Final report

Animal Health and Welfare Target Scoping

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Prepared by: Sonja Dominik
CSIRO Agriculture and Food

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Meat & Livestock Australia Limited
PO Box 1961
NORTH SYDNEY NSW 2059

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Abstract

The aim of this project is to review the feasibility and boundaries of four proposed targets to measure progress towards the Australian Beef industry's best animal care goal.

The targets were:

1. 100% of Australian cattle properties will be covered by a documented biosecurity plan by 2025.
2. Increase the attendance of beef industry participants throughout the supply chain in effective animal welfare related training, such as low-stress stock handling, nutrition, animal welfare officer and related courses to 90% by 2030.
3. By 2030, 80% of calves born in seedstock herds will be polled.
4. By 2030, industry will have 100% adherence to the Immune Ready Cattle Vaccination Guidelines.

A literature review was conducted to identify practice change that aligns with targets, cost benefit of these changes and potential boundaries to achieving the targets. The literature provided evidence that shifting to practices that promote good animal health and welfare has clear economic and social benefits to individual producers and the whole industry. It was suggested to review the targets to ensure they are measurable and achievable. This project provides supporting information to set challenging but realistic targets that assist in demonstrating high animal health and welfare standards in the beef industry.

Executive summary

Background

With the launch of the Australian Beef Sustainability Goals in June 2023, further work is needed to identify tangible targets which can demonstrate industry's progress towards the goals.

This project will build on the best animal care goal, that is: The Australian beef industry is guided by the five domains of animal welfare. The industry provides all cattle with an environment in which they can thrive in accordance with these domains.

The aim of this project is to investigate the feasibility and boundaries to four proposed targets.

Objectives

The final report investigates the feasibility and boundaries of the following draft best animal care targets:

1. 100% of Australian cattle properties will be covered by a documented biosecurity plan by 2025.
2. Increase the attendance of beef industry participants throughout the supply chain in effective animal welfare related training, such as low-stress stock handling, nutrition, animal welfare officer and related courses to 90% by 2030.
3. By 2030, 80% of calves born in seedstock herds will be polled.
4. By 2030, industry will have 100% adherence to the Immune Ready Cattle Vaccination Guidelines.

The report focusses on the following key questions/objectives:

- How can the benefits to producers of achieving the above targets be determined and showcased? What might these benefits be? (e.g. productivity efficiency, weight gain, cost benefit analysis).
- What does the industry need to do in order to achieve these targets, and what would the cost be?
- Are there any physical boundaries to what has been proposed?

The objectives have been achieved. The report provides a review of scientific studies that underpin the assessment of the targets and resulting recommendations.

Methodology

A thorough, but not exhaustive, scan of primarily scientific literature, but also of relevant webpages and fact sheets from reputable sources, was conducted to scope and assess the targets of the "Best animal care" goals of the Australian Beef industry. The aim was to identify;

- practice change to align with targets
- cost and benefits of practice change to industry to implement these changes
- boundaries that might need to be addressed for practice change to be successfully implemented

Results/key findings

The literature provided evidence that shifting to practices that promote good animal welfare, i.e. having an on-farm biosecurity plan, attending animal welfare related training, breeding for polled cattle, and adhering to "Immune Ready" guidelines, has clear economic and social benefits to individual producers and industry.

Targets were reviewed using the SMART framework (specific, measurable, achievable, relevant, timebound). All targets were relevant and timebound. The project discusses the interconnectedness of achievability with the specificity of the target group (e.g. industry, stud) and the ability to measure progress towards the target.

Benefits to industry

The Australian Beef Sustainability Framework documents and demonstrates the progress of the beef industry towards practices that enhance animal welfare. The project demonstrated that engaging with practices that promote good animal welfare as captured in the targets, such as having an on-farm biosecurity plan, attending training courses relevant to the improvement of animal welfare, breeding for polled and adhering to Immune Ready has substantial production benefits and social benefits for producers, farm workers, and the whole community. The targets are well aligned with the five domains of animal welfare and benefits speak strongly to the One Welfare concept (Pinillos et al. 2016) that recognises the interconnection of positive human, animal, and environmental outcomes. The targets are based around best-practice approaches and cost of implementation is small compared to the potential economic and social impacts. It is important to recognise that certain health and welfare targets may present greater challenges for specific industry segments. Nevertheless, the targets are designed to foster a dialogue across the entire industry and to guide research and development efforts, ultimately aiding the achievement of these goals.

Future research and recommendations

It is critical that targets are defined around principles that support an evidenced based demonstration of progress. It is suggested to review the targets based on trust principles. Simulation studies could be useful tool to assist in setting realistic targets. It is suggested to do a full cost-benefit analysis for the transition to practices that promote good animal welfare to form an economic value proposition for industry.

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1. Background

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This project will build on the best animal care goal, that is: The Australian beef industry is guided by the five domains of animal welfare. The industry provides all cattle with an environment in which they can thrive in accordance with these domains. The aim of this project is to investigate the feasibility and boundaries to the four proposed targets below.

2. Objectives

The final report investigates the feasibility and boundaries of the following draft best animal care targets:

Target 1 - 100% of Australian cattle properties will be covered by a documented biosecurity plan by 2025.

Target 2 - Increase the attendance of beef industry participants throughout the supply chain in effective animal welfare related training, such as low-stress stock handling, nutrition, animal welfare officer and related courses to 90% by 2030.

Target 3 - By 2030, 80% of calves born in seedstock herds will be polled.

Target 4 - By 2030, industry will have 100% adherence to the Immune Ready Cattle Vaccination Guidelines.

The report focusses on the following key questions/objectives:

- How can the benefits to producers of achieving the above targets be determined and showcased? What might these benefits be? (e.g. productivity efficiency, weight gain, cost benefit analysis).
- What does the industry need to do in order to achieve these targets, and what would the cost be?
- Are there any physical boundaries to what has been proposed?

The report provides a review of scientific studies that underpin the assessment of the targets and resulting recommendations.

3. Methodology

Scientific literature that was published post 2000 and relevant to Australian beef cattle production systems was reviewed. However, in some cases recent studies relating to extensive beef cattle production in other countries, such as Brazil and the US, were included. In one instance, a study in lambs was included too.

For each target, background was provided. A section describing the potential cost and benefits of shifting to practices that promote good animal welfare are summarised in a table. It was not within scope of this project to conduct a cost benefit analysis for each of the targets. In the final section of each target, the boundaries to achieving practice change towards the target are discussed. Target 1 had potentially a very broad scope. Consequently, two case studies with high relevance to the Australian beef industry have been detailed to exemplify potential impacts.

4. Results

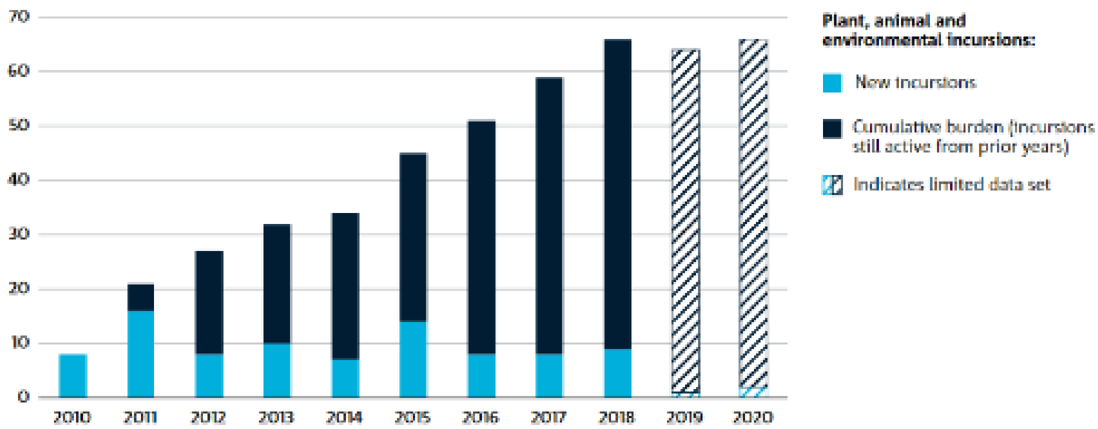
4.1 Target 1 - 100% of Australian cattle properties will be covered by a documented biosecurity plan by 2025

4.1.1 Background

“Biosecurity is the management of risks to the economy, the environment and the community from pests and diseases entering, establishing, or spreading in the Australian landscape. Through the combined efforts of the Australian, state and territory governments, industries, landholders, and the community, Australia’s biosecurity system reduces the risk of exotic pests and disease incursions that could cause harm to people, animals, plants, and other aspects of the environment.” (Buetre et al., 2013).

Biosecurity is critical to safeguard the health of the Australian population and environment and to maintain the competitive position of key agricultural industries in the global trade market ((Buetre et al., 2013). Over the last 10 years, disease outbreaks have been increasing in Australia, despite its strong biosecurity system (Fig. 1) (CSIRO Futures, 2020).

Figure 1. Indicative biosecurity incursions and cumulative burden in Australia (Data sources and timeframes referenced in CSIRO report (2020)).



Essential mechanisms to safeguard the nation include digitised, interoperable systems for animal traceability (CSIRO Futures, 2020) and a collective effort by state and territory governments, industries, producers, researchers, and the community (Department of Agriculture, 2022).

In the context of an agricultural property, biosecurity relates to the avoidance, containment and spread of pests or infectious diseases caused by bacteria, fungi, or viruses, affecting animal or plant species on-farm. The development of an on-farm biosecurity plan is a key activity that aims at preventing or eradicating pests and disease on an individual property. Early detection of infectious disease allows for rapid containment and prevention of spread and is an important tool to contribute to national biosecurity efforts. In this report we focus on the cost and benefits of a biosecurity plan for beef cattle operations from the perspective of infectious animal disease, both, established in Australia (endemic) and exotic (currently not present in Australia). Disease outbreaks can have major consequences for the beef industry with direct and indirect economic and social impacts.

The impacts and cost associated from disease outbreak are detailed in this section. Specifically, lost productivity from morbidity and mortality, and the costs of health treatments. The information is framed around two case studies 1) Foot-and-mouth disease (FMD), an exotic disease, with much larger scale impacts that are associated should an outbreak occur; 2) Bovine respiratory disease (BRD) as a disease endemic to Australia, which impacts on efficiencies in the production system, especially the intensive beef sector.

4.1.2 Case study 1 – Foot and Mouth Disease

Foot-and-mouth disease (FMD) is a severe, highly contagious viral disease in livestock. It affects cloven-hoofed (with divided hooves) animals, such as cattle, sheep, goats, camelids, deer and pigs (World Organisation for Animal Health, 2023). The disease currently occurs in Asia, the Middle East, Africa and parts of South America, but it is not present in Australia. The proximity of a recent outbreak in May 2022 in Indonesia poses a very serious threat to Australia's health and economy (Australian Government, 2023).

Response preparedness arrangements are essential to prevent disease outbreak. Considering the potential direct and indirect economic cost (Table 1), biosecurity efforts are vital and require an effort at all levels, including government, industries, producers and the community (Hafi et al., 2015). These biosecurity efforts include:

1) ongoing biosecurity surveillance by the Department of Agriculture, Fisheries and Forestry by managing controls at the border

2) response preparedness arrangements for emergency response and rapid eradication required by the state and territory agriculture departments

3) surveillance plans for the prevention and early detections of disease by producers and industry

The latter can be captured within an on-farm biosecurity plan. These are mostly voluntary, and requirements can vary between states and territories. Accreditation with the Livestock Production Assurance Program (LPA; Integrity Systems Company, 2023) requires participants to have a formal and documented on-farm biosecurity plan. Whilst participation in the LPA program is voluntary, many beef supply chains and processors are only procuring cattle from LPA accredited operations. Consequently, biosecurity planning becomes effectively mandatory for beef cattle producers that want to trade cattle. However, in 2022 only 86% of LPA accredited cattle producers audited had an actual documented plan (Australian Beef Sustainability Framework, 2023).

Direct economic impacts

The direct costs of an FMD outbreak are significant. The overall cost can be reduced with initial preparedness and early prevention. A biosecurity plan for beef cattle operations is a key mechanism to prevent the spread and enable quick eradication of an exotic infectious disease, such as FMD. With a biosecurity plan, the probability of the incursion of an FMD outbreak reduces from 16% to 1%

and the expected annual frequency of an outbreak reduces from once every 5 years to 1 in 100 years (Hafi et al., 2015).

One cost to producers to prevent an FMD outbreak include a biosecurity levy that producer will have to pay, effective from July 2024, to support governments prevention efforts of infectious disease. Slaughter levies collected for cattle make up the producers' contribution of 6% to the cost to maintain Australia's biosecurity system (Department of Agriculture, 2024).

The costs involved with the establishment, implementation and revision of an on-farm biosecurity plan includes those associated with auditing and the labour and potential costs of implementing changes on farm, including staff training. Keeping up to date with relevant documentation, and revising biosecurity plans accordingly, will be an ongoing time requirement to ensure a bio-secure beef cattle operation. The labour involved with the establishment of biosecurity plan can vary depending on the complexity, size, and location of the cattle operation. Animal Health Australia (2014a) published a resource for preparing a biosecurity plan for grazing enterprises in 30 minutes, which indicates a minimum time requirement. Hafi et al. (2015) estimated that a biosecurity system, that covers pasture and livestock, at the farm-gate improves the annual profits of a beef operation by $12,927. Because of the higher profits it also increases the value of the agricultural land.

The direct economic impacts from an FMD outbreak include the loss of export market access and reduced domestic prices, which can extend over a substantial period whilst the markets recover (Buetre et al., 2013). Additional costs are associated with eradication, damage, mitigation, and control measures. A large-scale outbreak of a zoonosis, such as FMD, can cost the livestock industries more broadly an estimated $80.31 billion across beef, sheep meat, pork, wool, and dairy products (Buetre et al., 2013).

In 2013, ABARES estimated the direct economic impacts to the beef industry of a large-scale FMD outbreak over 10 years at $32.26 billion (Buetre et al., 2013). This estimate was updated in 2022 to $53.77 billion (ABARES, 2022). A small outbreak in an extensive setting in Northern Queensland was estimated to have an impact of $5.6 to $6.2 billion depending on the eradication strategy (Buetre et al., 2013). Extensive production systems are likely to experience lower rates of disease spread due to a lower animal density and low-cost eradication strategies of eradicating infected herds are effective. In higher density areas, vaccination in addition to eradication is the most effective strategy but increases the cost to contain and stamping out a small outbreak due to delayed regaining of market access. For multi-state outbreaks the strategy of eradication and vaccination provides the best option.

As laid out in the Emergency Animal Disease Response Agreement (Animal Health Australia, 2023) and the AUSVETPLAN Operational Manual for valuation and compensation (Animal Health Australia, 2023), the cost of eradication of infectious disease might be shared between the government and industry. The cost sharing depends on the category of disease and the potential human health implications. If the exotic infectious disease only affects livestock, the livestock industries might have to cover 80% of the cost to contain and eradicate the disease (Animal Health Australia, 2022). The compensation relating to loss of property and livestock is managed by state and territory governments. It does not include allowances for loss of profit or production or any other consequential loss. Eligibility for compensation is determined by an inspector (Animal Health Australia, 2022). They assess that no unreasonable delay in reporting of signs of disease or death has occurred, and producers might not qualify for compensation if activities or lack of action have contributed to the spread of an emergency animal disease, or if a producer violated legislation or regulations, e.g. illegally importing any contaminated animal product (Animal Health Australia, 2023). An implemented biosecurity plan, which includes the familiarity with biosecurity legislation and regulation would help to prevent actions that might cause a producer to become ineligible.

Indirect economic impacts & social impacts

The impacts of an FMD outbreak will also have wide-spread effects on the broader industry with transport, trade and feedstock suppliers being negatively affected. It is estimated that profits might be reduced up to $11.5 billion over 10 years (Buetre et al., 2013). In addition, the beef industries might lose domestic market share to competing industries, such as grain and horticulture and possibly other livestock sectors, such as broilers.

At the individual producer and farming household level, loss of income and animal welfare concerns can cause mental health issues and reduce human welfare (Buetre et al., 2013). At the community level of restricted areas, uncertainty and social isolation might impact mental wellbeing and human health.

Table 1. Summary of costs and benefits associated with on-farm biosecurity.

Cost & benefit of an on-farm biosecurity plan	Amount / Estimate (where known)
Direct cost	
Cattle and livestock transaction levy	50 c per head for grass fed cattle
Beef production levy	0.06 c per kg of beef production
Cattle and livestock exporters charge	0.09523 c per kg of cattle live export live weight
Labour to write a farm biosecurity plan	Time to develop, implement and revise
Auditing	varied
Benefit (including plant biosecurity)	
Increased profitability	$12,927
Increased land value	unquantified
Improved producer familiarity with national strategy	unquantified
Flow on benefits to endemic disease management	unquantified
Cost associated with FMD outbreak	**Amount / Estimate (where known)**
Direct economic impact	
Containment, eradication, loss of market access	$ 53.77 billion over 10 years
Containment and eradication	Up to 80% might be carried by the beef industry
Ineligibility for compensation	Loss of value of property and livestock
Indirect economic & social impact	
Cost to associated industries	$11.5 billion over 10 years
Individual and household impact	Loss of income, human health
Community impact	Human health

4.1.3 Case study 2 - Bovine Respiratory Disease

Bovine respiratory disease (BRD) is a complex of diseases, which includes viral, bacterial and mycoplasmal infections (Ellis, 2001). Symptoms vary widely from respiratory to intestinal infections and hence, economic impacts also vary (Snowder et al., 2006). Bovine respiratory disease ranks as the leading cause of illness and mortality in Australian feed lots and costs the Australian feedlot sector over $40 million annually (Sackett et al., 2006).

While biosecurity practices captured in an on-farm biosecurity plan are key in reducing the prevalence of BRD, an integrated approach that targets the diverse factors is most effective. This includes vaccination, reduction of stress through yard weaning and minimisation of changes in the feedlot pen, in particular in the first four weeks (Meat and Livestock Australia Limited, 2024). Complete elimination of exposure to the pathogens causing bovine respiratory disease is presently unfeasible due to their endemic nature in the broader cattle population (Callan and Garry, 2002). Nonetheless, breeding for immune competence can remove the reservoir of highly susceptible animals and in combination with husbandry and production management practices, such as stress prevention, contain pathogens, and stop shedding, exposure, and transmission. Tailoring a combination of these control measures to individual farms can significantly reduce morbidity and mortality associated with BRD (Callan and Garry, 2002). Vaccines are a useful tool to prevent a BRD outbreak. An on-farm biosecurity might include a range of vaccination regimes depending on the origin of the cattle (bought or home-bred) and their destination (e.g. feedlot) (NSW Government - Local Land Services, 2024).

Direct economic impact

Analyses of carcase information from feedlot cattle in Australia has demonstrated that BRD reduces carcase quality with reductions in marbling, yield, fat depth and eye muscle area and in average daily gain and liveweight (pers. comms A. Ingham, L. Porto-Neto and A. Reverter, CSIRO, 2023). In addition, reductions in hot carcase weight were also reported by Blakebrough-Hall et al. (2020). In their study mortality attributed to BRD was 2.1%, which resulted in a net loss of $1,647.53 per death. Animals that were treated more than 3 times for BRD were 39.6kg lighter and returned $384.97 less than healthy animals. Sub-clinical BRD can be diagnosed through lung lesions at slaughter. Animals with severe lung lesions grew 0.3 kg/d less and were 14.3 kg lighter carcasses, returning $91.50 less than animals with no lesions. Mortalities increased by 34.7% in animals treated more than 3 times for BRD compared to healthy animals. All costs to cattle operations from BRD are summarised in Table 2.

Table 2. Direct economic impact associated with BRD.

Cost	Performance loss	Estimated unit cost	Estimated total cost
Vaccination		$10 per dose	$30
Treatment for BRD		Per animal and treatment $36.55 medication* $25.41 minimum wage†	$91.96
Mortality	2.1%	Per mortality	$1647.53
Final weight (> 3 treatments)	$39.6 kg	Per animal	$384.97
Final weight (sub-clinical BRD)	14.4 kg	Per animal	$91.50

* USDA Animal and Plant Health Inspection Service (2013)
† Fair Work (2023)

4.1.4 Boundaries

Scientific evidence shows that a biosecurity plan can safeguard individual producers and the beef industry overall from serious economic and social impacts. The cost of establishment, implementation and maintenance of biosecurity plan is small compared to the potential direct, indirect, and social impacts from infectious animal disease. Even the cost of an on-farm biosecurity plans to control endemic infectious disease is small compared to the potential economic impacts.

The clear value proposition of having an on-farm biosecurity plan suggests that either a lack of information or social impediments are the most significant barriers that would stop the industry from achieving the target. These might include:

- Knowledge and awareness
- Behavioural barriers
- Industry diversity
- Compliance and enforcement

Lack of adoption of an on-farm biosecurity plan might be caused by a lack of knowledge or awareness about the importance of biosecurity and its potential benefits and cost. Some beef producers may not fully understand the associated risks of an infectious disease outbreak or may underestimate the effectiveness of biosecurity measures on mitigating those risks. The Farm Biosecurity 2020 Producer Survey evaluated that 57% of farmers related the term biosecurity to 'controlling diseases, pests, and weeds' (Animal Health Australia and Plant Health Australia, 2020). To be highly effective, the transfer of the relevant information might require tailored communication to the needs and preferences of stakeholders in the beef industry.

Behaviours such as resistance to change and reluctance to adopt new practices might be barriers. Some beef producers may perceive biosecurity measures as onerous or inconvenient, especially if they require a change in established management practices or additional labour. In contrast to that perspective, a social study evaluated that seven out of the ten basic human values are connected to positive biosecurity behaviours in Australian beef cattle producers (Fountain et al., 2023). The value of benevolence ranked the highest, then security, followed by self-direction in relation to positive biosecurity behaviour. The study concluded that the values are highly significant for social cohesion, which suggests that a collective effort in disease management between government, industry and producers is likely to be successful. This result also reflects that the diversity of beef cattle industry, with a wide range of production systems and management practices, best achieves the adoption of biosecurity plans through coordinated efforts and collaboration among stakeholders across the entire industry supply chain. Although voluntary adoption of biosecurity plans may be a perceived barrier, the study highlighted that the emphasis on self-direction suggests that mandatory approaches may not be successful (Fountain et al., 2023). As alternative approach they suggest a prioritisation of biosecurity risks based on transmission and impact to allow for a self-directed decision-making process to align with the values that connect to positive biosecurity behaviour.

Setting realistic, achievable, and measurable targets to fosters the transition to more sustainable practices is challenging. A measurable target requires robust data that can provide evidence of trends. In 2022, 86% of audited beef cattle operations in LPA had a biosecurity plan (Australian Beef Sustainability Framework, 2023), however in a producer survey not linked to any particular scheme only 60% of respondents (across crops and livestock) had an on-farm biosecurity plan (Animal Health Australia and Plant Health Australia, 2020). This example demonstrates that survey approaches are useful, but they can yield inconsistent results depending on the data source. To ensure coherence and transparency, it is valuable to establish a consistent data collection method that accurately represents the specific target group, in this case, "Australian cattle properties". For instance, LPA audit data might serve as a representation of Australia's cattle properties, or a representative industry survey could be conducted. However, it is important to scrutinise whether data from an audited scheme mandating a biosecurity plan, such as LPA, truly represents the entire target group, in this case "Australian cattle properties". Alternatively, the target could be reframed to "100% of Australian cattle properties in LPA will be covered by a documented biosecurity plan by 2025", and LPA audit data would directly align with the target group. However, framing the target around a compliance scheme would foster genuine improvement in sustainable practices only if non-compliance does not result in punitive measures, such as termination of membership, but rather leads to constructive engagement aimed at shifting the non-compliant behaviour.

The target of 100% of cattle operations have a biosecurity plan within the next two years is a challenging timeframe. While the ambition behind this target is commendable, its achievability within such a short timeframe requires careful consideration. It is essential to assess the goal whether it aligns with practical timelines and to draw on previous experience on the effectiveness of enacting change. An informed approach to finalising the target goal and timeline might include detailing a plan of specific engagement strategies and campaigns aimed at driving behavioural shifts in practice, including an evaluation of the effectiveness of these actions.

4.2 Target 2 - Increase the attendance of beef industry participants throughout the supply chain in effective animal welfare related training, such as low-stress stock handling, nutrition, animal welfare officer and related courses to 90% by 2030

4.2.1 Background

The transition to a more sustainable red meat supply chain, including increased level of animal welfare, requires a new knowledge base (Šūmane et al., 2018). Training programs are a useful means not only to increase knowledge and skills, but also to obtain certification which allows to demonstrate competency. In the following, key areas, namely legislation and standards, nutrition and animal handling are detailed where training programs are a cost-effective approach to reducing the risk of economic and health impacts. Few studies provided actual estimates of economic impacts, however, the breadth of potential multi-facetted effects is described and summarized in Table 3.

4.2.2 Risks of non-compliance

4.2.2.1 Knowledge and adherence to legislation and standards

Standards for cattle welfare are framed around the Cruelty to Animals Act 1979 (Prevention of Cruelty to Animals Legislation (POCTA)). People involved in the care and welfare of animals must comply with the legislation. Standards assist in operationalising the legislative requirements and provide a framework for auditable certification programs. It is important for workers in livestock operations to be familiar with such documents to ensure compliant animal treatment and avoid inadvertent illegal practices. In New South Wales, violating legislation might carry charges such as $10,000-$1 million or 6 months to 2 years in prison, depending on the severity (Australian National Character Check, 2024).

Animal Health Australia developed on behalf of The Department for Agriculture, Fisheries and Forestry the Australian Welfare Standards and Guidelines for Cattle and for Land Transport of Livestock (Animal Health Australia, 2014b, 2012)to ensure a consistent standard for all cattle in

Australia. The cattle standards provide comprehensive details regarding the duties and oversight of cattle management for individuals involved in livestock care. They are based on scientific principles, in accordance with current practices, and mirror community expectations. The transport standards set out requirements for livestock-handling for the phases of transportation. National standards for processing plants are under development, but an auditable industry standard (Industry Animal Welfare Standard for Livestock Processing Establishments Preparing Meat for Human Consumption, Australian Meat Industry Council (2020)) and Code of Conduct (Standing Committee on Agriculture and Resource Management, 2002) are in place. The documents ensure staff are trained in livestock handling and management, including appropriate stunning procedures.

A number of training courses exist. For processing plants and feedlot sector, Australian Meat Processor Corporation (Australian Meat Processor Corporation, 2024) and the Australian Lot Feeder Association (Feedlot Tech, 2022) have developed Animal Welfare officer training programs to provide a certification of competency for managing, handling and, in the case of the officer at the processing plant, slaughtering animals. Other training courses comprise accredited livestock handling induction training program includes the concept of low stress livestock handling.

4.2.3 Risk of stress to animals

4.2.2.2 Nutritional stress

Adequate nutrition is key to a healthy and productive herd. Adequate nutrition can be visually assessed by body condition score. Abrupt changes in the diet or deficiencies can lead to nutritional stress (Carroll and Forsberg, 2007). Climate/weather and nutritional availability in extensive systems are inextricable linked. Climate change is likely to exacerbate the risks of variable of reduced nutritional supply to cattle (Lacetera, 2019). Starvation or malnutrition can lead to weight loss, lower productivity, and diminished immunity (Saker, 2006). On the other hand, overnutrition can result in obesity-related health issues. Stress, inflammation and feed intake in beef cattle form a complex of factors that can affect productivity (Gouvêa et al., 2022). Stressors that down-regulate the immune system, including nutritional stress, can lead to increased incidence and severity of respiratory infections (Hodgson et al., 2005). The potential economic impact from respiratory infections such as the ones experienced in the BRD complex has been outlined in the previous section 4.1.3.

4.2.2.3 Animal Handling

There are critical events in the lifetime of beef cattle that can affect their welfare. Multi-facetted factors interact, such as the environment, change of environment, feed and water availability, social interaction with conspecifics and human interaction during handling events. Handling is one of the controllable factors. Low-stress animal handling that reduces negative behavioural responses will decrease the state of arousal and associated physiological responses (Hemsworth and Coleman, 2011). An extensive review of literature on the human-animal interaction concluded that the actual effect of handling on production in extensive livestock species is minimal due to the sporadic interaction with humans (Hemsworth and Coleman, 2011). However, at other critical periods in the life of beef cattle, such as transport (Hultgren et al., 2022), feedlot (Schwartzkopf-Genswein et al., 2014) and abattoir (Ferguson and Warner, 2008), the effect is more pronounced due to a more intensive setting or prolonged periods of stress.

Since stress is difficult to quantify, studies, more commonly, explored the relationship of temperament with production and reproduction ((e.g. Coombes et al., 2014) or the use of temperament and stress measures as a predictive tool for production outcomes ((e.g. Anderson and Miller, 2018). The link between human-interaction and fearfulness has been well established as a potential cause of high state of arousal (Hemsworth and Coleman, 2011) and is comparable to the state of arousal caused by nervous temperament. Few studies reported the size of the effect of stress or temperament on production and reproduction traits.

Impact of stress on growth and meat quality

In studies that used temperament as a predictor for growth and meat quality, relationships between stress measures, muscle glycogen and pH, and meat quality were found (Anderson and Miller, 2018). The effects were small, but temperament at feed lot entry was a good predictor of shear force, an objective measure of meat tenderness. These findings agree with another study that found low negative relationships between flight speed, as a measure of temperament, and body condition score, carcase traits and meat quality (Petherick et al. 2002). The same study demonstrated no effect of positive interactions on flight speed. A study in tropically adapted breeds demonstrated that selection on improved temperament has positive correlated effects on meat quality traits (Kadel et al., 2006).

In feedlot cattle, chronic stress markers were higher compared to slaughter and a strong negative phenotypic relationship of r_p =-0.49 between temperament and average daily gain was established (Anderson and Miller, 2018). The study found that animals with the worst temperament had 0.46 kg and 20.8 kg lower average daily gain and hot carcase weight, respectively, compared to animals with the best temperament (Anderson and Miller, 2018). A low to moderate negative relationship of flight speed on average daily gain, more nervous animals have lower average daily gain, was found in feedlot cattle, but the size of the effect was not quantified (Müller and von Keyserlingk, 2006; Petherick et al., 2002).

Beef cattle experience periods of acute stress, sometimes prolonged, during transport and prior to slaughter. Duration of transport has a negative effect on meat tenderness (Hultgren et al., 2022). However, there are other contributing factors next to handling such as the number of rest breaks, driving style and the actual transport vehicle (Dalla Villa et al., 2009; Hultgren, 2019). A large body of work demonstrates that pre-slaughter stress negatively effects meat quality traits in beef (Ferguson and Warner, 2008). A comparison of cattle that received a treatment with electric prodder prior to slaughter dropped 4 points in MSA CMQ4 score because of lower meat quality parameters (Warner et al., 2007) and groups of cattle with higher carcase pH presented with higher stress indicators (Carrasco-García et al., 2020). Although Coombes et al. (2014) did not find a relationship between temperament, as measured in flight time, and meat quality, they found that cattle with more flighty temperament mobilized more glycogen than calmer animals, which presents a higher risk to lower meat quality. In a study on lambs, a relationship between plasma indicators of acute stress, such as plasma glucose and lactate, with loin ultimate pH was found prior to slaughter, indicating that there might be an effect on meat quality (Stewart, 2019). However, plasma indicators can be highly variable in response to stress. Nevertheless, all studies recommend that the avoidance of stress prior to slaughter mitigates the risk of stress affecting meat quality.

Impact of stress on reproduction

Acute stress can lead to compromised reproduction or maternal behaviour due to complex mechanisms of hypothalamic, pituitary, and ovarian function, however, the relationship is not yet well understood (von Borell et al., 2007). Between 5 – 42 days after insemination, conception rate can be affected if cows are exposed to acute stress, particularly during transport (Salverson, 2020). It was demonstrated that 6-12% pregnancy loss can occur if cows are transported between 5-42 days after insemination compared to transport during the first 4 days.

Cows with a nervous temperament had lower reproductive performance (Cooke et al., 2012; Kasimanickam et al., 2014). On average, excitable cows had 5.5% lower pregnancy rate, took 24 days longer to fall pregnant and pregnancy loss was 2.3% higher compared to cows with calm temperament (Kasimanickam et al., 2014). It must be noted that the lower reproductive performance in this study is attributed to temperament and not handling as a stressor. However, improving temperament through acclimation of heifers to human handling after weaning has been demonstrated to be a successful strategy to improve reproductive development (Cooke et al. 2012). The findings by Kasimanickam et al. (2014) might indicate that it would also positively affect reproductive performance at mature ages.

Bulls' reproductive performance can also be compromised by stressors, in particular in bulls used for artificial insemination. Stressful handling procedures might affect semen quality score (Fernandez-Novo et al., 2020), and bulls with excitable temperament have shown higher primary defects in their ejaculate compared to calmer bulls (Lockwood et al., 2017). Training and acclimatization to the semen extraction procedure has been demonstrated to lead to lower stress as indicated in lower cortisol levels in hair in Angus cattle (Lockwood et al., 2017).

Most studies that investigate the effect of stress on reproduction have been conducted in dairy cattle and in relation to artificial insemination. It Is worth noting, the level of human animal interaction in dairy systems is much more frequent than in extensive beef cattle or feedlot operations and provides more scope for prolonged stress, if the experience is negative. Strategies such as avoiding stress in cows during conception and habituating cattle to positive human interactions are likely to have a positive effect on temperament and reproductive outcomes.

Impact of stress on risk of animal and human injuries

In Australia "being bitten or hit by an animal" causes 4% of total fatalities and 9% of all compensation claims between 2008 -2011 across all agricultural industries (Safe Work Australia, 2013). "Being hit by moving object" was the most common cause of injury related to cattle with 82%. More recently, a break-down of presentations to a regional Queensland hospital between 2018-2021 attributed 193 of the presentations as related to cattle (Savage et al., 2023). The most common injuries were associated with being trampled (39.4%), kicked (18.7%) and crushed (22.3%) and 46% of patients had to be admitted (Savage et al., 2023). It is a legal obligation of the employer and of the individual to ensure the health and safety of their employees and themselves, respectively. Understanding animal behaviour and low-stress handling practices in combination with appropriate handling equipment can reduce the risk of injury or death caused by animals (Langley and Morrow, 2010).

The relationship between animal welfare and human wellbeing has been recognised in the "One Welfare" concept (Pinillos et al., 2016). Witnessing an animal suffer, being mistreated or a farm worker not feeling empowered to provide the best animal welfare can evoke stress and reduce job satisfaction (Brando et al., 2023). A positive association has been established between the handler's empathy and the quality of animal interaction with pre-slaughter (Leon et al., 2020) which would indicate that it is a win-win situation when animals are handled well, animal welfare increases, and the handler's mental wellbeing is also positively affected. It has been suggested that training should not just focus on the skills to handle animals in a low stress approach but also include a cognitive-behavioural component to teach an understanding of the underlying attitudes of the handler (Hemsworth, 2018).

Understanding the behaviour and movement of individual and herds of cattle enables low stress handling and lower risk of injury to the handler and the animal (Moran and Doyle, 2015). Handling procedures that induce fear increase the risk of injury to animals by slipping or falling, caused by erratic movement. Injuries might include hip and pelvic injuries, or hoof injuries that lead to lameness (Moran and Doyle, 2015). In feedlot cattle, upper limb injuries and lacerations, caused by bad temperament, pen flooring, or sustained from handling procedures before and after arrival, have been named as some of the main factors for lameness (Terrell et al., 2014). The cost of treating lameness was estimated to be $21 (converted to $AUS from a 2014 estimate in feedlots of $US 13.90 US on average) and 26.46% of treatment cost in feedlots (Schwartzkopf-Genswein et al., 2014).

Table 3. Risks and potential impacts that can be mitigated through training courses.

Topic	Risk	Effect of stress	Cost
Welfare legislation and standards	Violation of legislation		$10,000 – $1 million 6 months – 2 years imprisonment
Nutrition	Starvation or malnutrition	• body weight • productivity • feed intake • inflammation • frequency and severity of respiratory disease	decreased decreased decreased increased increased
Animal Handling	Increased stress		
	• at feedlot (chronic) and transport and pre-slaughter (acute)	Production • average daily gain • hot carcase weight • carcase quality • meat tenderness • MSA score • ultimate pH	• 0.46kg decrease • 20.8kg decrease • reduced • reduced • reduced • increased
	• transport (acute)	Reproduction • pregnancy loss • pregnancy rate • time to fall pregnant	• 2.3% higher • 5.5% lower • 24 days longer
	• on-farm (acute)	Safety to humans • number of deaths • number of reported injuries • mental wellbeing	• increased • increased • decreased
		Safety to animals • Injuries • Lameness	• increased • $21 per animal

4.2.4 Boundaries

Factors such as lack of knowledge of legislation and standards, nutrition and the effects of stress caused by poor animal handling directly effect on-farm productivity, carcase quality and the physical and mental health of livestock handlers (Table 3). The risks that the lack of knowledge carries can be mitigated through training courses. The red meat industry has developed a range of courses that can enhance the skills and competence in the red meat supply chain. The benefits in production, reproduction, job satisfaction and safety outweigh the cost for training courses. In addition, issued certification is a useful demonstration of competency in the new knowledge and skills.

The clear value proposition of increasing knowledge suggests that a lack of information or social boundaries are the most significant barriers that would prevent the industry from achieving the target. Some of these are like the boundaries for Target 1:

- Awareness and access
- Cultural and behavioural barriers
- Training program quality and effectiveness

A wide range of training courses are available. However, awareness of available training opportunities and accessibility, such as geographical location or cost might need to be reviewed to ensure that supply chain stakeholders are sufficiently enabled to take up these training opportunities.

The transition to a more sustainable red meat supply chain requires a new knowledge base (Šūmane et al., 2018). Training programs are useful means not only to increase knowledge and skills and to facilitate demonstrable competency. Resistance to change or traditional practices within the beef industry that might be outdated and do not consider appropriate animal welfare as legislated and regulated by standards. The effectiveness and quality of training programs play a key role in attracting and effectively upskilling industry participants. Courses might need to consider a different dimension for animal handling, where the outcomes are based on the interaction between the handler and the animal. The best outcomes can be achieved by educating not just aspects of the animal behaviour but also include a cognitive-behaviour component, challenging existing attitudes in animal handlers (Hemsworth, 2018). If training courses speak to the values of benevolence and self-direction that have been identified as key motivators for engagement, participation and up-take is likely to increase (Fountain et al., 2023).

For a target to be achievable it must be measurable for evaluation. Reliable outcome-based metrics to track progress towards increased animal welfare are challenging. Rules-based indicators, such as the attendance in training courses is straight forward to track and a useful metric. A variety of training courses in different format exist, so it might be beneficial to identify and list relevant training courses to ensure consistent and high-quality training outcomes. It is recommended to evolve the targets with the development of appropriate low-cost outcome-based metrics that demonstrate actual animal welfare outcomes.

The current definition of the target group ("industry participants") is broad. It may require further refinement to ensure that the target is specific and measurable and fosters improved animal welfare. A suggested refinement might be "beef industry stakeholders that handle animals or supervise staff that handle animals". This definition more precisely identifies the industry participants who can impact animal welfare outcomes across the supply chain and clarifies the group for data collection.

4.3 Target 3 - By 2030, 80% of calves born in seedstock herds will be polled

4.3.1 Background

Dehorning or disbudding of cattle is a common practice in beef cattle operations to reduce the injury risk for handlers and other animals in the herd. The Australian Standards and Guidelines for Cattle (Animal Health Australia, 2014b) outlines age and appropriate pain management for disbudding and dehorning to reduces the impact of this painful procedure. However, breeding cattle to be polled, i.e. without horns, means that animals do not have to subjected to disbudding or dehorning at all.

When the genomic era in animal breeding emerged in 2001 as a powerful pathway to identify genes through linked markers for various characteristics and disease in livestock, the identification of the polled gene was considered as “low hanging fruit”. However, it took until 2010 for the first polled test, based on microsatellite markers, to be commercialised (Henshall et al., 2011). Refinements were made by moving from a single marker to a haplotype in 2014, with higher accuracy for Angus and Limousin (Henshall et al., 2014) and a further development increased effectiveness even more (Lyons and Randhawa, 2020) . Some breeds are naturally polled and the frequency of the polled allele varies. The demand for polled cattle in Northern Australia has been high (Williams et al., 2021), recognising the benefit in these extensive settings in reduced labour, and reduced cost and associated complications with dehorning cattle. The percent of polled calves born in seedstock herds has dropped slightly from 73.3% in 2020 to 71.9% in 2022, with a 3.6% increase since 2010 (Australian Beef Sustainability Framework, 2023, 2022). Table 5 summaries the cost of different strategies to deal with horns in beef cattle.

4.3.2 Genetic testing

The polled phenotype underlies a mendelian inheritance pattern. It is determined by an autosomal dominant locus with two alleles, P (polled) and p (horned) (White and Ibsen, 1936). The locus was mapped to chromosome 1 on the bovine genome (Georges et al., 1993). However, there are at least three genes associated with horn and scur formation, namely, poll, scur, and African horn and phenotypic expression of these genes can sometimes mask the real horn phenotype.

Using genetically tested bulls with homozygous (PP) or heterozygous (Pp) genotype is the most effective strategy to increase the frequency of the polled allele (P) and the polled phenotype in a herd. The current genomic test for polled, based on single nucleotide polymorphism, has shown high levels of accuracy of over 99% for taurine and indicus breeds (Lyons and Randhawa, 2020).

Progress in polledness over the last 20 years has been significant for European breeds such as Limousin, Charolais, Simmental and Hereford with less progress in Brahmans and composites such as Santa Gertrudis (Lyons and Randhawa, 2020). The Wagyu breed is close to 100% horned and the effectiveness of the test in Wagyu cattle has not been described. Wagyu cattle were not included in the development of the polled test (Lyons and Randhawa, 2020).

4.3.3 Direct economic impact of horned cattle

Horns are a major cause of injuries to other animals, in particular in the feedlot and during transport, with economic consequences from hide damage and carcase bruising (Prayaga, 2007). The cost to the Australian beef industry of bruising has been estimated at $30 Million per year (Commonwealth Scientific and Industrial Research Organisation, 2014), noting that not all bruising is caused by horns.

Dehorning or disbudding carries a cost that includes the cost of treatment of complications. A Brazilian modelling study assumed cost associated with disbudding and treatment of complications to be $2.10 and $8.56 respectively (Oliveira et al., 2023; converted from Brazilian Real). An Australian study estimated the cost of disbudding to be higher at around $10 (Lyons and Randhawa, 2020). The Brazilian study evaluated that a combination of phenotypic selection and disbudding reduced the frequency of horned cattle from 92% in 2021 to 12% by 2050 and disbudding and treatment cost per 100 animals would be $40 lower than without phenotypic selection. A faster rate of change could be achieved by using bulls with known genotype. An increased frequency of the polled phenotype within herd or industry-wide is not expected to have negative influence on production, carcase, fertility and behaviour traits (Lyons and Randhawa, 2020).

Dehorning was found to be a major factor of calf death in tropically adapted breeds in extensive systems (Bunter et al., 2014). Post-branding 2.1% of dehorned calves died, which is 15.9% of all dead calves. Complications from dehorning post-branding accounted nearly for all deaths in that period. The cost was estimated to be $6 Millon per year (Bell and Sangster, 2022).

The polled test is bundled into a genomic 50K SNP chip, which also provides information on breed relevant defects and determines parentage, $5 per sample can be attributed to the polled test (Lyons and Randhawa, 2020). Stand-alone tests for polled are available at about $25.

The Brahman breed is still lagging in the availability of polled bulls. A total of 1,533 Brahman animals from 22 herds were genomically tested for polled (Australian Brahman Breeder's Association, 2018). The allele frequency of polled was calculated at 20% for the Australian Brahman population resulting from the test results of 39 homozygous polled, 443 heterozygous polled, and 1,051 horned animals (Mueller et al., 2021). It was established that the homozygous polled animals had $6 lower JapOX Index compared to heterozygous or horned animals. The study simulated the reduction of the horned allele frequency at different selection pressures and the results from the simulation demonstrated that increased selection pressure on the horned phenotype compromises genetic gain (Table 4).

Table 4. Resulting frequency of horned allele after 20 years with varying selection pressures with an initial gene frequency of 20%.

Scenario	Frequency of horned allele	Genetic gain
Selection on $JapOx only	80%	$8 / year
Preferentially using polled sires	30%	$6.70 / year
Dehorning is banned	8%	$5.50 / year

Table 5. The cost of different strategies to minimise the horn phenotype in beef cattle.

Strategy	Cost item	Effect	Cost
No action			
	Injury to other animals	• Bruising • Hide damage • Wounds	• Up to $30 Million pa • Increased • Increased
	Injury to handler	• Number of reported injuries	• Increased
Disbudding/dehorning			
	Cost of disbudding/dehorning		• ~$10 per animal
	Complications of disbudding/dehorning	• Infection • Calf death	• ~$22 per animal • 15.9%; estimated at $6 Millon pa
Genetic selection on polled			
	Genomic testing		• ~$5 polled test as part of a bigger chip • $25 testing stand-alone test
	Selection intensity on polled		• Potential reduction in genetic gains

4.3.4 Boundaries

Scientific evidence shows that polledness in cattle increases animal welfare, handler safety and has production benefits by causing fewer injuries to other animals (Table 3). The main contributing factors to achieving the target are:

- availability for an effective test
- initial polled allele frequency in the herd
- availability of bulls that are homo- or heterozygous for the polled allele
- preparedness of breeders to adopt a breeding strategy for polled
- effective strategy for introgression of the polled allele that minimizes impact on genetic gain and inbreeding

A genomic test that is effective for a number breeds is available and the cost of the test outweighs any potential cost of dehorning or disbudding (Lyons and Randhawa, 2020). However, in 2020 the test was reported to still have undetermined results for 13.7-17% for Charolais, Shorthorn, Brangus and Brahman (Lyons and Randhawa, 2020). The undetermined rate was highest for Wagyu samples at 30.4%, but Wagyu were not included in the original development of the microsatellite test (Lyons and Randhawa, 2020).

The beef industry has certainly recognised the benefits of polled cattle (Rayner, 2023). However, there has been the perception that polledness in bulls is associated with poorer reproduction. A small effect has been detected in Brahmans and a small negative association with production in Droughtmaster, but it has been largely disproven in a BREEDPLAN analysis (Randhawa et al., 2021). Strategies of reducing the horned allele in a herd require a trade-off between the speed of introgressing the polled allele and selection pressure that can be exerted on a breeding objective (Mueller et al., 2021). Other factors on the strategy for introgression are the initial polled allele frequency in the herd and the availability of bulls that are known homo- or heterozygous for the polled allele. For breeds with few polled animals, such as Wagyu, Brahman and Santa Gertrudis a breeding strategy also has to balance the risk of diversity loss and inbreeding (Lyons and Randhawa, 2020). Without simulations it is difficult to assess if the target of 80% in 2030 is realistic. The timeframe provides a sensible transition period for a genetic shift, and based on the simulations for Brahman cattle by Mueller et al. (2021) a 10% increase in polled calves born in the stud sector appears achievable. However, achieving the goal requires targeted research and development into the continued development of effective genetic tests for all breeds. Approaches to drive the achievement of the target could include the assessment of initial gene frequencies for specific breeds and simulation studies to explore realistic time frames for introgression of the polled gene whilst safeguarding economic sustainability and maintaining genetic diversity.

The target demonstrates a proactive approach to ensuring future markets sustainability even if welfare policies become stricter regarding dehorning practices. Similar to target 1, it would be useful for this target to identify a consistent method for gathering the relevant data to track progress. Options could include survey data covering a representative sample of the whole stud sector or records from BREEDPLAN.

4.4 Target 4 - By 2030, industry will have 100% adherence to the Immune Ready Cattle Vaccination Guidelines

4.4.1 Background

Incorporating vaccines into a comprehensive herd health strategy is critical to the biosecurity of beef cattle operations and to the whole beef industry. They play a pivotal role in preventing infectious endemic disease in livestock and are also an important part of a strategy to contain the outbreak of an exotic infectious disease (Schat, 2014). A health strategy that includes vaccination is a proactive approach to enhance animal well-being and productivity.

Saleyards are vital hubs in the cattle industry, facilitating contact and transmission of disease. On average, saleyards handle approximately 6 million head of cattle annually (Department of Agriculture, Fisheries and Forestry 2019). Figure 1 exemplifies a single day of sheep and cattle movements into and from Victorian saleyards (Victorian Auditor General 2015). Traceability systems such as the National Livestock Identification Scheme are important components to uphold national biosecurity.

A survey evaluated that an increasing number of livestock producers check the health status when purchasing new cattle (Animal Health Australia and Plant Health Australia, 2020). However, according to an industry perspective only about half of all beef producers observe a quarantine period on induction of new stock, with 30% drenching or dipping, and 16% vaccinating (Rayner, 2023). In 2022, a survey of 803 beef producers explored vaccination rates for some endemic disease (Table 6, Sloane and Walker, 2022). Compared to 2010, they increased by only 2-4%.

Figure 1. Sheep and cattle movements into and out of saleyards on 29 January 2015 (Victorian Auditor General, 2015).

Map courtesy of Department of Economic Development, Jobs, Transport & Resources.

Table 6. Vaccination rates for selected endemic infectious diseases in 2022.

Endemic infectious disease	Vaccination rate
Botulism / Booster	27% / 64%
Clostridial disease	76%
Pestivirus	23%
Bovine ephemeral fever	10%

Responding to the need for a trusted process that demonstrates a commitment to animal health and biosecurity at the sale yards "Immune Ready" was launched in 2020. Immune Ready Guidelines provide information to buyers and sellers for the care of cattle to protect them at all stages of sale from the most common endemic infectious diseases (Immune Ready, 2022). Immune Ready provides a credential that is underpinned by a National Cattle Health Declaration. On one hand, it demonstrates a proactive approach by the seller to the reduction of disease risk and improved health and welfare of their cattle and they can use the logo as a differentiator for their cattle. On the other hand, it provides the buyer with confidence in the purchase of immunised cattle that will not be a biosecurity risk for introduction on their farm. Other vaccine programs have been introduced but have not been successful due to their sectoral application (Condon, 2024). Immune Ready is an industry first that engages all of supply chain.

4.4.2 Economic impact

Appropriate use of animal health treatments supports an economically competitive beef cattle industry in Australia. Treatments incur additional cost, but animal health and productivity are significantly improved, with lower treatment cost for diseases and lower mortalities. Good animal management that is fostering a high level of health and welfare has not just economic benefits, but also impacts positively on human health (ACIL ALLEN Consulting, 2018). These effects have not been quantified. Table 7 summarises the economic impact of the diseases that are required to be eligible to for "Immune Ready" status (Immune Ready, 2022). Nine of the diseases are named on the priority list of endemic diseases in the red meat industry (Shephard et al., 2022).

Table 7. Economic impact of infectious diseases recommended for vaccination in Immune Ready.

	Treatment	Prevention	Production	Total
	$ million	$ million	$ million	$ million
Clostridial infection* (south)	0	18.4	5.0	23.4
Leptospirosis[§]				• Calf mortality • Abortions • Zoonosis
Pestivirus* South North	 0.0 0.0	 5.0 2.7	 58.5 48.2	 63.5 50.9
Vibriosis* South North	 0.0 0.0	 2.3 3.2	 20.9 17.3	 23.2 20.5
Bovine respiratory disease† complex including Infectious bovine rhinotracheitis				40.0
Bovine Johne’s Disease* South North	 0.0 0.0	 0.0 0.0	 0.5 0.1	 0.5 0.1
Botulism* South North	 0.0 0.0	 0.0 8.7	 3.0 20.4	 3.0 29.1
Calf scours* (south)	4.2	5.5	10.7	20.5
Salmonella[‡]				• Respiratory disease • Infections • Diarrhoea • Mortality • Embryonic death
Pink eye* South North	 1.5 0.1	 3.0 0.2	 4.4 0.8	 8.9 1.1
Bovine Ephemeral Fever* South North	 0.0 1.1	 0.0 0.4	 0.1 20.7	 0.1 22.4
Tick Fever* (north)	0.0	3.4	4.1	7.6

*Shephard et al. (2022)
†Sackett et al. (2006)
[‡]NADIS Animal Health Skills (2009)
[§]Zelski (2007)

4.4.3 Boundaries

Scientific evidence shows that a vaccination program for cattle is an important tool to safeguard beef operations from endemic infectious disease when introducing new animals. The cost of potential disease outbreak outweighs the cost of vaccination, plus the Immune Ready logo may provide market advantage.

The value proposition adhering to "Immune Ready" guidelines is clear for the conventional beef sector. A lack of participation in the scheme in conventional beef operations might suggests producers are not well informed or attitudes, perceptions, and behaviours prevail that would stop industry from achieving the target. Understanding the impact of vaccination on premiums for organic beef was outside the scope of this study; however, it would certainly shift the value proposition for this sector of the beef industry.

Immune Ready is still a new scheme and adherence rates need to be monitored. The guidelines provide useful information about what vaccines are recommended for which class of cattle and which location. Current vaccination rates might suggest that there is still a lack of knowledge or awareness about the importance of the role of vaccines in on-farm biosecurity (Sloane and Walker, 2022), and some beef producers may underestimate the effectiveness of vaccination to mitigate biosecurity risks. A producer survey evaluated reasons for boosting for clostridial disease and only 6% were unaware that it was needed, which is a minor group (Sloane and Walker, 2022) and might suggest that in this case relevant information is not a problem. The cost and labour involved with vaccination might be seen as a hurdle.

Since on-farm biosecurity is an important component to uphold national biosecurity, it makes sense to package communication. To be highly effective, the transfer of the relevant information might require tailored extension material and courses to the needs and preferences of stakeholders in the beef industry. If the information of training material enhances the values of Australian beef producers, such benevolence, security and self-direction, it is more likely to be taken up and implemented on-farm (Fountain et al., 2023). The social study by Fountain et al. (2023) found that values that drive behaviours and attitudes in Australian beef cattle producers are highly significant for social cohesion. When adhering to Immune Ready, producers engage in a collective effort to uphold on-farm biosecurity not just of their own property but also of the property of others. Highlighting the benefits to others and the whole industry might be a useful concept in education material.

The current vaccination rates and the small increase in vaccination rates over the last 12 years (Sloane and Walker, 2022) suggest that it might be challenging to achieve the planned 100% adherence of industry to Immune Ready guidelines. While aspirational, a variety of reasons can lead to non-adherence and the target goal of 100% might be unrealistic. A large part of the industry sees the scheme as a step forward and as an improvement on previous vaccination schemes and it will be interesting to monitor the uptake. However, the National Standard for Organic and Bio-dynamic Produce restricts the use of vaccines in organic beef. An ambitious target, such as this one, opens up the conversation about evolving indicators from demonstrating vaccination status to affordable outcome-based indicators that demonstrate the health status of animals in the sale yards. This approach would be more inclusive of sectors of the beef industry that may face economic and ideological barriers to adopting the Immune Ready guidelines.

For a target to be achievable, it is important to be specific about the target group and to ensure that evidence can be provided on the progress towards the target. If the target group is defined as "industry", consistent survey approaches would be necessary to track trends. However, data collection at an industry scale presents significant challenges. Leveraging the electronic National Vendor Declaration could serve as a valuable and consistent source of industry-scale data to inform this target. The framing of the target should always prioritise fostering a genuine improvement in sustainable practices. Data sources should only based around compliance or certification schemes if non-compliance does not trigger corrective action, such as termination of membership, but instead encourages those responsible to take ownership of their actions and actively work towards positive change.

5. Conclusion

The Australian Beef Industry is in the process of identifying tangible targets which can demonstrate industry's progress towards the best animal care goal, that is: The Australian beef industry is guided by the five domains of animal welfare. The industry provides all cattle with an environment in which they can thrive in accordance with these domains.

The four targets reviewed in this project addressed on-farm biosecurity, attendance of welfare relevant training courses, breeding for polled cattle and adherence to the Immune Ready guidelines. They are all relevant targets to underpin aspects of the five domains of animal welfare. The SMART (Specific, measurable, achievable, relevant and timebound) framework has served as a basis to review of the targets. Considerations for refinement have been suggested.

5.1 Key findings

5.1.1 Target 1 - 100% of Australian cattle properties will be covered by a documented biosecurity plan by 2025

The target is relevant, and time bound. It is specified that the target is to be achieved in "Australian cattle properties". The question arises how progress can be measured at that scale. A consistent survey approach is feasible but needs to be representative of all Australian cattle properties. The scope could be more succinctly defined to e.g. "participants of LPA" or other certification programs, which would assist in obtaining records and making progress measurable. However, defining the target group around a scheme might be counterproductive to improved practices at industry scale if adherence is enforceable. Eliminating non-compliant members would move the metric closer to the target but would not demonstrate an improvement in sustainable practices at industry scale. Even with high quality training material or legislative enforcement it will be challenging to achieve 100% compliance, in particular at industry scale and within a less than 2-year time frame. Considering the inevitability of some level of non-compliance due to various factors, setting an ambitious target below 100% would be more realistic. The effectiveness and nature of specific actions to drive change is a key consideration when determining the timeframe to achieve the target.

5.1.2 Target 2 - Increase the attendance of beef industry participants throughout the supply chain in effective animal welfare related training, such as low-stress stock handling, nutrition, animal welfare officer and related courses to 90% by 2030

The target is relevant, and time bound. It is specified that the target is to be achieved in by "participants of the supply chain". Similar as was discussed for Target 1, the question how progress can be measured in a specific target group needs to be considered carefully. The current definition of the target group ("industry participants") might require refinement to ensure specificity, measurability, and promotion of animal welfare. An enhanced definition could prioritise "beef industry stakeholders that handle animals or supervise staff that handle animals" encompassing individuals with direct influence on animal welfare outcomes across the supply.

Participation in recognised training courses is a practical approach to demonstrate in a measurable way progress in welfare-friendly practices. Keeping in mind that training does not imply that the skills and knowledge are implemented and lead to better animal welfare outcomes. Welfare science will continue to develop new approaches to measure animal welfare. It is suggested to monitor welfare science outputs for practical and easy to implement approaches to evolve the target in the future from a rules-based (i.e. trained or not) to an outcome-based metric that describes the actual impact on animal welfare. The target of 90% by 2030 is realistic, yet it may benefit from a more specific definition of training requirements. This could entail outlining a set of training courses that drive the desired outcome, along with clarifying the data collection methods supporting the target.

5.1.3 Target 3 - By 2030, 80% of calves born in seedstock herds will be polled

The target is relevant, and time bound. To ensure Target 3's feasibility across all breeds, simulations would offer valuable insights into achievable progress without compromising productivity. While the target set a realistic transition time, validated is necessary, in particular for breeds with low frequency of the polled allele.

Specificity in the target group also helps guide the data collection process to demonstrate progress. While consistent survey approaches could provide a representative sample of the entire stud sector, other data sources such as the BREEDPLAN data base could be considered if deemed representative.

Progress towards the target, especially for breeds with a low frequency of the polled allele, will benefit from the availability of polled sires and ongoing research into effective genomic tests. Accompanied by simulation studies exploring breeding strategies, these efforts will drive progress towards achieving the target.

5.1.4 Target 4 - By 2030, industry will have 100% adherence to the Immune Ready Cattle Vaccination Guidelines

The target is relevant, and timebound. The target goal aims at "100% adherence in the industry" presents challenges to demonstrate adherence at such a broad scale. Full adherence is unlikely due to varied reasons for non-compliance. This poses particularly complex considerations for the organic sector, but it also initiates dialogue on developing more flexible metrics in the future.

The electronic National Vendor Declaration could serve as a potential data source providing consistent, reliable, and high-quality data if it is considered to be true representation of the whole industry. It is key that framing of the target group and scope always prioritise fostering genuine improvement in sustainable practices.

5.1 Benefits to industry

The Australian Beef Sustainability Framework documents and demonstrates the progress of the beef industry towards practices that enhance animal welfare. The project demonstrated that engaging with sustainable practices as captured in the targets, such as having an on-farm biosecurity plan, attending training courses relevant to the improvement of animal welfare, breeding for polled and adhering to Immune Ready has substantial production benefits and for producers, their staff, and the whole community. The targets are well aligned with the five domains of animal welfare and benefits speak strongly to the One Welfare concept (Pinillos et al., 2016) that recognises the interconnection of positive human, animal, and environmental outcomes. The targets are based around best-practice approaches and cost of implementation is minor compared to the potential economic and social impacts. The targets may pose greater challenges for specific industry segments, emphasizing the need for tailored approaches. Nevertheless, these targets serve to stimulate dialogue across the industry and inform research and development initiatives.

6. Future research and recommendations

The Australian Beef industry is in the process of identifying tangible targets which can demonstrate industry's progress towards the best animal care goal, that is: The Australian beef industry is guided by the five domains of animal welfare. The industry provides all cattle with an environment in which they can thrive in accordance with these domains.

It is critical that targets are defined around principles that support an evidenced based demonstration of progress. The Australian Competition and Consumer Commission has useful guidelines for businesses on making trustworthy environmental claims on products (Australian Competition and Consumer Commission, 2023) which would provide a useful background for reviewing the targets based trustworthy principles. Simulation studies could be useful to explore several scenarios in relation to Target 3 to inform timeframes.

It was out of scope for this project to make specific suggestions for timelines and target goals based on scientific evidence, such as simulation studies, but considerations for refinement have been provided. It was also out of scope to conduct a cost benefit analysis of engaging in more sustainable practices that foster positive animal health and welfare. This also includes detailing differences for different sectors of the beef industry. Cost-benefit analyses are provide useful information to underpin decision making. A socio-bio-economic model has been developed to conduct a cost benefit analysis of adopting more welfare friendly practices. It assesses the economic and social impact of changes in animal welfare holistically at the multiple levels (animal, farm worker, producer, consumer) (Keshavarzi et al., 2023). The development of the model unearthed substantial data gaps that prevent a full cost benefit analysis. Future research could fill the data gaps to enable the development of an economic value proposition to industry to transition to more welfare friendly practices.

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