livestock from Australia and in relation to the sale and distribution of Australian meat and livestock and the consumption of Australian meat in countries other than Australia;
e) To investigate and evaluate the needs of industry for meat and livestock research and development and to encourage and facilitate the exploitation and commercialisation of the results of meat and livestock research and development;
f) To undertake, coordinate and fund meat and livestock research and development activities;
g) To undertake and carry-out the joint functions and to consult, collaborate and cooperate with producers of livestock, meat processors and meat and livestock exporters and their representatives for the benefit of industry in the performance of the joint functions;
h) To collect information and statistics relating to the industry and to prepare, analyse and distribute information and statistics relating to the industry for the benefit of the industry;
i) To collaborate with Federal and State government, government departments and agencies in relation to animal health and welfare, meat safety and hygiene, crisis and issues management, regulatory activities and any other activities which may be necessary or convenient for the improvement of the productivity or the market performance of the industry; and
j) Generally do all other things that may appear to the company to be incidental or conducive to the attainment of the objects or any of them for the benefit of the industry.

9.3.2 Rural Research, Development and Extension Priorities

The Australian Government has developed producer-oriented priorities to target rural research, development and extension funding. The priories are:

- Advanced technology to enhance innovation of products, processes and practices across the food and fibre supply chains through technologies such as robotics, digitisation, big data, genetics and precision agriculture.
- Biosecurity to improve understanding and evidence of pest and disease pathways to help direct biosecurity resources to their best uses, minimising biosecurity threats and improving market access for primary producers;
- Soil, water and managing natural resources to manage soil health, improve water use efficiency and certainty of supply, sustainably develop new production areas and improve resilience to climate events and impacts; and

- Adoption of R&D focusing on flexible delivery of extension services that meet primary producers' needs and recognising the growing role of private service delivery.

9.3.3 National Science and Research Priorities

The Australian Government has developed a set of Science and Research Priorities (and corresponding Practical Research Challenges) that are designed to increase investment in areas of immediate and critical importance to Australia and its place in the world. These priorities and their practical research challenges are summarised in Table 37 below.

Science and Research Priority	Practical Research Challenge
Food	Knowledge of global and domestic demand, supply chains and the identification of country specific preferences for food Australia can produce. Knowledge of the social, economic and other barriers to achieving access to healthy Australian foods. Enhanced food production through: ▪ Novel technologies such as sensors, real-time data systems and traceability, all integrated into the full production chain. ▪ Better management and use of waste and water, increased food quality, safety, stability and shelf-life. ▪ Protection of food sources through enhanced biosecurity. ▪ Genetic composition of food sources appropriate for present and emerging Australian conditions.
Soil and Water	New and integrated national observing systems, technologies and modelling frameworks across the soil-atmosphere-water-marine systems. Better understanding of sustainable limited for productive use of soil, freshwater, river flows and water rights, terrestrial and marine ecosystems. Minimising damage to and developing solutions for restoration and remediation of soil, fresh and potable water, urban catchments and marine systems.
Transport	Low emission fuels and technologies for domestic and global markets. Improved logistics, modelling and regulation: urban design, autonomous vehicles, electrified transport, sensor technologies, real time data and spatial analysis Effective pricing, operation and resource allocation.
Cybersecurity	Highly-secure and resilient communications and data acquisition, storage and analysis for government, defence, business, transport systems, emergency and health services. Secure, trustworthy and fault-tolerant technologies for software application, mobile services, cloud computing and critical infrastructure. New technologies and approaches to support the nation's cyber security: discovery and understanding of vulnerabilities, threats and their impacts, enabling improved risk-based decision making, resilience and effective responses to cyber intrusions and attacks. Understanding the scale of the cyber security challenge for Australia, including the social factors informing individuals, organisations, and national attitudes towards cyber security.
Energy	Low emission energy production from fossil fuels and other sources. New clean energy sources and storage technologies that are efficient, cost-effective and reliable. Australian electricity grids that readily integrate and more efficiently transmit energy from all sources including low-and-zero-carbon sources.
Resources	Fundamental understanding of the physical state of the Australian crust, its resource endowment and recovery. Knowledge of environmental issues associated with resource extraction. Lowering the risk to sedimentary basins and marine environments due to resource extraction. Technologies to optimise yield through effective and efficient resource extraction, processing and waste management.
Advanced Manufacturing	Knowledge of Australia's comparative advantages, constraints and capacity to meet current and emerging global and domestic demand. Cross-cutting technologies that will de-risk, scale up and add value to Australian manufactured products. Specialised, high value-add areas such as high-performance materials, composites, alloys and polymers.
Environmental Change	Improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors. Resilient urban, rural and regional infrastructure. Options for responding and adapting to the impacts of environmental change on biological systems, urban and rural communities and industry.
Health	Better models of health care and services that improve outcomes, reduce disparities for disadvantaged and vulnerable groups, increase efficiency and provide greater value for a given expenditure. Improved prediction, identification, tracking, prevention and management of emerging local and regional health threats. Better health outcomes for Indigenous people, with strategies for both urban and regional communities. Effective technologies for individuals to manage their own health care.

Table 37 – Australian Government Research Priorities

9.3.4 Australian Government Levy Principles and Guidelines

The Australian Government has developed a set of levy guidelines and principles to help industry bodies prepare a source case for a levy or charge to be considered by industry members.[63]

[63] Department of Agriculture, Fisheries and Forestry (2009), *Levy Guidelines and Principles: Policy for the Management of New and Amended Levies within Australia*, Australian Government, Canberra

The principles are as follows:

1. The proposed levy must relate to a function for which there is market failure.
2. A request for a levy must be supported by industry bodies representing, wherever possible, all existing and/or potential levy payers, the relevant levy beneficiaries and other interested parties. The initiator must demonstrate that all reasonable attempts have been made to inform all relevant parties of the proposal and that they have had the opportunity to comment on the proposed levy. A levy may be initiated by the Government, in the public interest, in consultation with the industries involved.
3. The initiator of a levy proposal shall provide an assessment of the extent, the nature and source of any opposition to the levy, and shall provide an analysis of the opposing argument and reasons why the levy should be imposed despite the argument raised against the levy.
4. The initiator is responsible to provide (a) an estimate of the amount of levy to be raised to fulfil its proposed function; (b) a clear plan of how the levy will be utilised, including an assessment of how the plan will benefit the levy payers in an equitable manner; and (c) demonstrated acceptance of the plan by levy payers in a manner consistent with Levy Principle 2.
5. The initiator must be able to demonstrate that there is agreement by a majority on the levy imposition/collection mechanism or that, despite objections, the proposed mechanism is equitable under the circumstances.
6. The levy imposition must be equitable between levy payers.
7. The imposition of the levy must be related to the inputs, outputs or units of value of production of the industry or some other equitable arrangements linked to the function causing the market failure.
8. The levy collection system must be efficient and practical. It must impose the lowest possible 'red tape' impact on business and must satisfy transparency and accountability requirements.
9. Unless new structures are proposed, the organisation(s) that will manage expenditure of levy monies must be consulted prior to introduction of the levy.
10. The body managing expenditure of levy monies must be accountable to levy payers and to the Commonwealth.
11. After a specified time period, levies must be reviewed against these Principles in the manner determined by the Government and the industry when the levy was first imposed.
12. A proposed change must be supported by industry bodies or levy payers, or by the Government in the public interest. The initiator of the change must establish the case for change where an increase is involved, must estimate the additional amount which would be raised. The initiator must indicate how the increase would be spent and must demonstrate the benefit of this expenditure for levy payers.

9.3.5 MLA Strategic Plan

Pillar	Priority	Key Performance Indicator	Measure/units	Benchmark (2015-16)	2016-17	2017-18	2018-19	2019-20
1. Consumer and community support	Continuous improvement of the welfare of animals in our care	Restrict % consumers limiting red meat consumption due to animal welfare concerns to 10%	% of annual survey respondents	7%	7%	7%	8%	10%
		Four new products including vaccines, diagnostic tests and tools to reduce the cost and welfare impact of endemic and emergency disease in Australia	tool, diagnostic or vaccine developed	n.a	one new tool, diagnostic or vaccine	one new tool, diagnostic or vaccine	one new tool, diagnostic or vaccine	one new tool, diagnostic or vaccine
	Stewardship of environmental resources	Restrict % consumers limiting red meat consumption due to environmental concerns to 10%	% of annual survey respondents	7%	7%	7%	8%	10%
		Reduce cost of feral animals and weeds by $50m	dollars/impact assessment	$2.5b	-$5m	-$15m	-$30m	-$50m
	Role of red meat in a healthy diet	Restrict % of main grocery buyers limiting red meat consumption for health reasons	% annual survey respondents – beef	15%	15%	16%	16%	17%
			% annual survey respondents – lamb	19%	19%	20%	20%	21%
2. Market growth and diversification	Efficiency and value in trade and market access	Achieve $15m in new market opportunities	dollars/impact assessment					$15m
		Deliver $150m in new export market opportunities' KPI to go with 'Efficiency and value in trade and market access' priority.	dollars/impact assessment					$150m
	Marketing and promoting Australian red meat and livestock	Increase percentage of global consumers who prefer Australian red meat	% annual survey respondents (weighted index) – beef	22.2%	22.2%	22.2%	22.8%	23.4%
			% annual survey respondents (weighted index) – lamb	20.4%	20.6%	20.8%	21.2%	21.4%
		Increase percentage of domestic main grocery buyers willing to pay a premium for Australian red meat	% annual survey respondents – beef	19%	20%	20%	21%	22%
			% annual survey respondents – lamb	21%	22%	22.5%	23%	23.5%
3. Supply chain efficiency and integrity	Optimising product quality and cost efficiency	Improve the MSA beef eating quality index by 2 points	points/MSA index	57.61	58.11	58.61	59.11	59.61
		Improve beef compliance through optimising efficiency across the value chain	%, benchmarking report	93.9%	94.25%	94.5%	95%	95.25%
	Guaranteeing product quality and systems integrity	Increase producer awareness and compliance of integrity systems by 20%	annual survey of participants	75%	79%	83%	86%	90%
4. Productivity and profitability	Production efficiencies in farms and feedlots	Engage ≥ 2,000 producers in decision support programs who will improve business performance by ≥ 5%	baseline regional benchmarks of productivity/profit and benefit cost ratio measures	By 2020, improvement in total factor productivity of: 1.75% (southern beef); 0.5% (northern beef); 0.5% (sheepmeat); 1.5% (feedlot); 0.5% (goat)				
			annual survey of participants	By 2020 improvement in business performance by ≥ 5%				
	Processing productivity	Leverage co-investment through the MLA Donor Company (MDC) in the processing automation R&D portfolio by $10m p.a.	$, annual co-investment	0	$10m	$10m	$10m	$10m
	Live export productivity	Live Export Global Index complete and cost of delivery reduced by 1%	% annual cost	15-16 cost of delivery	0	-0.25%	-0.5%	-1%
5. Leadership and collaborative culture	Building leadership capability	Improve stakeholder endorsement of MLA programs by .6 points	score of out 5; annual survey respondents	2.5	2.6	2.7	2.9	3.1
	Protecting and promoting our industry	Improved industry crisis and issues management capability	annual simulation conducted with PICs	0	1	1	1	1
6. Stakeholder engagement	Engagement with producers and stakeholders	Increase member satisfaction with MLA by .4points	score out of 5; annual MLA membership survey	3.5	3.6	3.7	3.8	3.9
		Improve proportion of users who find MLA Market Information 'extremely or highly valuable'	% annual survey respondents	57%	58%	60%	61%	62%
		Improve stakeholder endorsement of the value of MLA products and services	annual survey	Review current surveys	Methodology, benchmarks and targets set	Continuous improvement		

9.3.6 Alignment of MLA Strategic Plan with Australian Government Guidelines and the Meat Industry Strategic Plan

Pillar	Priority	Australian Government		Meat Industry Strategic Plan (MISP 2020) priorities
		Science and Research Priorities	Rural Research, Development and Extension Priorities	
1. Consumer and community support	Continuous improvement of the welfare of animals in our care	• Food • Soil and water • Environmental change • Transport	• Adoption of research and development • Biosecurity • Advanced technology	Welfare of the animals in our care
	Stewardship of environmental resources	• Food • Soil and water • Environmental change • Resources	• Adoption of research and development • Soil, water and managing natural resources • Advanced technology	Stewardship of environmental resources
	Role of red meat in a healthy diet	• Food • Health	• Adoption of research and development • Advanced technology	Red meat in a healthy diet
2. Market growth and diversification	Efficiency and value in trade and market access	• Food	• Advanced technology • Adoption of research and development	Efficiency and value in trade and market access
	Marketing and promoting Australian red meat and livestock	• Food	• Advanced technology • Adoption of research and development	Marketing and promoting Australian red meat and livestock
3. Supply chain efficiency and integrity	Optimising product quality and cost efficiency	• Food • Transport	• Advanced technology • Adoption of research and development	Optimising product quality and cost efficiency
	Guaranteeing product quality and systems integrity	• Food	• Advanced technology • Adoption of research and development • Biosecurity	Guaranteeing product and systems integrity
4. Productivity and profitability	Production efficiencies in farms and feedlots	• Soil and water • Food • Transport • Environmental change	• Advanced technology • Adoption of research and development • Soil, water and managing natural resources	Production efficiency in farms and feedlots
	Processing productivity	• Environmental change • Advanced manufacturing • Food • Energy	• Advanced technology • Adoption of research and development	Processing productivity
	Live export productivity	• Transport • Food	• Advanced technology • Adoption of research and development	Live export productivity
5. Leadership and collaborative culture	Building leadership capability	• Food	• Adoption of research and development	Building industry capability
	Protecting and promoting our industry	• Food • Environmental change	• Adoption of research and development • Biosecurity	Promoting and protecting our industry
6. Stakeholder engagement	Engagement with producers and stakeholders	• Food	• Adoption of research and development	-

9.4 Appendix 4: ABRI BREEDPLAN Related Product and Service Offerings

ABRI offers a range of products and services to domestic and international clients, including BREEDPLAN under license from the owners. The following subsections describe the services offered by ABRI in addition to BREEDPLAN.

9.4.1 ILR2

The International Livestock Registry (ILR2) is a multi-species capable animal registry software package service offered by ABRI that is used by over 190 breed associations worldwide, containing records for over 40 million animals. The technical details of ILR2 are summarised in the following Table 38.

Technical Detail	Description
Development Tools	ILR2 is a client-server system based on Linux. The database management system is open source and the user interface is Windows based, operating on Windows 2000 or later versions.
Hardware	ILR2 allows large databases to be run on relatively inexpensive industry-standard servers, including laptop PCs.
Data Interchange	ILR2 has developed efficient procedures for exchanging data and reports with third parties such as DNA laboratories, PC herd management systems and genetic evaluation agencies. Data transfer can be automated by web services.
Debtors accounting module	Transactions processed through ILR2 can generate a charge at appropriate rates to the members, with invoices generated automatically and can be retrieved electronically for any period of time. Payments are receipted in ILR2. At the end of each month, statements are produced and the totals for the debtors system are posted into the general ledger system used by the association.
Report generation	ILR2 is able to produce a range of reports, all of which can be automatically converted to PDF and emailed to recipients. Reports are also stored on the database for easy retrieval for any nominated period of time.
Flexible configuration	ILR2 is scalable an economically handles the business of breed associations ranging in size from 20 to 10,000 plus members.
Internet solutions	Decision-making information, recording of registrations and performance data through the Internet. Specific internet solutions include animal or member enquiries, sale catalogues, semen lists, registrations, inventory updates, entry of performance data, mating prediction service, inbreeding coefficient calculation and downloading of files and reports.
Genetic evaluation	ILR2 facilitates exportation of data for genetic evaluation, importing of EBVs and EPDs and inclusion of EBVs/EPDs on reports and internet services.

Table 38 – Technical Details of ILR2

ILR2 implementation for beef cattle associations includes BREEDPLAN access.

9.4.2 HerdMASTER

HerdMASTER is a herd management software system that has been continuously developed over the course of the past 30 years. It is used in over 30 countries and has in-build support for over 136 breed societies. The software can be customised for the individual needs of operations, catering for a wide variety of traits, procedures and treatments.

The current version, HerdMASTER 4, allows for tighter breed association – BREEDPLAN integration, as well as the ability to import or export data from almost any device or software. There are versions of the HerdMASTER package that are tailored for:

- Commercial operators where breeding is not an issue;
- Small stock operations such as sheep, goats and alpacas;
- Stud cattle operations which contains all of the features of the package designed for commercial operations, as well as stud specific features.

The specific features of each version are summarised in Table 39 below.

	Commercial	Small Stock	Stud
Unlimited number of animal records	Yes	Yes	Yes
One license for multiple devices	Yes	Yes	Yes
Copy information directly into Microsoft Excel	Yes	Yes	Yes
Import from devices	Yes	Yes	Yes
Import from TSI devices	Yes	Yes	Yes
Integration with PNP devices	Yes	Yes	Yes
Universal file import	Yes	Yes	Yes
Excel file import/export	Yes	Yes	Yes
Crush side recording unit	Yes	Yes	Yes
Advanced customisable filters	Yes	Yes	Yes
Column filters on animal lists	Yes	Yes	Yes
Animal worksheets	Yes	Yes	Yes
Multiple properties	Yes	Yes	Yes
Multiple locations within a property	Yes	Yes	Yes
Business contact database	Yes	Yes	Yes
Customisation of own traits	Yes	Yes	Yes
Customisation of treatments	Yes	Yes	Yes
Inventory and batch control of treatments	Yes	Yes	Yes
Automatic calculations (e.g. average daily weight gain)	Yes	Yes	Yes
Integration with society traits	Yes	Yes	Yes
Central server sync available	Yes	Yes	Yes
Bulk add animals	Yes	Yes	Yes
GeneProb	Yes	Yes	Yes
Transferable pedigree trees	No	Yes	Yes
Visual farm	No	Yes	Yes
Import EBVs	No	No	Yes
Import tag buckets from NLIS	Yes	Yes	Yes
NLIS audit	Yes	Yes	Yes
Submit movements and sales to NLIS	Yes	Yes	Yes
Send re-tags to NLIS	Yes	Yes	Yes
Create customised reports	Yes	Yes	Yes
Custom sales catalogue generation	No	Yes	Yes
Invoicing	No	Yes	Yes
Export to societies and associations	No	Yes	Yes
Export to BREEDPLAN	No	No	Yes
Export to NLIS	Yes	No	Yes
Export to TSI device	Yes	Yes	Yes
BREEDPLAN integrity reports	No	No	Yes
BREEDPLAN completeness reports	No	No	Yes
EBV reports	No	No	Yes
Mob reports	Yes	Yes	Yes
Animal reports	Yes	Yes	Yes
Weight reports	Yes	Yes	Yes
Contact reports	Yes	Yes	Yes
QA reports	Yes	Yes	Yes
Sales and purchases reports	Yes	Yes	Yes
Inventory reports	Yes	Yes	Yes
Activity reports	No	Yes	Yes
Pedigree reports	No	Yes	Yes
Production reports	No	Yes	Yes
Sire performance reports	No	Yes	Yes
Mating reports	No	Yes	Yes
Multi-sire matings	No	Yes	Yes
Semen inventories	No	Yes	Yes
Embryo inventories	No	Yes	Yes
Embryo flushes	No	Yes	Yes
DNA testing export	No	No	Yes

Table 39 – Product Features of Different HERDMaster Versions

HerdMASTER has comprehensive integration with BREEDPLAN and societies that use the ILR service. The BREEDPLAN Completeness of Performance Comparison function can be used to compare data that has been recorded in HerdMASTER with the data that has been submitted to BREEDPLAN. Custom traits can be mapped to ABRI BREEDPLAN traits for submission and HerdMASTER 4 comes with pre-set traits for over 135 breed societies. HerdMASTER offers dedicated support for EBV files, whereby a

user can import EBV and society files and HerdMASTER will check that data against the operator's herd details and apply the data. EBV graphs and direct EBV information for each animal can also be determined.

9.4.3 Internet Solutions

Internet Solutions is a web-based service operated by ABRI that provides instantaneous online access to a wide range of information on animals, members, pedigrees and breeding information on line. Specific services include:

- Animal and member enquiry service
- Sales catalogue and semen lists
- Online transactions to access a range of data entry functions
- Mating prediction and inbreeding service
- Secure login access to download society reports by files

9.4.4 Beef Extension Services

ABDI provides genomic and other advice to the seedstock and commercial sector through Southern Beef Technology Services and Tropical Beef Technology Services.

9.4.4.1 Southern Beef Technology Services

South Beef Technology Services (SBTS) is a joint initiative of MLA, ABRI and several breed societies that account for the majority of cattle in southern Australia. It provides members of participating breed societies with technical support that enables them to maximise their understanding and use of the different genetic technologies that are available such as BREEDPLAN, BreedObject Selection Indexes, Internet Solutions, TakeStock and DNA based technologies. This is delivered in the form of day to day advice and technical support over the telephone or email, regular workshops, publications and property visits.

Technical assistance is also made available to service providers in the beef industry such as agents, scanner and veterinarians. The breed societies that are collaborators in SBTS are:

- Herefords Australia
- Shorthorn Beef
- Murray Grey Beef Cattle Society
- Charolais Society of Australia
- Limousin
- Simmental Australia
- Red Angus Society of Australia
- South Devon Cattle Society of Australia
- Devon Cattle Breeders Society of Australia
- Blonde d'Aquitane Society of Australia and New Zealand
- Speckle Park International

9.4.4.2 Tropical Beef Technology Services

Tropical Beef Technology Services (TBTS) is the same service as SBTS, but focused on tropical cattle breeds. The breed societies that are collaborators in TBTS are:

- Australian Brahman Breeder's Association

- Australian Brangus Cattle Association
- Droughtmaster Stud Breeder's Society
- Australian Senepol Cattle Breeders Association
- Santa Gertrudis Australia
- Simmental Australia

9.5 Appendix 5: 2015-16 ABRI BREEDPLAN Product Delivery and Development Plan

Table 40 below summarises the 2015-16 ABRI BREEDPLAN Product Delivery and Development Plan.

Initiative	Description
Maintaining membership and usage	In 2015-16, the use of BREEDPLAN by Australian herds recorded an approximate 8 percent decrease in throughput (as measured by weaning waits processed). However, the number of herds submitting performance records declined by only 0.5 percent. ABRI does not have a national beef breeding extension program in place. It works in a targeted way with existing BREEDPLAN users to encourage them to continue their commitment and to increase their recording of both phenotypic and genomic data. While overall BREEDPLAN membership is declining, ABRI is concentrating on ensuring that those herds and breeding groups that are having the biggest influence within the sector are performance recording, optimising their use of the available genetic technologies and increasing the rates of genetic progress being achieved in their herd. This, in turn, will drive the genetic progress made for the economically important traits within the seedstock sector and flow through to the commercial beef industry.
Implementation of enhanced BREEDPLAN software	ABRI will continue the implementation of Version 6.2 of the BREEDPLAN software. ABRI will continue to invest in the development of the BREEDPLAN system on a Linux environment, as version 6.2 requires that analyses are run on the Linux servers. ABRI will continue to work closely with AGBU on the delivery of new technology and in the support and updating of existing technology. AGBU is finalising the 'single-step' BREEDPLAN software which includes genomic data into the genetic evaluation. Considerable development and investment is still need in the genetics pipeline and ABRI will continue to liaise with both AGBU and clients to co-ordinate the necessary processes.
Data quality	ABRI will continue to invest in improving the quality of data submitted to and utilised in BREEDPLAN analyses.
Outliers	ABRI will roll-out the improved system it has developed to identify and report outlier observations (observations identified as being extreme) to breeders before the records are included in the evaluation. ABRI also intends to investigate options for improving the strategy (or logic) for the identification of outlier records. This R&D will be undertaken in liaison with AGBU.
Completeness of performance	ABRI will continue to promote the use of the 'Completeness of Performance' product by breeders in Australia and overseas.
Data audit software	ABRI will continue to promote the use of its data audit software.
BreedObject	The latest version of BreedObject software (Version 6) is under development by AGBU and includes new and improved methodology for generating Index values. It includes new breeding objective traits as well as the incorporation of additional traits from the multi-trait model. This ongoing development work is important as BreedObject is a tool for formalising breeding objectives that are used to calculate the rate of genetic progress in each breed. BreedObject also provides the input for the TakeStock genetic benchmarking service and the MateSel mate selection service. ABRI is expecting the continuing testing and implementation of this new software when provided by AGBU. Once implemented, the transition of breeds to Version 6 will require new versions of BreedObject parameter files. BreedObject index enhancements are expected for a number of Australian and overseas clients.
TakeStock	ABRI will continue to promote the use of TakeStock, which can now be produced on a routine basis for all Australian breed that have BreedObject Indices.
MateSel	The licensor of MateSel has recently provided a web-based version of MateSel and ABRI is currently developing online and/or consultant versions of this product which will provide industry with a more advanced service.
GeneProb	ABRI will continue to develop the GeneProb service and offer it to Australian and international clients. Developments are currently underway for a number of breeds.
Research Projects	ABRI will promote more rapid uptake of improvements and enhancements from research projects such as the Beef Information Nucleus project. ABRI will continue to provide high-level technical support via our team of graduates and technical staff in areas such as designing data collection and submission of protocols and general support and liaison. ABRI will develop the necessary software and parameter files so that data from the Repronomics project can be utilised in the BREEDPLAN production analyses for the major tropical breeds.

Initiative	Description
Collection of quality data	*Carcase Traits* ABRI will continue to evaluate new technology which will enhance the quality of Carcase EBVs in a way that flows through to faster genetic progress. ABRI will continue to be involved in the evaluation of the economics and logistics of introducing additional procedures and accreditations that will maintain the required quality controls and encourage live animal scanning. ABRI will continue to work with AGBU and the Wagyu Association to implement addition research outcomes from the Wagyu Association BIN project into the standard BREEDPLAN analysis. ABRI will continue to work with AGBU to implement a production system version of the software to handle 'lean' scan data, whereby groups of animals are removed from the BREEDPLAN analysis where their fat scans are either too low or have insufficient variation. *Marker Assisted EBVs* ABRI will continue to provide high level support and advice to clients using the 'blending' (blends genomic data into the BLUP solution for a range of traits) function in the software to ensure efficient quick delivery of results. Currently Australian Angus, Pan American Hereford and Australian and American Brahman are using this service and ABRI is not anticipating additional breeds wishing to include genomic predictions into BREEDPLAN results once the 'single-step' methodology is released. *DNA Data* ABRI is currently offering clients the option to store and utilise large amounts of DNA SNP data. As the primary use of these records will be in GROUP BREEDPLAN analyses, ABRI is developing processes to store these records and provide the level of quality assurance required for genetic evaluation. Additionally, ABRI is investigating the incorporation of associated services for clients such as parentage verification and breed composition.
ILR2 System	ABRI will continue to roll-out its ILR2, third generation software which is based on state-of-the-art software tools. ABRI will continue to develop the ILR2 services to ensure that clients have access to current technologies for submitting, sharing and storing data and for the reporting of results. These enhancements will also provide options for database clients to reduce their service costs.
National Field Extension	ABRI will maintain a strong emphasis on an active field program revolving around Tropical Beef Technology Services in northern Australia and Southern Beef Technology Services in southern Australia. These activities will provide participating stakeholders organisations and their members with structured, consistent education and technical support for the range of genetic technologies that are available and will provide all breeds undertaking genetic evaluation through GROUP BREEDPLAN in Australia with a coordinated national genetic technology extension program. They are based on objectives developed from a formal consultation process with MLA, AGBU, ABRI, participating breed societies and the experienced consultants within the extension teams.
Multi-country Genetic Evaluations	ABRI will continue to liaise with countries that trade genetics with Australia to encourage the adoption of multi-country genetic evaluations using BREEDPLAN. ABRI will continue to consolidate the client base and link breed societies in single analyses. ABRI will implement the research outcomes from the investigation into evaluation of Brahman data across Australia, United States, South Africa and Namibia. The participating countries reached a general agreement on implementing this research into regular production.
Across-breed Genetic Evaluations	ABRI will continue to liaise closely with MLA, AGBU and breed societies to encourage the development and adoption of across-breed analyses. In anticipation that breeds will wish to progress development of across-breed evaluations, ABRI will continue to provide high level support and advice to clients in this regard. ABRI is also planning technical developments required to enable the efficient combining of datasets.
Non-breed society clients	ABRI will continue to provide services and support to clients who choose to deal directly for their genetic evaluation services and aims to work with AGBU to find way to minimise the cost and difficulty of recording for these clients consistent with them providing quality information.
International presentation of BREEDPLAN	ABRI will continue to promote BREEDPLAN in countries that it has an existing presence and will seek to bring on new countries.

Table 40 – Summary of the 2015-16 ABRI BREEDPLAN Product Delivery and Development Plan

9.6 Appendix 6: Ipsos Market Research Results

The following subsections detail the key observations from market research undertaken by Ipsos in 2016, as far as they pertain to BREEDPLAN.[64]

9.6.1 BREEDPLAN Usage and Herd Size

The market research indicates that in both the seed-stock and commercial sectors, users of BREEDPLAN tend to have larger herds. This is illustrated in Figure 70 below.

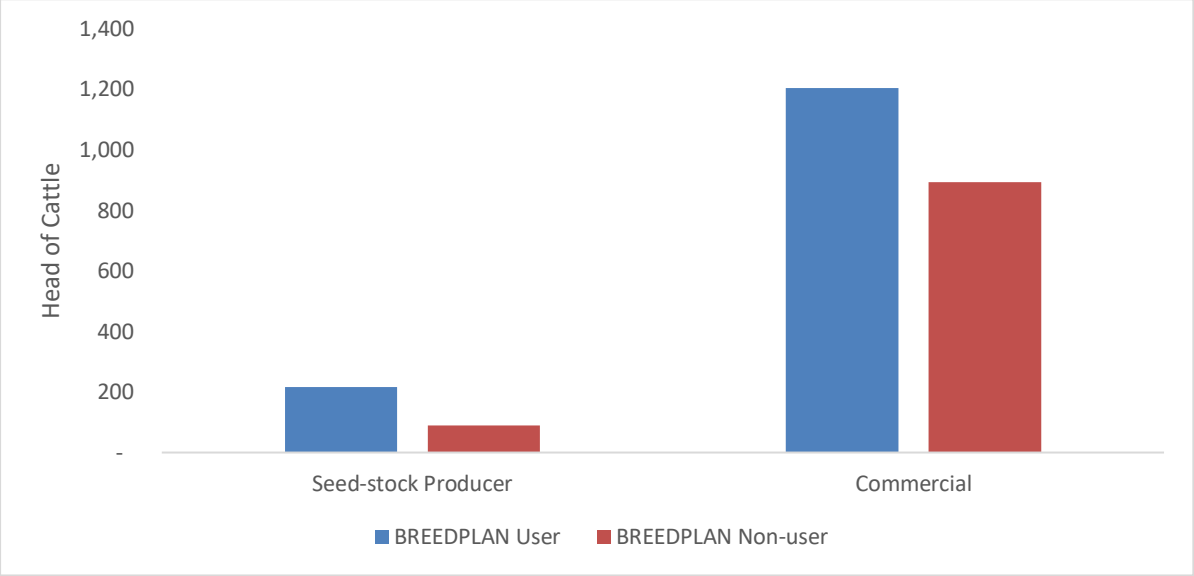

Figure 70 – Average Herd Size of BREEDPLAN Users and Non-Users – Seed-stock versus Commercial Producers

9.6.2 Software Usage

The market research indicates that there is significant variation with the software that is used to record animal data across both seed-stock and commercial producers. This is summarised in Table 41 below.

Software	Seed-stock Producer		Commercial	
	BREEDPLAN User	BREEDPLAN Non-user	BREEDPLAN User	BREEDPLAN Non-user
Microsoft Excel	17%	21%	17%	10%
HERDMaster	13%	7%	2%	0%
Stockbook	11%	11%	3%	1%
Kool Software	1%	0%	0%	0%
Other	51%	54%	67%	75%
Unsure	11%	11%	13%	16%

Table 41 – Stock Management Software Usage (Percentage of Respondents)

[64] Dodd, J., Peeters, D., and Oblitas-Costa, N. (2016), *Understanding the Usage and Perceptions of Genetics and Genomics in the Australian Beef and Sheep Sectors,* Meat and Livestock Australia and Ipsos

9.6.3 Breed Association Membership and BREEDPLAN

Not surprisingly, in the seed-stock sector almost all users of BREEDPLAN are members of breed associations. While a significant portion of commercial BREEDPLAN users are members of breed associations, the majority are not. This is summarised in Table 42 below.

Breed Association Membership	Seed-stock Producer		Commercial	
	BREEDPLAN User	BREEDPLAN Non-user	BREEDPLAN User	BREEDPLAN Non-user
Member	98%	79%	37%	10%
Non-member or unsure	2%	21%	63%	90%

Table 42 – Breed Association Membership and BREEDPLAN Usage

It is worth noting that in the meat sheep sector 10 percent of LAMPLAN users in the sheep seed-stock and 84 percent of LAMPLAN members in the commercial meat sheep sector are not members of a breed association (or unsure).

9.6.4 Duration of BREEDPLAN Use and Experience of Non-users

The market research indicates that approximately 32 percent and 18 percent of seed-stock and commercial producer non-users of BREEDPLAN respectively have had previous experience with BREEDPLAN, but 68 percent of seed-stock and 82 percent of commercial producer non-users of BREEDPLAN have no experience with BREEDPLAN.

The market research indicates that approximately 91 percent of seed-stock and 85 percent of commercial producers that use BREEDPLAN have been using it for over five years. This is illustrated in Figure 71 below.

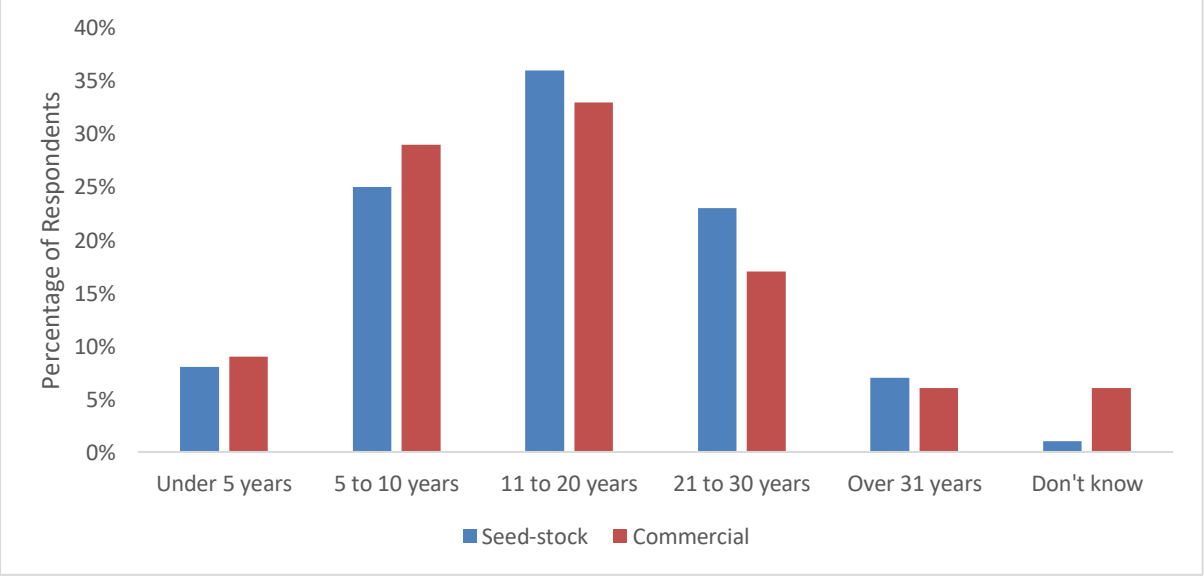

Figure 71 – Length of Time Using BREEDPLAN (Seed-stock and Commercial Producers)

9.6.5 Differences between the Tropical and Southern Beef Industry

The following Table 43 compares the different importance placed on various traits across the seed-stock and commercial sectors in the tropical and southern beef industries.

	Seed-stock	Commercial
Tropical Sector	Temperament (47%) Body shape/structure (38%) Scrotal size (25%) 400 day growth rate (6%) Birth weight (6%) Fat depth (6%)	Temperament (42%) Pregnancy test result (22%) Scrotal size (18%) Days to calving (7%) 600 day growth weight (5%) Calving ease (5%) 400 day growth weight (4%) 200 day growth weight (3%)
Southern Sector	Birth weight (35%) Fat depth (29%) Temperament (28%) 400 day growth rate (26%) Body shape/structure (18%) Scrotal size (11%)	Temperament (30%) 400 day growth rate (15%) 600 day growth rate (14%) 200 day growth rate (13%) Pregnancy test result (12%) Scrotal size (10%) Milk production (8%) Days to calving (2%)

Table 43 – Importance Placed on Traits – Tropical and Southern Seed-stock and Commercial Producers Compared

The northern seed-stock sector is dominated by Brahman and Droughtmaster breeds, collectively accounting for 72 percent of respondents in the northern sector and the Angus breed accounts for 42 percent of respondents in the southern sector. In the northern sector, only 9 percent of seed-stock producer respondents used Artificial Insemination (AI), whereas in the southern sector, 36 percent of seed-stock producer respondents used AI.

Table 44 below indicates that there are significant differences in measurements that seed-stock producers use to keep track of genetic gain in the northern and southern sectors.

	Northern Seed Stock Producers	Southern Seed Stock Producers
Birth weight	9%	27%
Net physical factors	62%	43%
Scrotal size	38%	9%
Net gestation/weaning/fertility factors	47%	23%
Feedback from buyers	12%	3%

Table 44 – Difference in Measurements Used to Track Genetic Gain – Northern and Southern Seed-stock Producers Compared

As illustrated in Table 45 below, there are also significant differences in performance data that is recorded from cattle.

	Northern Seed Stock Producers	Southern Seed Stock Producers
Birth weight	19%	57%
Pregnancy test result	25%	6%
Eye muscle area	6%	28%
Fat depth	6%	30%

Table 45 – Difference in Performance Data Recorded – Northern and Southern Seed-stock Producers Compared

Finally, as indicated in Table 46 below, there is difference in performance data that is reported back to BREEDPLAN.

	Northern Seed Stock Producers	Southern Seed Stock Producers
Birth weight	21%	54%
Eye muscle area	3%	27%
Fat depth	3%	28%

Table 46 – Difference in Performance Data Recorded with BREEDPLAN – Northern and Southern Seed-stock Producers Compared

As illustrated in Figure 72 below, the market research suggests cattle producers in the southern sector have a higher degree of trust in BREEDPLAN.

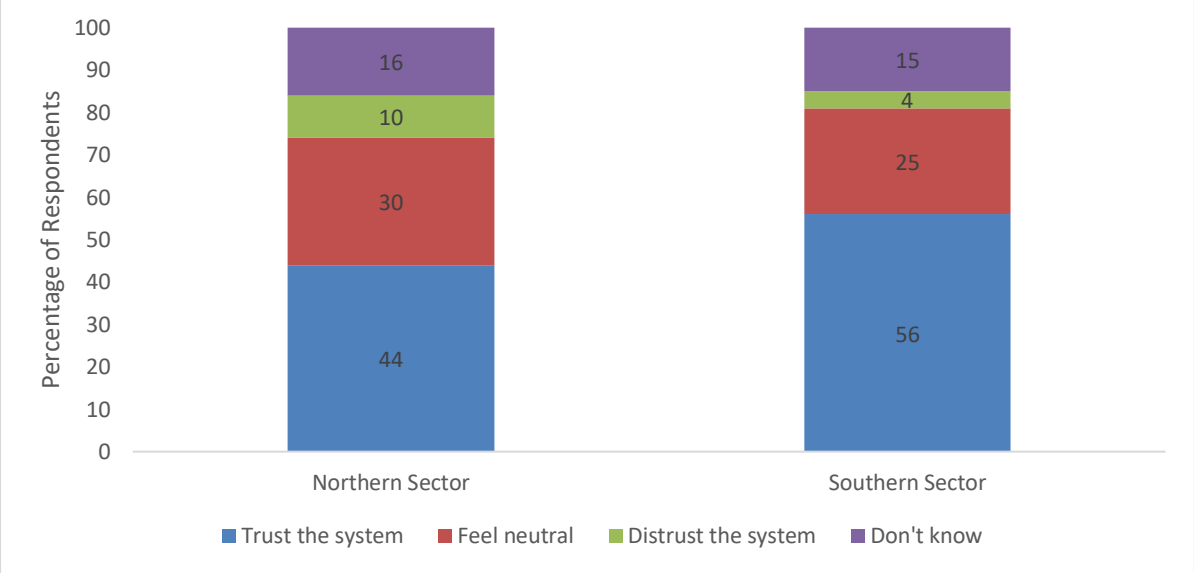

Figure 72 – Trust in the BREEDPLAN System – Northern and Southern Beef Sectors Compared

9.6.5.1 BREEDPLAN Training

The market research indicates that less than a third of respondents in both the northern and southern sectors have received formal training in BREEDPLAN, with 32 percent of northern sector respondents and 21 percent of southern sector respondents having undertaken training with MLA, their breed association or state department of primary industry. In the case of both the northern and southern sectors, MLA (TBTS and SBTS) are the main providers of training. This is summarised in Table 47 below.

Training Provider	Northern Sector	Southern Sector
MLA	29%	13%
Breed Society	6%	21%
DPI	16%	11%

Table 47 – Sources of Training in BREEDPLAN

9.6.6 Management and Perceptions of Genetic Progress

The market research indicates that while BREEDPLAN users are more likely to have clearly set breeding objectives, the vast majority of non-users of BREEDPLAN also have clearly set objectives. In the seed-stock sector, 96 percent of BREEEDPLAN users had clearly set breeding objectives, compared to 86 percent of non-users of BREEDPLAN. In the commercial sector, 88 percent of BREEDPLAN users had clearly set breeding objectives, compared to 65 percent of non-users.

While putting a bull into a herd of cows is still the most common method of breeding, the use of technology, particularly AI, is far more common in the seed-stock sector than it is in the commercial sector. This is summarised in Table 48 below.

Breeding Method	Seed-stock		Commercial	
	BREEDPLAN User	Non BREEDPLAN User	BREEDPLAN User	Non BREEDPLAN User
Artificial Insemination	36%	18%	1%	1%
Embryo Transfer	3%	7%	1%	0%
Putting a bull into a herd	61%	71%	96%	90%
No breeding undertaken	0%	4%	1%	9%

Table 48 – Main Breeding Methods Used

The market research indicates that the main measure of breeding progress in both the seed-stock and commercial sectors are weight gain measurements, with temperament and maternal qualities also being important. BREEDPLAN users in both the seed-stock and commercial sector tend to pay attention to a wider range of measures. Figure 73 below illustrates the measures that seed-stock respondents use to track progress toward breeding objectives.

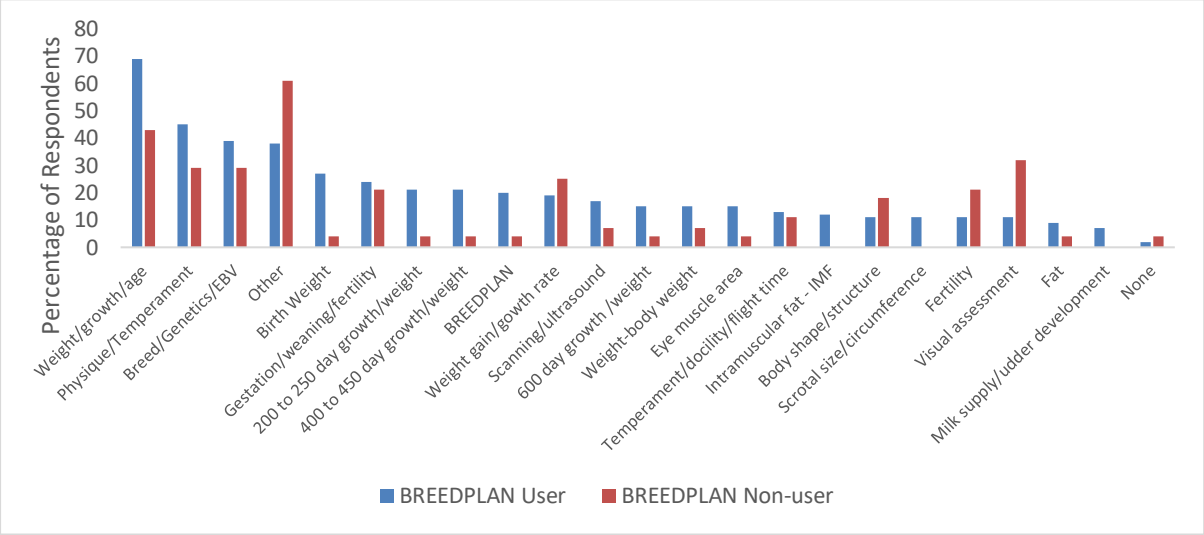

Figure 73 – Measurements Used to Track Progress toward Breeding Objectives – Seed-stock Sector

Figure 74 below illustrates the measurements that commercial producers use to track progress toward breeding objectives.

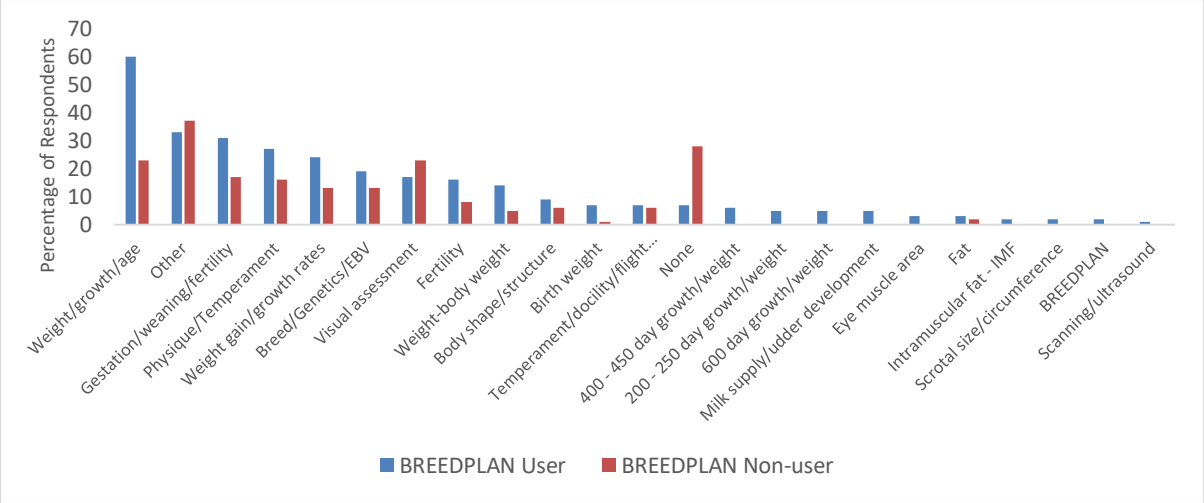

Figure 74 – Measurements Used to Keep Track of Progress towards Objectives – Commercial Producers

Interestingly, the survey indicates that there is little difference in satisfaction with genetic gain across BREEDPLAN users and non-users. This is illustrated in Figure 75 below.

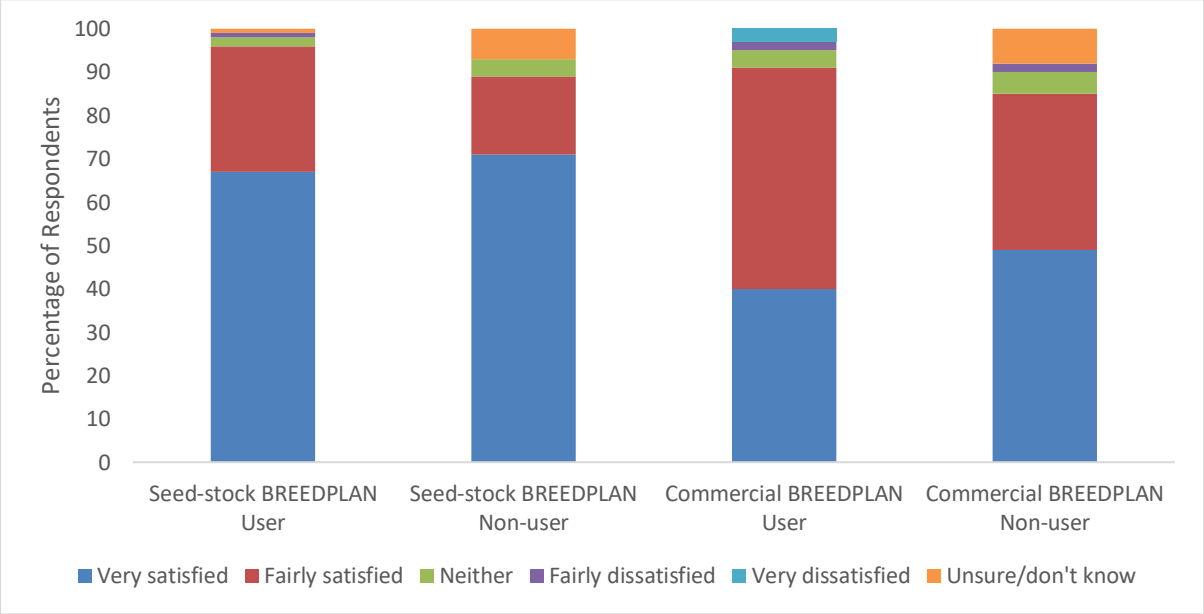

Figure 75 – Satisfaction with Genetic Gain Achieved over the Past Decade

The most commonly cited reasons for being dissatisfied with genetic gain is rate of change, system accuracies and cost. This is illustrated in Figure 76 below.

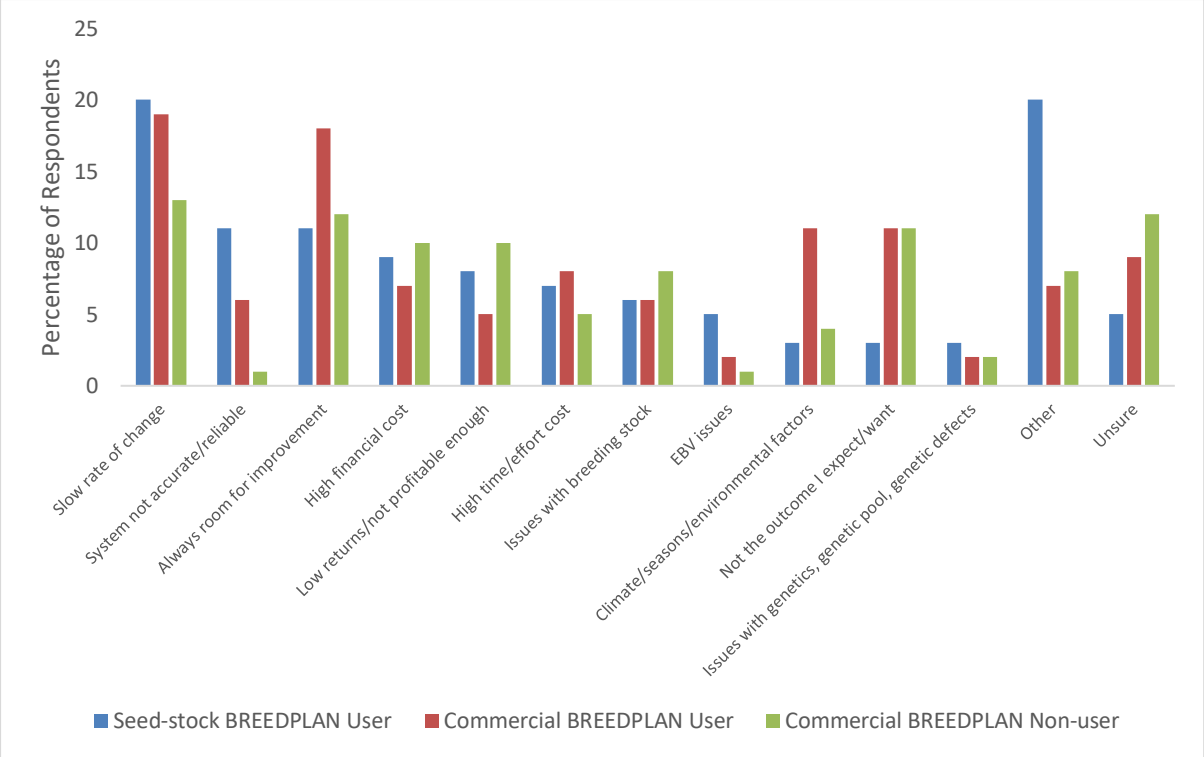

Figure 76 – Reasons for Being Less than Fully Satisfied with Genetic Gain

9.6.7 Perceptions as to What BREEDPLAN Is

As illustrated in Figure 77 below, respondents in from the seed-stock sector almost overwhelmingly perceived BREEDPLAN as a database for helping decisions.

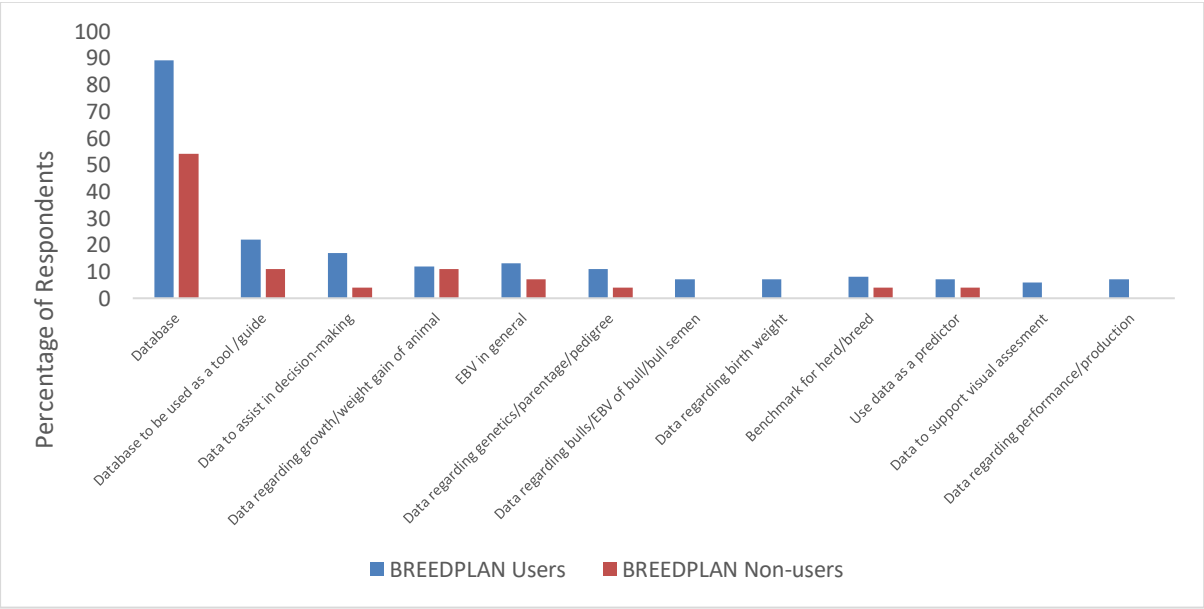

Figure 77 – Perceptions of What BREEDPLAN is – Seed-stock Sector

This is also the case for the commercial sector, albeit it would appear the commercial users of BREEDPLAN place greater emphasis on specific measures for weight gain and EBVs as a predictor. This is illustrated in Figure 78 below.

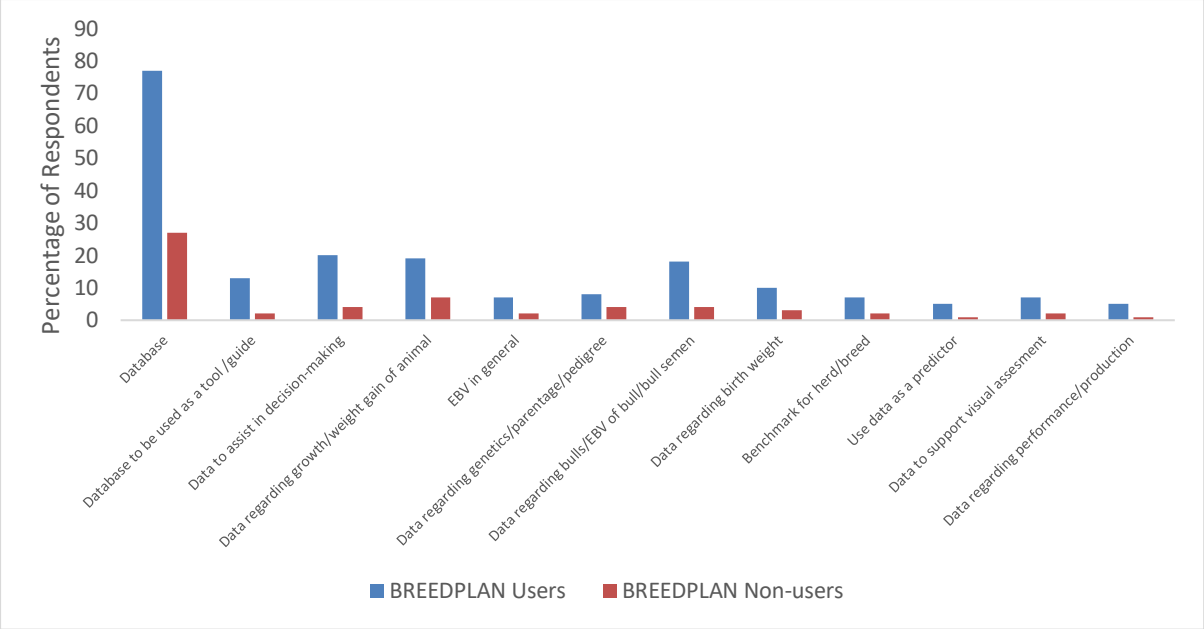

Figure 78 – Perception of What BREEDPLAN is – Commercial Sector

9.6.8 Perceived Benefits and Problems Associated with BREEDPLAN

The vast majority of seed-stock respondents consider the main benefit of BREEDPLAN is its function as a decision support tool. This is illustrated in Figure 79 below.

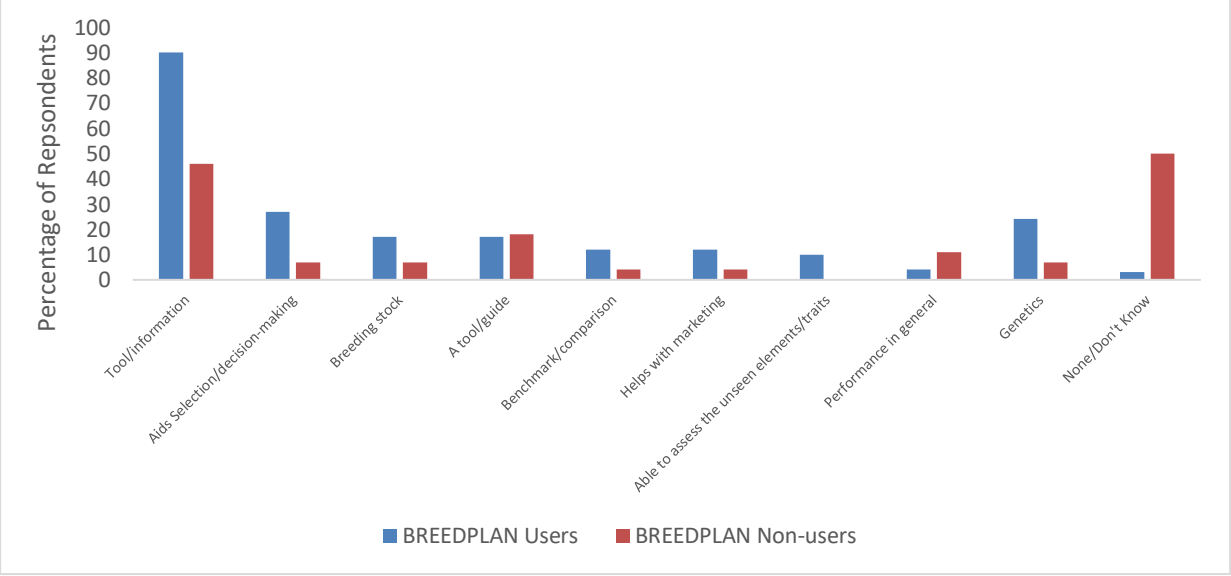

Figure 79 – Main Perceived Benefits of BREEDPLAN – Seed-stock Sector

As illustrated in Figure 80 below, BREEDPLANS role as a decision-support tool is also perceived as its main benefit by the commercial sector.

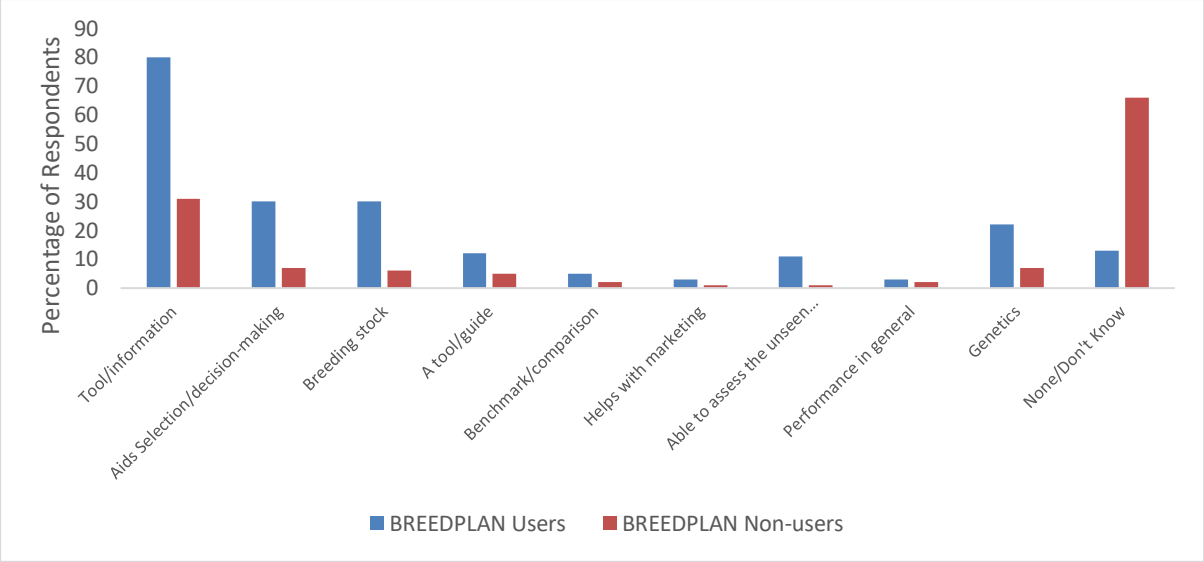

Figure 80 – Main Perceived Benefits of BREEDPLAN – Commercial Sector

The main perceived problems associated with BREEDPLAN from the seed-stock sector's perspective is accuracy, complexity and time involved in using it, with a significant portion of non-users citing that BREEDPLAN does not have any problems, or they don't know about them. This is illustrated in Figure 81 below.

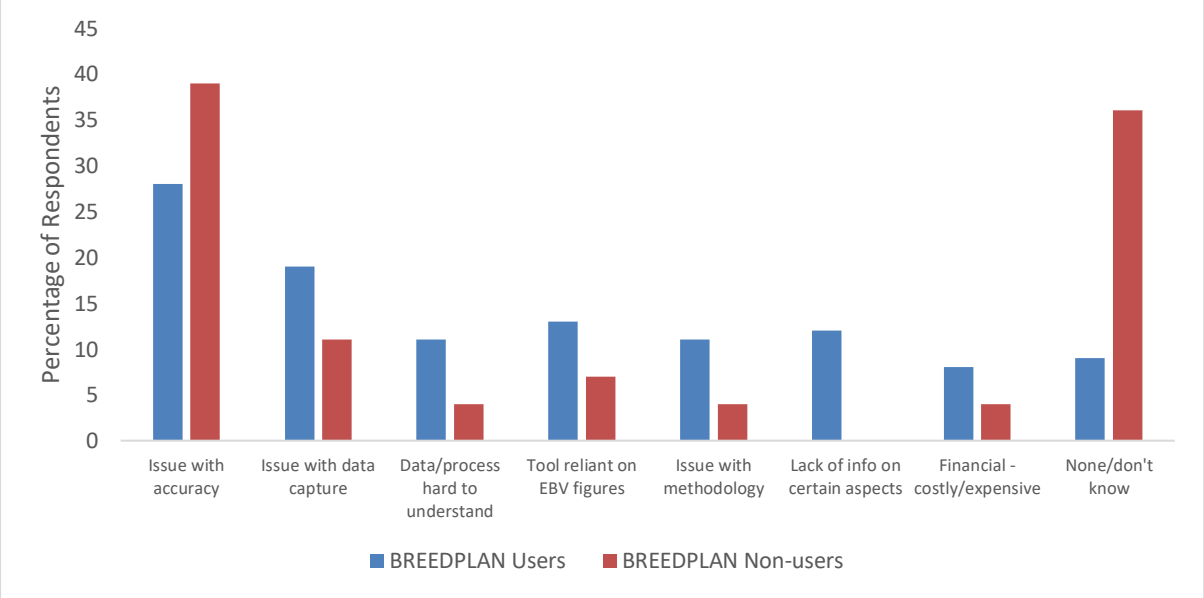

Figure 81 – Most Commonly Cited Problems with BREEDPLAN – Seed-stock Sector

These are also the main perceived problems in the commercial sector. However, far more users and non-users of BREEDPLAN are either unaware of problems or don't perceive there to be any problems associated with BREEDPLAN. This is illustrated in Figure 82 below.

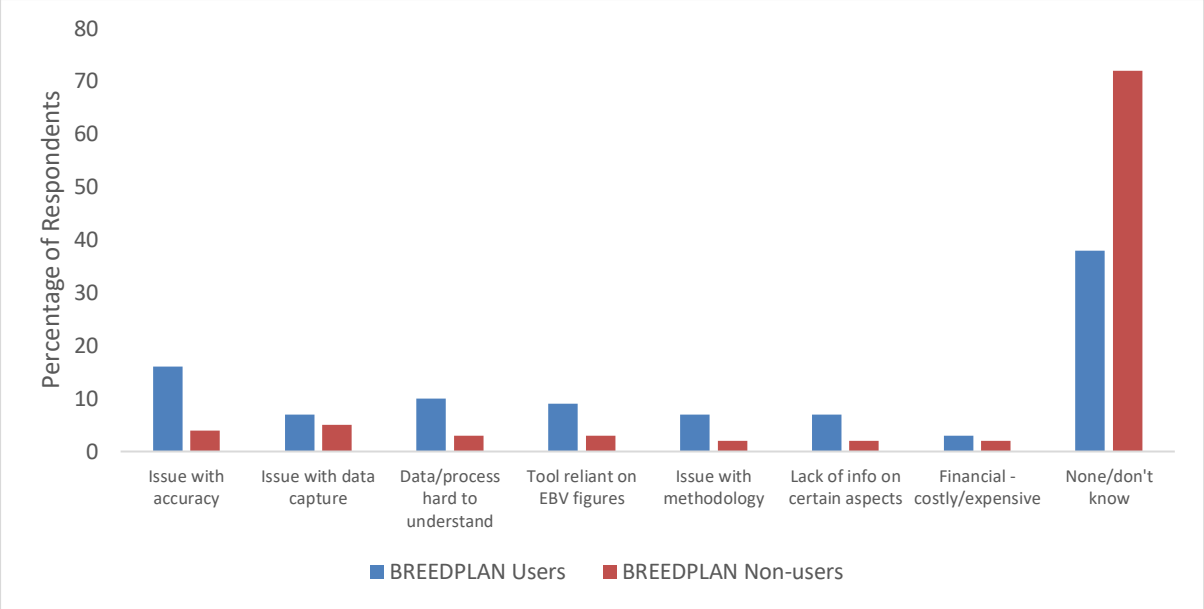

Figure 82 – Commonly Cited Problems with BREEDPLAN – Commercial Sector

9.6.9 Sources of Advice on Genetics

Among seed-stock producers, the main source of advice on genetics is from colleagues, followed by the breed association and their own research, with a significant portion not seeking advice. This is illustrated in Figure 83 below.

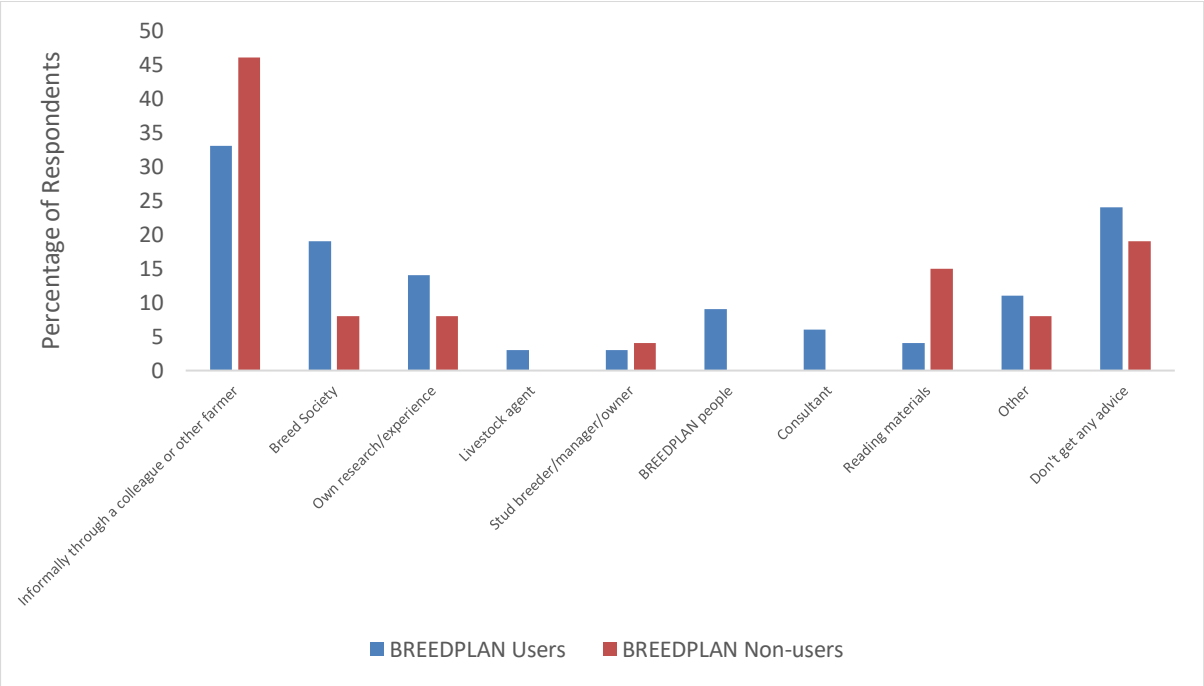

Figure 83 – Most Common Sources of Advice on Genetics – Seed-stock Producers

These are also common sources of advice among commercial producers, with livestock agents also being a relatively common source of advice. This is illustrated in Figure 84 below.

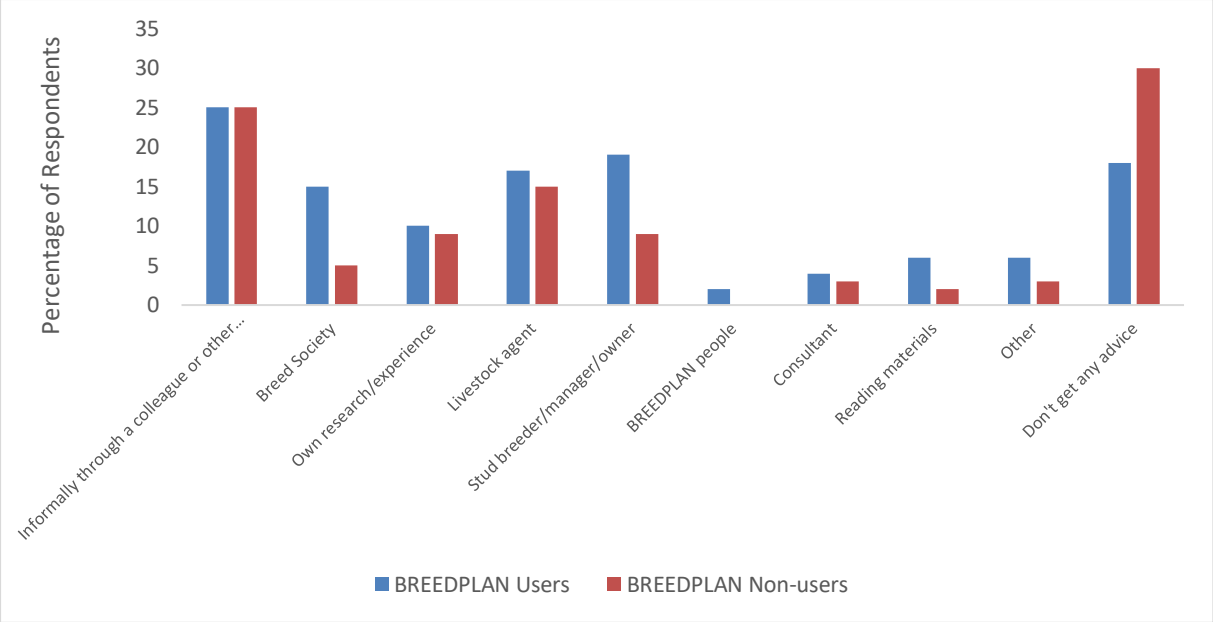

Figure 84 – Most Common Sources of Advice on Genetics – Commercial Producers

9.6.10 Sources of BREEDPLAN Training and Guidance

The market research suggests that a significant portion of respondents have not received any training or guidance in the use of BREEDPLAN. This is illustrated in Figure 85 below.

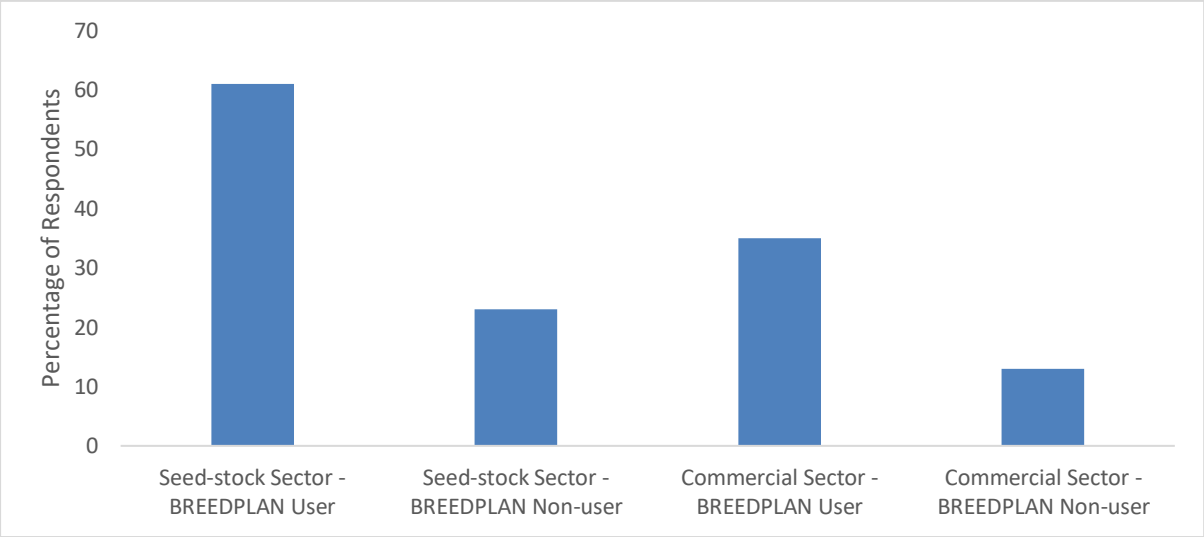

Figure 85 – Portion of Respondents who have Received Training or Guidance in BREEDPLAN

Among seed-stock respondents, the most common reasons for not having had training is a perceived lack of need. This is illustrated in Figure 86 below.

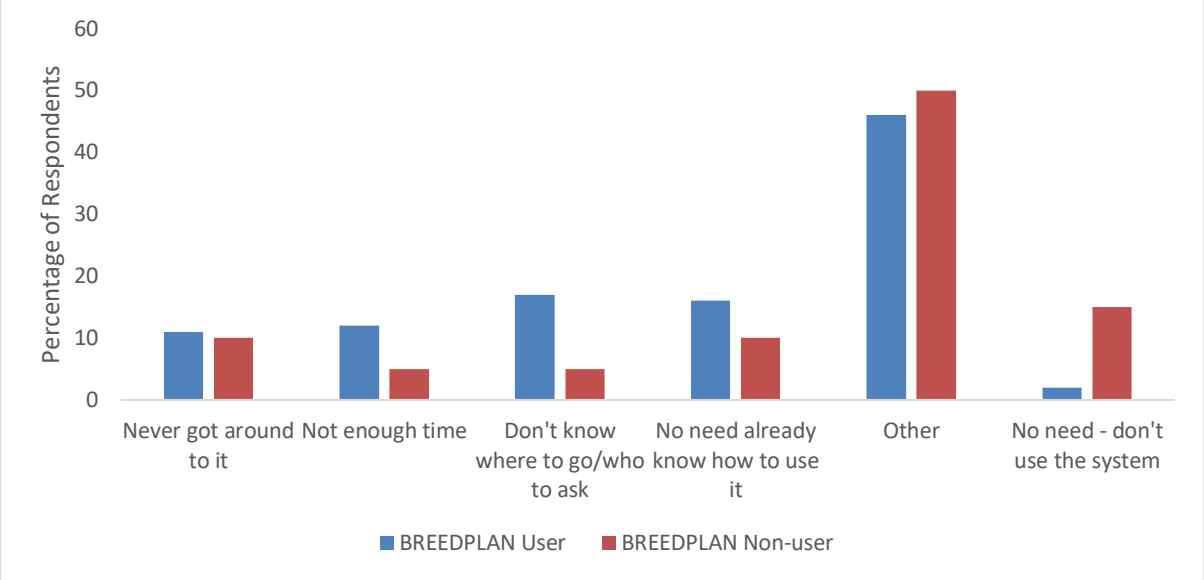

Figure 86 – Reason Why Seed-stock Producers have Not Received Training in BREEDPLAN

In the case of commercial producers, competing priorities and time are the main reasons for not seeking out training in BREEDPLAN. This is illustrated in Figure 87 below.

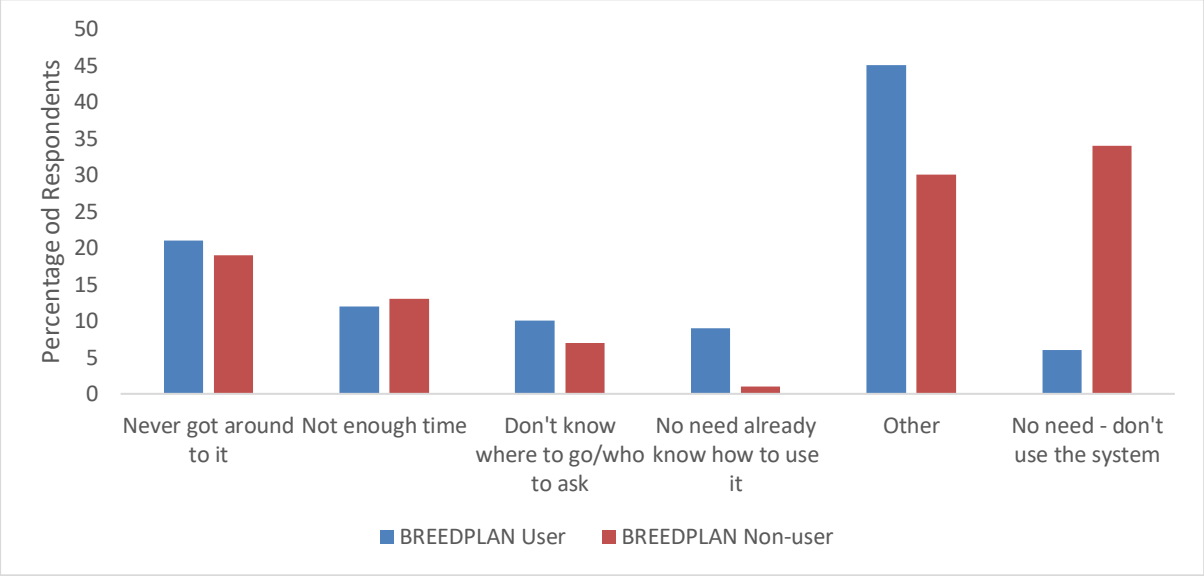

Figure 87 – Reasons Why Commercial Producers have not Received Training in BREEDPLAN

In the seed-stock sector, the most common source of training and guidance on BREEDPLAN is the breed associations, followed by BREEDPLAN People. This is illustrated in Figure 88 below.

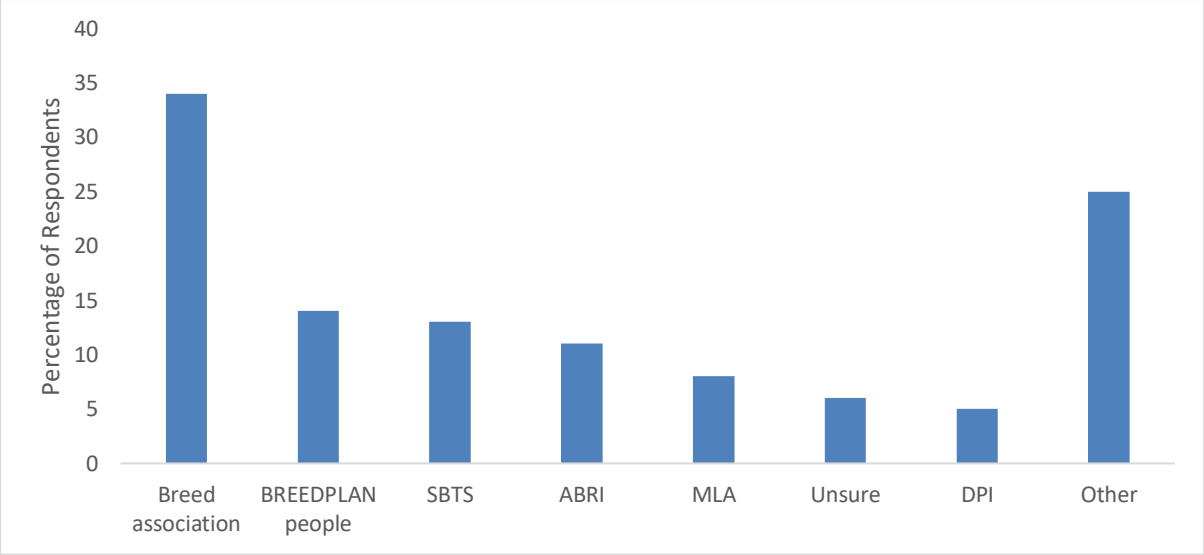

Figure 88 – Source of BREEDPLAN Training and Guidance

As illustrated in Figure 89 below, it is also the expectation of the seed-stock sector that the breed association will provide this training or guidance.

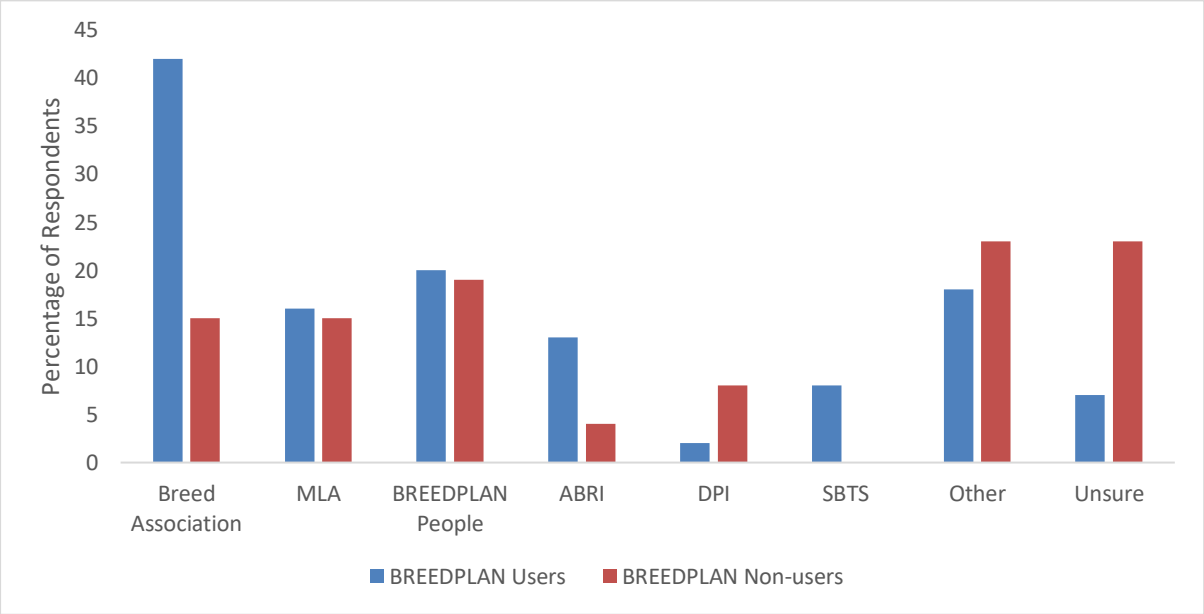

Figure 89 – Expectations as to Who Should Provide BREEDPLAN Training

In the commercial sector, breed associations play a more limited, but nevertheless relatively significant, role in providing training or guidance. This is illustrated in Figure 90 below.

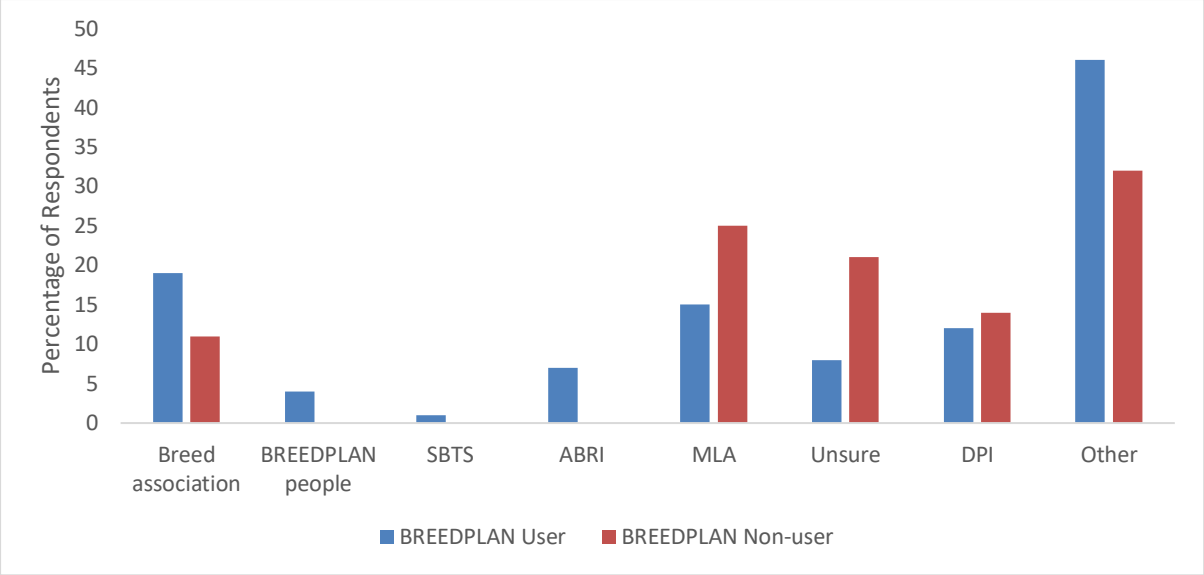

Figure 90 – Source of BREEDPLAN Training and Guidance – Commercial Sector

The commercial sector has a much higher expectation that MLA will provide the training and guidance for BREEDPLAN. This is illustrated in Figure 91 below.

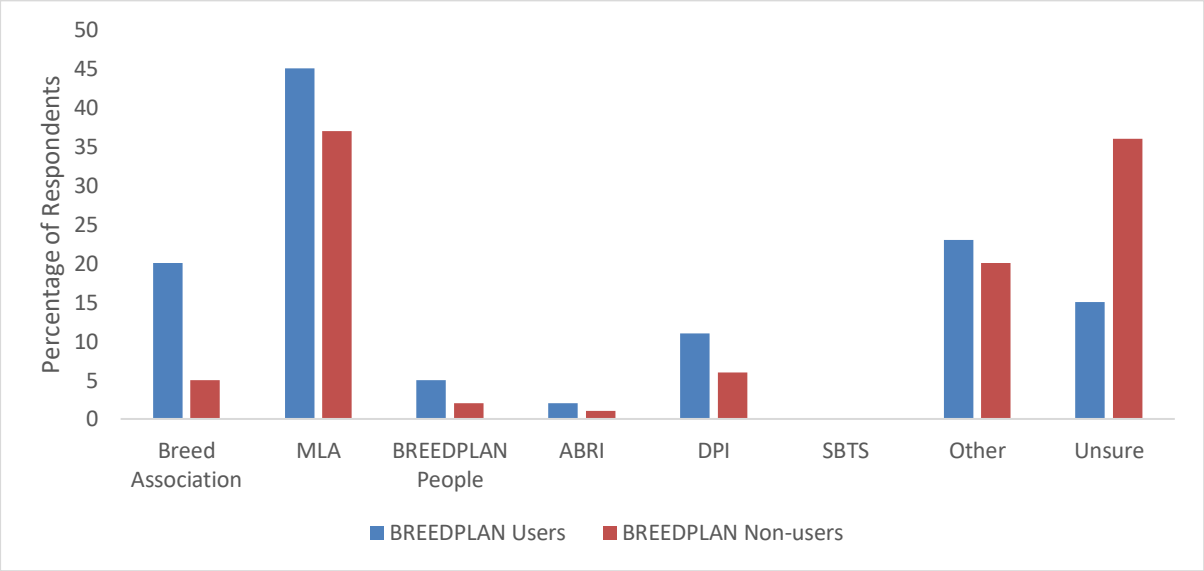

Figure 91 – Expectations as to Who Should Provide BREEDPLAN Training and Guidance – Commercial Sector