Economic Impact of Phasing Out Mulesing

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Pegasus Economics is a boutique economics and public policy consultancy firm that specialises in strategy and policy advice, economic analysis, trade practices, competition policy, regulatory instruments, accounting, financial management and organisational development.

This report has been commissioned by FOUR PAWS.

The views and opinions expressed in this report are those of the author.

Front cover photograph shows two Dohne Merino dam ewes with their lambs in the Bega Valley in New South Wales. The breed is naturally bare-breeched, eliminating the need for mulesing.

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Executive Summary

Flystrike and Mulesing

Flystrike is a serious financial and animal welfare issue for the sheep industry and is caused by the sheep blowfly (*Lucilia cuprina*).

Flystrike was seldom a concern in Australian sheep farming between the arrival of the first migrants with their sheep in 1788 and the late 19th and early 20th Century when the sheep were plain breeched, or without wrinkles and wool on their breeches. However, this changed with the introduction of Vermont Merino rams with its extremely wrinkly skin that spread through the local population and its arrival coincided with the first reports of significant outbreaks of flystrike. Once Australian farmers began breeding the wrinkled Vermont Merino sheep with the smooth-bodied Australian Merino sheep, it became difficult to remove the "wrinkled" trait later on.

Mulesing is a surgical procedure that involves cutting away the skin around the tail and perineum, with the resulting scar tissue providing a bare surface that is resistant to flystrike. While mulesing has been shown to be a cheap, fast, and effective method of reducing the risk of breech strikes, it is a very painful procedure. Due to animal welfare concerns, mulesing has received global scrutiny for its negative impacts on animal welfare.

The overall incidence of mulesing appears to have more than halved since the early 2000s when it was over 90%. Even amongst Merino flocks the relative incidence of mulesing has significantly declined since the early 2000s.

Economic Risks Posed by Mulesing

Mulesing is threatening the 'social licence' for sheep production and it's affecting the marketability of sheep products, renewing pressure for the development of more effective and efficient methods to manage flystrike.

There is a concern that Australian wool could be boycotted by major processors, retailers and consumers due to mulesing. The pain inflicted upon sheep from mulesing threatens export markets for Australian wool. Over 330 brands have publicly stated their opposition to using mulesed wool and have either completely ended their use of mulesed wool, or are working towards doing so. Mulesing also poses a risk to Australian sheep meat products and exports.

Australian Wool Innovation (AWI), the statutory body responsible for research and development and marketing of Australian wool, has often sought to downplay the impact of concerns over animal welfare in relation to mulesing and the associated market risks. However, following the decision by New Zealand to outlaw mulesing during 2018– joining South Africa, Uruguay and Argentina in banning the practice - Australia has become isolated in being the only major wool exporting nation that still permits mulesing.

Australian Wool Industry Response on Mulesing

Despite the Australian wool industry committing to phase-out mulesing in November 2004 by the end of 2010, AWI announced in July 2009 that the industry would be reneging on this commitment. Rather than seek to phase-out mulesing, the Australian wool industry has instead chosen to pursue two-pronged strategy to address the mulesing issue: (i) a system of voluntary declarations of mulesing practices in wool auctions; and (ii) pain relief for mulesed sheep.

Alternatives to Mulesing

Historically, AWI has spent tens of millions of dollars on research into alternatives to mulesing and blowfly research. However, the various non-surgical alternatives to mulesing have been trialled with little or no improvement in welfare or flystrike prevention over the surgical mulesing technique.

There would appear to be agreement that it is possible to selectively breed Merino sheep to be resistant to breech strike that would not require mulesing. Genetic selection for flystrike resistant sheep is not a new idea with work first commencing in the 1930s.

It has been suggested there is substantial genetic reductions in flystrike incidence that can be achieved after 10 years of selection based on modified Australian Sheep Breeding Values.

However, there is one approach that has already proven successful for Merino wool sheep farmers wanting to make the conversion over to non-mulesed wool through selective breeding. While most Merino sheep in Australia are wrinkled, a plain-bodied (low wrinkle) Merino sheep does exist and is called the SRS® Merino (SRS stands for soft rolling skin). This Merino type has been bred in Australia since the late 1980s and comprises about 7% of the Australian Merino sheep flock. There is survey evidence to suggest that transition to a non-mulesing mob is possible within about a 5-year timeframe, around half the time that has been suggested in research funded by AWI.

Economic Costs and Benefits of Transitioning from Mulesing

Ceasing mulesing through adopting plainer and non-wrinkled Merinos suggests that Merino sheep growers would collectively be around $120 million better off over a 7-year period through utilising a cost-benefit analysis model developed for Meat & Livestock Australia.

Conversion to a plainer and less wrinkled Merino sheep also carries a number of additional economic benefits that will potentially reduce costs and increase the income of wool sheep producers. The available evidence suggests that plain bodied Merino sheep produce almost as much wool as wrinkly Merino sheep. It has also been found that there is more variability in fibre diameter amongst lambs sired by ribby/wrinkly rams than smooth rams. Smoother and plainer Merino sheep also display better reproductive properties.

Given the overwhelming weight of evidence against the propagation of wrinkly Merino sheep on economic grounds, the obvious question arises as to why there is such vehement opposition towards phasing out mulesing within sections of the Australian wool industry and engaging in a more concerted effort towards genetic selection and development of a Merino sheep that doesn't require mulesing. The answer may lie in the fact that development of a plainer Merino would leave those Merino stud operators that have invested heavily in and sell wrinkly Merino genetics with what would effectively become stranded assets that are rendered worthless.

Conclusions

Mulesing threatens the social licence of Australian wool producers and the sustainability of Australia's export markets for wool that could also cause collateral damage and fallout for Australian sheep meat export markets. Wool processors, major brands and consumers could potentially render wool from wrinkly Merino sheep requiring mulesing as obsolete, in turn stranding the wrinkly Merino genetic stock and rendering it worthless.

There is a feasible alternative to the propagation of wrinkly Merino sheep requiring mulesing. This is the development of a plainer and less wrinkly Merino sheep through selective breeding that the available evidence suggests would perform better on a range of economic criteria including the return on wool. Contrary to popular mythology, plain bodied Merino sheep can produce almost as much wool as wrinkly Merino sheep and of a more consistent quality.

The ongoing propagation of a wrinkly Merino sheep that requires mulesing is a deliberate choice on the part of some sections of Australian wool producers even though customers have expressed a clear preference for non-mulesed wool. Author and sheep farmer Massey (2011) has observed the long-running mulesing debate reveals that wool industry leaders and AWI still nourish the old agri-political belief that holds that the customer is the enemy.

1. Introduction

Pegasus Economics (Pegasus) has been commissioned by FOUR PAWS Australia to examine the economic and trade implications from retaining as well as phasing out of the practice of mulesing on Australian sheep.

The views and opinions expressed in this report are entirely those of the author.

2. Sheep and their Economic Applications

2.1 Taxonomy of Sheep

The number of permanent incisor (adult) teeth they possess on their lower front jaw can be used to estimate a sheep's age as sheep have no front teeth on their top jaw (Cottle D. J., 2010a, p. 5). Sheep can be categorised on the basis of sex and age. When born, sheep usually have no teeth (Cashburn, 2016). Within a week after birth, the milk teeth or temporary teeth appear in the front lower jaw and by the time the sheep is two months old these, eight in all, have erupted. These temporary teeth are eventually replaced by permanent incisors or adult teeth, which appear in pairs, commencing with the two central teeth, followed by one on either side at intervals, until the eight temporary teeth have been replaced. During the period the teeth are growing, sheep are referred to by the number of permanent incisors present, such as two-tooth, four-tooth, six-tooth, eight-tooth or full mouth. Sheep will usually be over two before they are six-tooth, and at least three before they are full mouth.

As sheep age, the adult teeth will start to spread, wear and eventually break (Schoenian, 2015). This progressive deterioration is known as 'broken mouth', the rate depending on the conditions under which the sheep has grazed (Cashburn, 2016).

Sheep can be divided into the following categories:

- A lamb is a sheep that is: (a) under 12 months of age or; (b) does not have any permanent incisor teeth in wear (Australian Meat Industry Council and Sheep Producers Australia, 2019). A permanent incisor is considered 'in wear' if it touches the upper pad when the sheep's mouth is closed or it is above the height of the lamb's milk teeth either side of the permanent incisors.
- Hoggets are castrated male and female sheep with no 'ram-like' characteristics and up to two permanent adult teeth (Meat & Livestock Australia, 2016).
- Ewes are female sheep with more than two permanent adult teeth (Meat & Livestock Australia, 2016).
- Wethers are castrated male sheep with no 'ram-like' characteristics and with more than two permanent adult teeth (Meat & Livestock Australia, 2016).
- Rams are male sheep that have not been castrated and castrated male sheep that display 'ram-like' characteristics (Meat & Livestock Australia, 2016) such as aggressive behaviour (e.g. head butting) (Schoenian, 2021).

2.2 Economics of Sheep Production

Sheep are farmed throughout the world, with most production constrained by temperature and rainfall to islands, coastal regions and the fringes of continental deserts (Sargison, 2008, p. 451). In some regions sheep are used to exploit pastures which are unsuitable for other agricultural

purposes, while elsewhere sheep production is integrated into other agricultural systems to enable cost-effective and efficient grassland management or crop rotation. The major sheep farming areas are located within the latitudes 35–55 degree north in Europe and Asia and between 30 and 45 degree south in South America, Australia and New Zealand (Morris, 2017, p. 19).

Sheep farming gives rise to four main products:

- wool
- sheep meat
- hides and skin
- milk (Morris, 2009, p. 59).

Selection for wool type, flocking instinct and other economically important traits over the centuries has resulted in more than 500 distinct breeds of sheep occurring worldwide (Cottle D. J., 2010a, p. 5).

There are three management systems used throughout the world for sheep production, namely extensive production for wool and meat, intensive dairy production and traditional pastoralism (Kilgour, Waterhouse, Dwyer, & Ivanov, 2008, p. 214). There are many different types of extensive sheep systems in the world, but a distinguishing feature is that sheep graze in enclosed fenced systems where they are individually owned (Morris, 2017, p. 22). These are the basis of sheep production systems in the United Kingdom, New Zealand, Australia and Uruguay.

While sheep dairying is traditionally pasture-based, recent intensification in some countries has resulted in the development of fully housed systems (Kilgour, Waterhouse, Dwyer, & Ivanov, 2008, p. 213). Dairy sheep farms are mainly located in subtropical-temperate areas of Asia, Europe, and Africa (Pulina, et al., 2018, p. 6716). Dairy sheep are concentrated in countries in the Mediterranean and Black Sea regions with relevant Greek or Roman cultural heritage where dairy products are typical ingredients of the human diet.

Under the conditions of traditional nomadic pastoralism sheep are perceived as a valuable resource and a feature of this system is the close contact between sheep and their human carers, since sheep are herded during the day and housed at night, often in the main dwelling (Kilgour, Waterhouse, Dwyer, & Ivanov, 2008, p. 213). Under these systems, however, there is a high degree of unpredictability in the climate, herbage availability and disease risk. In the more arid regions of Asia, Africa and the Middle East, sheep are increasingly multipurpose in their generation of products and in sustaining the livelihoods of those who farm the sheep (Morris, 2017, p. 20).

In temperate regions of the world where sheep are cultivated, meat is the major product while in many countries wool production is in decline (Morris, 2017, p. 20). In Australia, the world's largest fine wool producer, meat production has been steadily increasing in importance since the early 1990s (discussed further below).

On an international scale, wool production is a relatively small trade (Doyle, Preston, McGregor, & Hynd, 2021, p. 15). A major disruptor to the wool industry was the innovation of a range of synthetic fibres in the early to mid-20th century and in the 1960s and 1970s there was huge growth in synthetic fibre production used to produce clothing. Hence, global wool production went into long-term decline (ABARES, 2022, p. 66) as the use of wool in textiles faced major competition from synthetic fibres (Sargison, 2008, p. 451). Synthetic fibres have dominated the world fibre market since the mid-1990s (Textile Exchange, 2025, p. 9). Animal fibres had a combined market share of 1.0% in 2023, with sheep wool making up the majority of this, with global clean wool production totalling around 1 million tonnes and accounting for 0.9% of global fibre production (Textile Exchange, 2025, p. 9). Apparel wool from sheep contributes about half of that amount (Doyle, Preston, McGregor, & Hynd, 2021, p. 15). Traditionally, apparel wool has been used either as outer knitwear or as woven suiting attire.

Fibre diameter, measured in micrometres (microns or µm), is the most important fibre attribute determining the price of a parcel of fine wool; fine wool attracts a premium price because it can be made into fabrics which either cannot be made, or are more expensive to make, from coarser wool (Cottle & Baxter, 2015, p. 166). There are two reasons why fine fibres are more highly valued by the consumer and by the textile industry. The first is that fineness confers softness of handle to fabrics, including less prickle, and the second is that fine fibres enable fine yarns to be spun, which in turn enables the manufacture of lighter or more finely textured fabrics. Generally, fine wool is most suitable for apparel, medium wool is most suitable for furnishings and coarse wool is most suitable for floor coverings (Curtis & Dolling, 2006, p. 22).

Finer wools, those 19 µm and below, are used for expensive suiting materials in the luxury and prestige segments of the market where demand varies quickly with economic sentiment (Rowe, 2010, p. 994). The price of wool in the 20–23- µm range competes directly with cotton and polyester and normally trades at around four to five times the price of these fibres. The third market segment for wool is for broader micron categories – above 24 µm and in this market wool again competes on price with synthetic fibres for carpets and upholstery.

Historically, the sheep meat industry has developed as a by-product of the wool industry (Jones K. G., 2004, p. 1). Sheep are inferior as convertors of their feed to meat relative to poultry and pigs, largely because of the overhead costs of breeding stock and replacements, however, they can inhabit and yield a product on land unfavourable to other forms of agriculture (Morris, 2009, p. 59).

Sheep meat accounted for around 4.5% of global meat production in 2024 (OECD/FAO, 2025; FAO, 2025). While sheep meat consumption is a relatively small part of the global meat market, it remains an essential source of protein for many consumers in the Middle East and North Africa, where pig meat is not a viable substitute for religious reasons (OECD/FAO, 2025, p. 87).

Sheep meat produced from young sheep with no permanent incisor teeth in wear is referred to as lamb while sheep meat produced from more mature sheep (with at least one adult tooth in wear) is referred to as mutton. The colour of lamb meat ranges from pale pink to pale red and is generally lean while its mild flavour makes it very versatile for several uses (Prakash, 2016). On the other hand, mutton has a deep red colour and is much fattier than lamb; its flavour is strong and gamey and the meat is often stewed to help tenderise it (Prakash, 2016). Mutton can have a distinctive odour and flavour that makes it unattractive to consumers (Sheep CRC, 2008). The relatively high melting point of mutton fat contributes to a waxy mouthfeel that is unacceptable to many (Gurunathan, 2022, p. 329). Mutton typically attracts a lower price than lamb due to age, fat content, flavour, and eating quality (Meat & Livestock Australia, 2016b).

Sheep skins and hides are often considered a by-product of the sheep meat manufacturing process (Sargison, 2008, p. 451). Sheep hides are the second most used type of hide after cattle hide, with production estimated to be around 2.0 million tonnes in 2023 (Textile Exchange, 2025, p. 62). The largest producers were China with 30%, Australia with 8%, and New Zealand with 4% of global sheep hide production. Africa collectively is also a major supplier (Mazinani & Rude, 2020, p. 296).

3. Australian Sheep Flock

3.1 Merino Sheep and the Australian Wool Industry

Based on the production of fine wool from Merino sheep, Australia has been a world powerhouse of high-quality wool production and exports for over 150 years (Biki, 2023).

Wool from Merino sheep is rated alongside the finest quality animal fibres, which include the goat fibres Mohair and Cashmere (Plowman, Thomas, Perloiro, Clerens, & de Almeida, 2019, p. 659). Merino sheep are the oldest established sheep breed in the world and was developed on the Iberian

Peninsula (present day Spain and Portugal) (Pereira, et al., 2006, p. 1420). While the exact origin of Merino sheep is unclear (Plowman, Thomas, Perloiro, Clerens, & de Almeida, 2019, p. 659), the most plausible view is that Merinos were introduced by and named after the Beni-Merines, an Arabic Moors tribe originally from North Africa (Klein, 1920, pp. 4-5).

In the Middle Ages, Spanish monarchs improved the native sheep by crossing them with North African stock (Cottle D. J., 2010a, p. 7). During this period Spain was noted for its fine wool and built up a monopoly for this wool during the 12th to 16th centuries. The Merino fleece, habitually referred to as a "golden" one, was the envy of all of Europe—a necessary raw material for any fine-wooled manufacture (Woods R. J., 2017, p. 4). Constant demand for Merino wool across industrial northern Europe and in Great Britain ensured that it was a significant source of income for the Spanish crown. It was not until the 1700s when the Spanish Empire went into decline that Spanish Merinos were exported (Cottle D. J., 2010a, p. 9). Before this, the export of Merinos was a crime punishable by death.

The first Merino sheep imported into Australia was undertaken by Captain Henry Waterhouse and Lieutenant William Kent who brought 26 Merino sheep in 1797 from the Cape of Good Hope, in present-day South Africa, to Port Jackson, in the then colony of New South Wales (AG Staff, 2024). Those first Merinos were descended from a flock originally gifted by King Carlos III of Spain to the Netherlands' Prince William of Orange, who relocated the sheep to South Africa in 1789 to breed.

The Australian sheep industry was initially founded on wool production from Merino sheep (Keogh, Henry, & Day, 2016, p. 38) that provided the economic impulse that opened up the Australian continent (Harman, 1971, p. 41). Stimulated by the introduction of superior Merino sheep breeds, the opening up of extensive grazing land after 1813, and a favourable climate and soil, from its humble origins the Australian wool industry came to dominate both the national economy and world markets for wool (Cashin & McDermott, 2002, p. 250). By the 1850s Australia was massive producer of wool (Massy, 2011, p. 3). For the early Australian colonies wool provided a valuable commodity that could be exported back to Britain and the rest of the world (Perrett, 2015).

Wool, along with gold, was the dominant commodity on which the economic fortunes of the Australian economy depended during the latter half of the 19th Century, and both were key commodity exports well into the 20th Century (Cashin & McDermott, 2002, p. 251). Prosperity in the Australian wool industry peaked in 1950-51 with a short-lived but extreme price increase triggered by American demand for wool generated by the Korean war (Cottle D. J., 2010, p. 55). During this period, Australia was said to be "riding on the sheep's back." By the early 1960's wool still accounted for more than one third of Australia's aggregate exports (Cashin & McDermott, 2002, p. 251).

To this day, Australian wool production is still based on the Merino breed and remains the largest component of Australian wool production (Tim Harding & Associates and Rivers Economic Consulting, 2014, p. 19).

Overall, Merino sheep still form the bulk of the Australian sheep flock. Ewes kept for breeding represent 69% of the Australian sheep flock, with Merinos making up 64% of all breeding ewes (Intuitive Solutions, 2025). Wethers represent 11% of the Australian sheep flock, with Merinos representing 88% of all wethers.

3.2 Australian Sheep Farming

The Australian sheep flock, currently estimated at 74.2 million (Meat & Livestock Australia, 2025), is the third largest in the world following mainland China and India.[1] The Australian sheep flock has peaked twice at 170 million in 1965 and again in 1990 (Australian Bureau of Statistics, 2013).

[1] The estimates of the Chinese and Indian sheep flock comes from the United Nations FAOSTAT database.

However, the development of synthetic fibres in the years following the Second World War created growing competition and declining prices for Australian wool (Keogh, Henry, & Day, 2016, p. 38).

Wool and sheep meat are the primary outputs from sheep farming, with market conditions for each commodity affecting the size and composition of the national sheep flock (Deards, et al., 2014, p. 6).

Sheep breeds in Australia fall into three broad categories:

1. wool producers
2. dual-purpose
3. prime lamb (Cottle D. J., 2010a, p. 7).

In turn, the wool producers can be divided into Merino and carpet-wool breeds (Cottle D. J., 2010a, p. 7).

There are three broad sheep grazing zones on the Australian mainland: the wheat-sheep zone, the high rainfall zone and the inland pastoral zone (Australian Surveying and Land Information Group, 1990, p. 44). The major factor differentiating between the zones is average annual rainfall, ranging from 500-1000mm for the high rainfall zone, 400-700mm for the wheat-sheep zone and 150-400mm for the pastoral zone (Cottle, Daly, & Hergenhan, 2014, p. 1.1). These differences in annual rainfall generate differences between zones in patterns of pasture growth and the opportunities for other enterprises such as cropping and dairying.

In the eastern half of Australia, the high rainfall zone lies on the wetter, coastal side of the wheat-sheep zone, where natural pastures are rich (Australian Surveying and Land Information Group, 1990, p. 44). The wheat-sheep zone is characterised by regular cropping, in addition to the grazing of sheep and cattle (Cottle D. J., 2010, p. 64).

The inland pastural zone lies on the drier, inland side of the wheat belt in the eastern half of Australia (Australian Surveying and Land Information Group, 1990, p. 44). Although the largest of the three Zones, it carries the fewest sheep. Grazing is extensive because of low rainfall and poor native pasture. Land use in the pastoral zone is characterised by extensive grazing of native pastures as cropping is marginal as the growing season is less than 5 months due to inadequate rainfall (Cottle D. J., 2010, p. 64). Sheep are run in the southern part of the pastoral zone in central Queensland and northern New South Wales (NSW) where the rainfall is higher than in the other states.

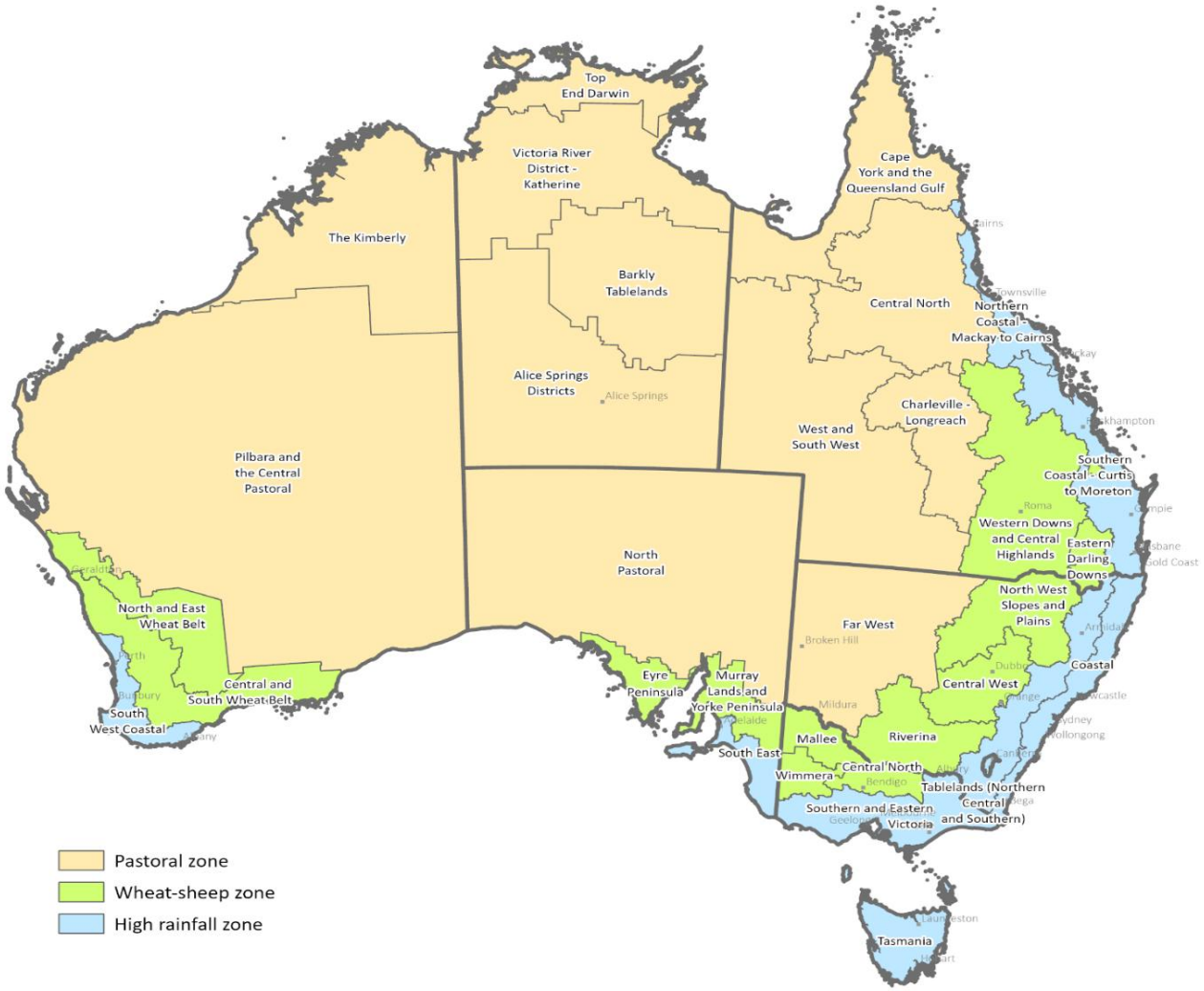
Although the wheat sheep zone has a growing season of less than 9 months and only occupies 11% of the land in Australia used for sheep grazing, it supports most of the nation's sheep (Cottle D. J., 2010, p. 64). This zone contains many of the Merino studs and about 65-70% of Australia's Merinos (Cottle D. J., 2010, p. 65). Strong and medium-wool Merinos account for 95% of the sheep in the South Australian and Western Australian sectors. Most sheep in this zone are run in NSW.

The high rainfall zone covers the area adjacent to the coast of the three eastern mainland states, small parts of South Australia and Western Australia, and the whole of Tasmania (Cottle D. J., 2010, p. 65). Due to the higher rainfall and hillier topography, it is more suitable for the intensive grazing of pastures and fodder crops than for the production of grain. Although it is the smallest area of the three zones, it contains 30 to 40% of the total sheep population. Most of the sheep in this zone are run in Victoria. About 80% of sheep in the zone are Merinos, mainly fine-wool. Lamb producers are also mainly located in the high rainfall areas (Cottle D. J., 2010, p. 61).

In Western Australia sheep are virtually confined to the wheat-sheep zone in the southwest of the state, an area of 100-200 km in width extending from Geraldton, north of Perth, to around Albany on the south coast (Australian Surveying and Land Information Group, 1990, p. 44). It is bounded on the west by a narrow band of wet, forested country unsuitable for sheep raising, and on the east by extremely arid country generally unsuitable for all livestock.

A map of the three zones is provided in Figure 1 below.

Figure 1: Australian Broadacre Zones and Regions



Source: Topp, Ryder, & Smith (2025, p. 11).

3.3 Australian Wool and Sheep Meat

Most wool in Australia is shorn from Merino sheep which typically ranges in mean fibre diameter from 11 to 27 µm (Australian Wool Exchange, 2014, p. 4). Crossbred sheep grow wool typically between 24 and 40 µm. A small quantity of carpet wool (34 µm and broader) is grown in Australia but is not usually sold through auction. Sheep on a farm are usually run in mobs of similar sex and/or age. Age, breeding, sheep husbandry practices and environmental conditions are all factors that influence the type of wool produced by sheep.

The finer the micron the higher the wool price (Australian Wool Exchange, 2014, p. 15). The premium paid for finer wool has led to a decrease in the average fibre diameter of the Australian wool clip, with production of fine, superfine and ultrafine wool increasing as a total percentage of the fleece wool clip (Nolan, 2012, p. 12).

Wool produced has usually been sold at auction that traditionally operated as a free market of buyers and sellers (Michalk, 1990, p. 190). However, that changed with the establishment of the Reserve Price Scheme (RPS). The RPS was a buffer stock scheme designed to maintain minimum

prices – the so-called Minimum Reserve Price (MRP) – for wool sold at auction, that was established in November 1970 (Haszler, 1994, p. 87).

Beginning in the early I970s the Australian wool growers paid a 'Wool Tax' on wool production, with the proceeds accumulating in a Market Support Fund that was used to finance buffer stock operations by the Australian Wool Corporation (AWC), a statutory marketing authority for the wool industry (Bardsley, 1994, p. 1088).

Under the buffer stock operations, the AWC bought up wool offered at auction that failed to reach the reserve price in order to protect wool growers against unduly low prices resulting from temporary irregularities in demand at auction (Michalk, 1990, p. 190). When the Market Support Fund was exhausted buffer stock purchases were financed by commercial borrowing against the security of the stockpile accumulated by the AWC (Bardsley, 1994, p. 1088). However, buffer stock schemes, such as the RPS, can become expensive, especially if the set price is in excess of the long-run, market-clearing level as the scheme has to fund and maintain a stockpile until prices rise again (Abbott & Merrett, 2019, p. 791). Buffer stock schemes are prone to failure because of forecasting errors about market price levels and as overshooting the long-term market price induces increased production that puts further downward pressure on prices (Abbott & Merrett, 2019, p. 810).

In 1987 the wool industry gained effective control over the setting the MRP through changes to the governing legislation for the AWC (Massy, 2011, p. 110). After the passage of the new legislation price-setting responsibilities shifted to the Wool Council of Australia, the peak representative body of the Australian wool industry (Abbott & Merrett, 2019, p. 799). The critical problem with the RPS was that management of the scheme fell into the hands of a group who were overly optimistic about the price of wool and underestimated the risks of the scheme (Abbott & Merrett, 2019, p. 801). The RPS, whose original purpose had been designed ostensibly to try to ‘stabilise’ wool prices, eventually morphed into a mechanism to force customers to pay more, reflected the traditional antipathy wool growers held for the customer, the merchant or wool buyer, who were always seen as ‘ripping them off’ (Massy, 2011).

When wool prices rose in 1987, largely because of a fall in the value of the Australian dollar, the wool industry made a mistake and set a floor price that was unsustainably high (Bardsley, 1994, p. 1089). The higher wool prices set off a boom in Australian wool production but also initiated a retreat by fibre users who substituted wool for cheaper cotton and synthetic fibres (Bardsley, 1994, p. 1094).

By mid-1989, wool prices fell to the floor, and were sustained only by market intervention by the AWC (Bardsley, 1994, p. 1089). By the late 1980s, a combination of a rising floor price and falling market prices meant that the AWC acquired a large stockpile of wool and had borrowed heavily to fund its purchases (Abbott & Merrett, 2019, p. 793). The AWC misread the market and then refused to reduce its excessive floor price quickly enough to prevent a rapid accumulation of stocks (Abbott & Merrett, 2019, p. 811).

By April 1990 AWC was buying 60% of the wool clip (Massy, 2011, p. 244). At this point the Commonwealth Government was being asked by wool growers to guarantee the debt of AWC, as without this guarantee AWC would have been no longer able to borrow and the floor price could not have been sustained (Bardsley, 1994, p. 1095). In May 1991 the Commonwealth Government acceded to industry demands and guaranteed the stabilisation debts of AWC, thus transferring the liability for any loss from the industry to the public sector as a whole. In return, the Government demanded the RPS be lowered.

However, the reduction in the RPS proved to be insufficient to stimulate demand and the stockpile kept growing (Bardsley, 1994, p. 1095). At the beginning of February 1991 the Commonwealth Government announced the suspension of the RPS by which time AWC had amassed a wool

stockpile of 4.77 million bales and accrued debt of $2.8 billion (Massy, 2011, p. 342). The price of wool subsequently fell overnight from 700 cents per kilo (c/kg) to 430 c/kg (Bardsley, 1994, p. 1087).

In late April 1991 the Commonwealth Government announced the formal abolition of the RPS as from 30 June 1991 (Massy, 2011, p. 342). In the years before the crash, the AWC and its affiliates spent $5 billion of woolgrower, taxpayer and borrowed funds on stockpiling wool (Abbott & Merrett, 2019, p. 800).

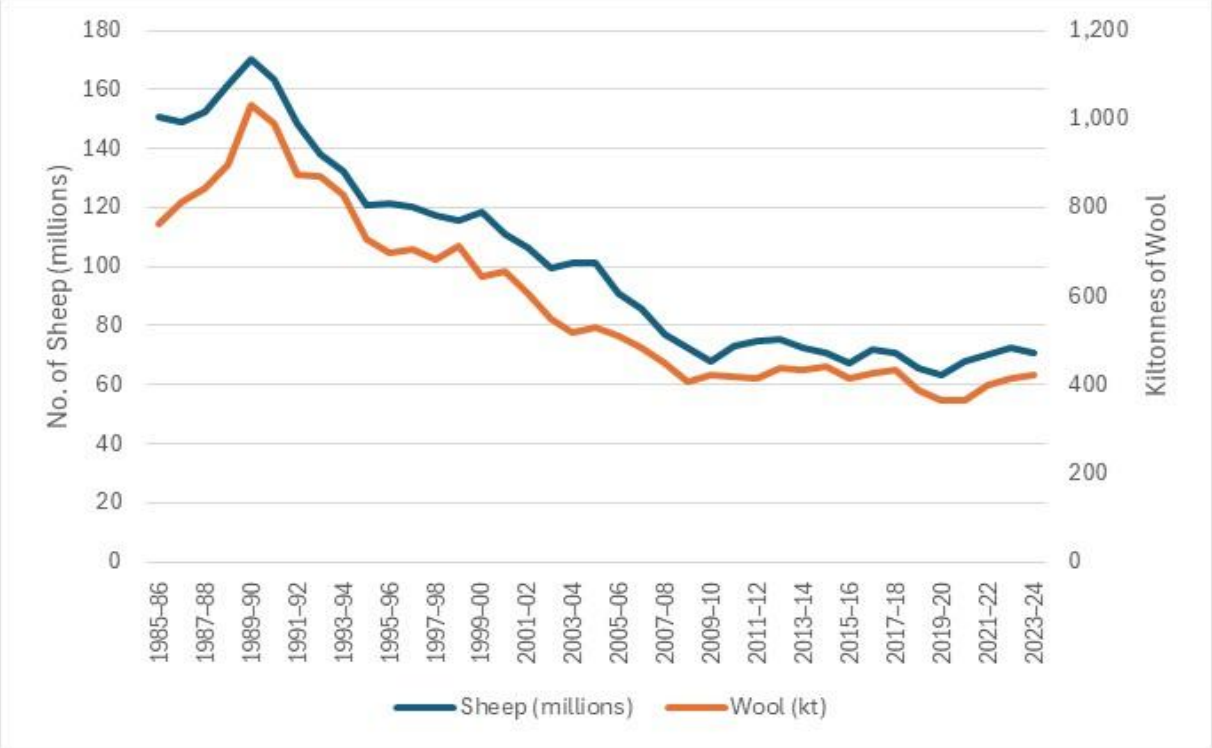
According to Massy (2011), since medieval times the interests of the wool industry have been best served by treating the customers as people to be collaborated with towards the glory of wool and not as mere exploitative middlemen. However, the RPS did not follow this path and it turned out to be the most disastrous and most costly failure of any commodity program in history.

The collapse of the RPS had a dramatic impact on the Australian wool industry (Abbott & Merrett, 2019, p. 810). The failure of the RPS resulted in a substantial industry rationalisation over the next decade, and for some, this triggered an even greater focus on wool quality and, for others, a shift in emphasis to sheep meat production (Biki, 2023, p. 32).

The Australian sheep flock has fallen considerably from its most recent peak of 170 million in 1990 precipitated by the collapse of wool prices following the collapse of the RPS ushered in a period of structural adjustment that manifested itself in a number of ways. Overall, the number of sheep and farms carrying sheep declined (ABARE, 2004). The fall in wool prices, coupled with rising grain prices, saw a shift towards cropping by many farms and an expansion of cropping in more marginal areas (Dahl, Leith, & Gray, 2013, p. 207). The decline in wool production was much greater than the fall in sheep numbers, reflecting the creation of a younger flock structure driven by a move towards lamb production (ABARE, 2004). The focus on lamb production contributed to a decline in the number of wethers in the Australian sheep flock and a concurrent increase in the proportion of ewes required for lamb production (Chow, K, 2013). There has also been a consistent and well documented trend towards production of finer wool in the Australian Merino sheep industry since the late 1980s (Swan, Purvis, & Piper, 2008, p. 1168).

The decline in the Australian sheep flock and the concurrent fall in Australian wool production is outlined in Figure 2 below.

Figure 2: Australian Sheep Flock Numbers (millions) and Australian Wool Production (kilotonnes) – 1985-2023-24



Source: ABARES (2025a).

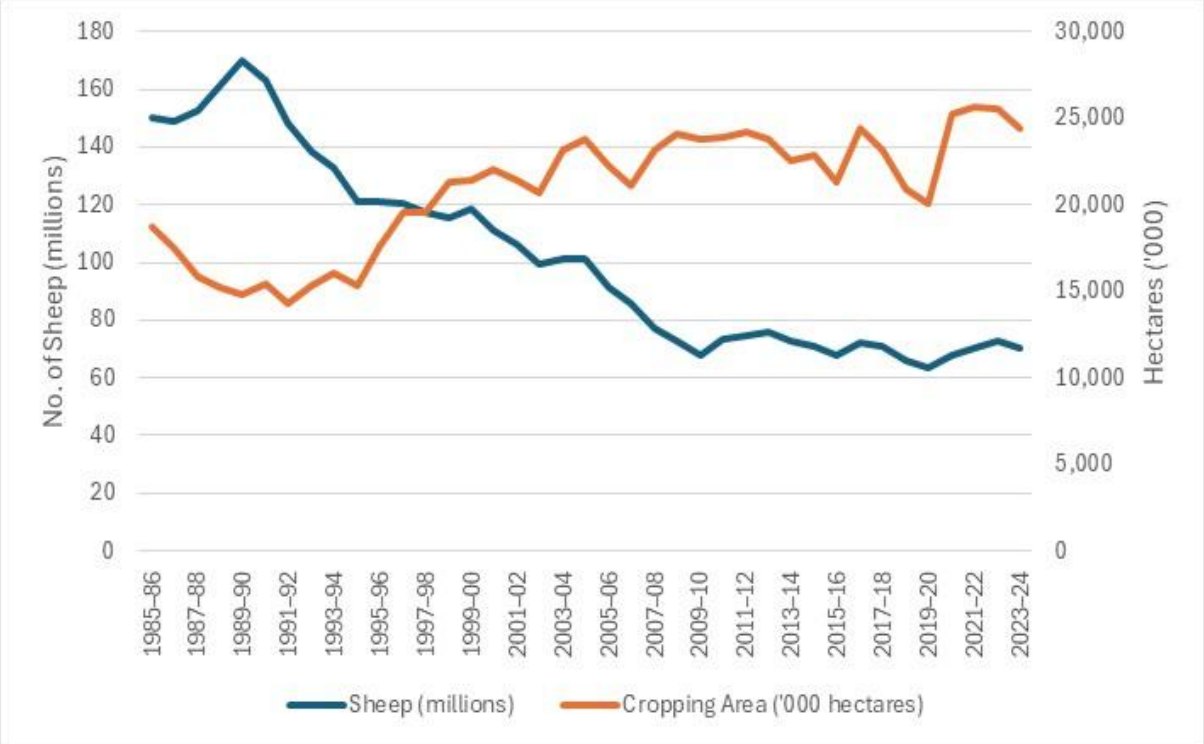
The big shift towards lamb production for meat has been very evident over the last three decades starting in the mid-1990s, around five years after the RPS was dismantled (Biki, 2023, p. 8). The relative increases in Australian lamb production as compared to the overall decrease in the Australia sheep flock is outlined in Figure 3 below.

Figure 3: Australian Sheep Flock Numbers (millions) and Australian Lamb Production (kilotonnes) – 1985-2023-24

Source: ABARES (2025a).

The main change in land use replacing sheep production has been an increase in area devoted to cropping (Rowe, 2010, p. 991). The increase in the area devoted to cropping as compared to the fall in the Australian sheep flock is outlined in Figure 4 below.

Figure 4: Australian Sheep Flock Numbers (millions) and Area Devoted to Cropping ('000 hectares)

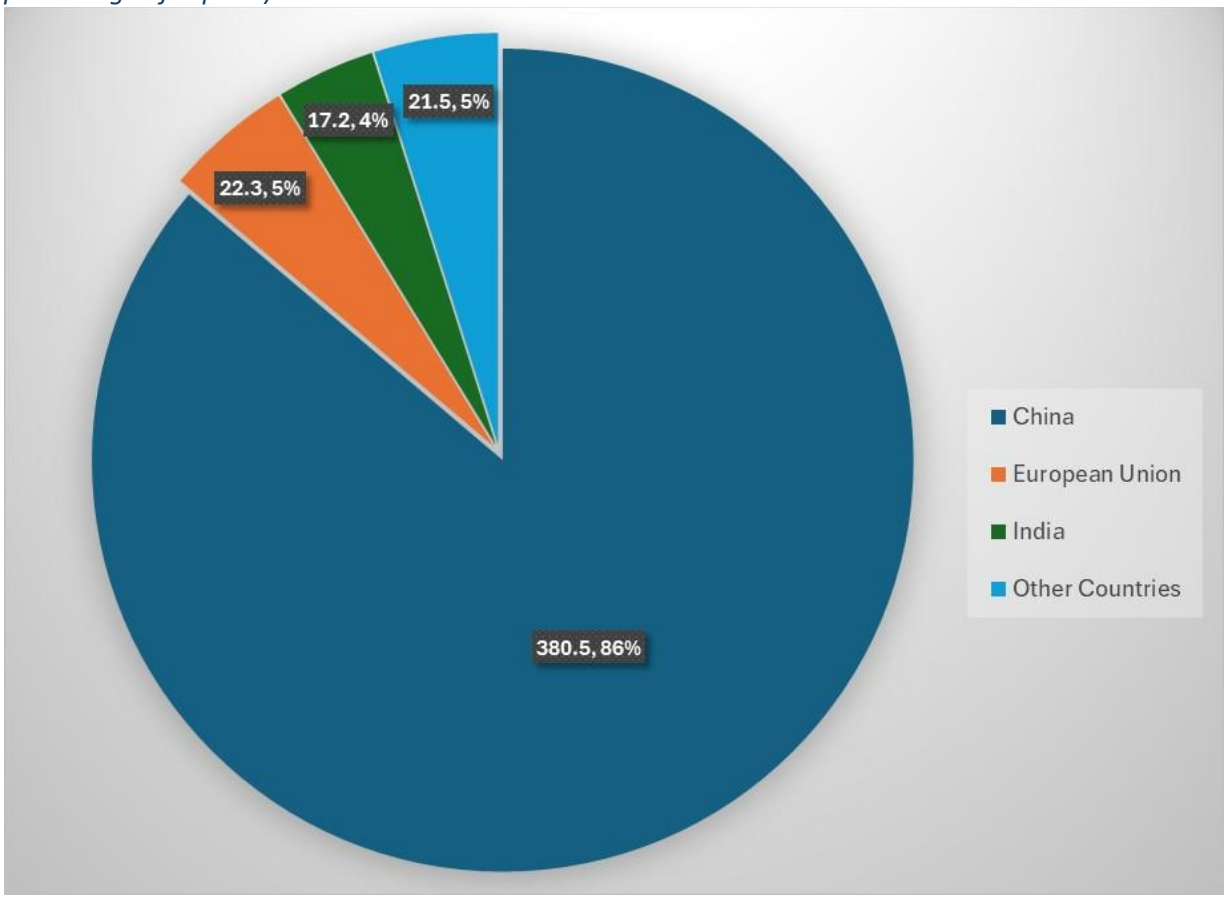


Source: ABARES (2025a).

For most of the 1990s wool consumption fell in Western Europe and Japan, the major high quality, high unit value markets, with a minor offset in rising consumption in the United States (Richardson, 2001, p. 106). However, the United States was a much lower quality market, with high concentration on blended worsted and cheaper woollen products.

Australia is the leading global supplier of wool and the world's largest wool export nation (Animal Health Australia and Wool Producers Australia, 2021). Since the 1950s, the destinations for Australia's wool exports have shifted from the UK and Europe towards Asia (Cottle D. J., 2010, p. 55). China accounted for 86% of Australian wool exports in 2023-24, followed by the European Union accounting for 6% (primarily Italy and the Czech Republic), India for 4% and other countries accounting for 5% (ABARES, 2024). This is outlined in Figure 5 below.

Figure 5: Australian Wool Exports by Volume – 2023-24 (greasy wool equivalent by kilotonnes and percentage of exports)



Source: ABARES (2024).

Australian wool is converted into a wide range of apparel and interior textile products, from the finest suits, sportswear and babywear, through to socks, shoes, and luxurious home textiles (Animal Health Australia and Wool Producers Australia, 2021). These products are primarily consumed in Europe, Asia and North America.

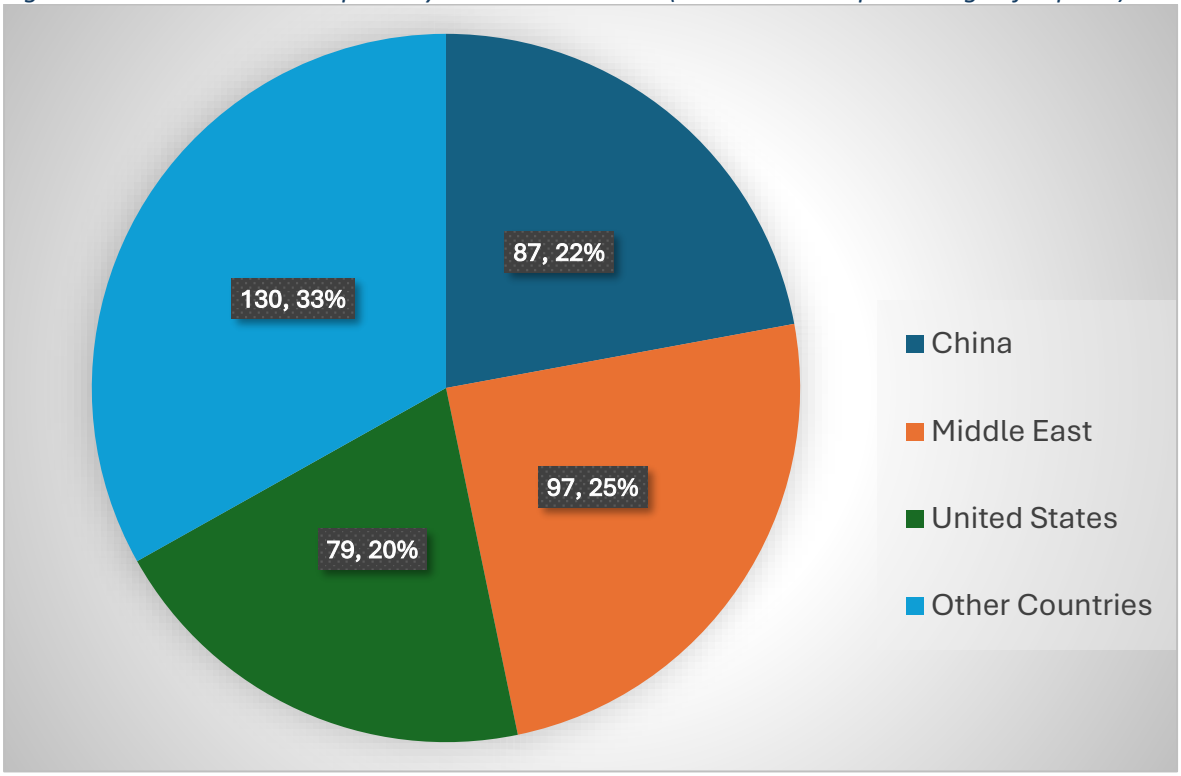
However, recent decades have seen a shift in consumer preference away from tailored apparel (such as business suits) to greater 'casualisation' in apparel choices (such as jeans, T-shirts and sportswear) (Australian Wool Innovation, 2010, p. 12). The shift towards casualisation has had a negative impact on wool, as it is primarily used in the manufacture of tailored apparel and has yet to develop a significant presence in the casual wear market. Due to diminishing returns in traditional markets for wool, new markets will need to be developed for wool such as next-to-skin knitwear and athleisure market where wool is worn as a base layer or "next to skin", which requires the fibre to have low fibre diameter (less than 18 µm) to capitalise on the unique fibre characteristics, such as

breathability, resisting odour, and moisture-wicking capabilities (Doyle, Preston, McGregor, & Hynd, 2021, p. 16). Next-to-skin lightweight knitted fabrics are expected to create increased, and more stable, demand for finer micron wools (Rowe, 2010, p. 996).

The domestic market consumes approximately 35% of Australia's total sheep meat production (Department of Agriculture, Fisheries and Forestry, 2024). Of this, Australian consumer preference is strongly in favour of lamb, which accounts for 95% of domestic distribution of sheep meat.

The major export markets for lamb are the United States, the Middle East and China which is outlined in Figure 6 below.

Figure 6: Australian Lamb Exports by Volume – 2023-24 (kilotonnes and percentage of exports)



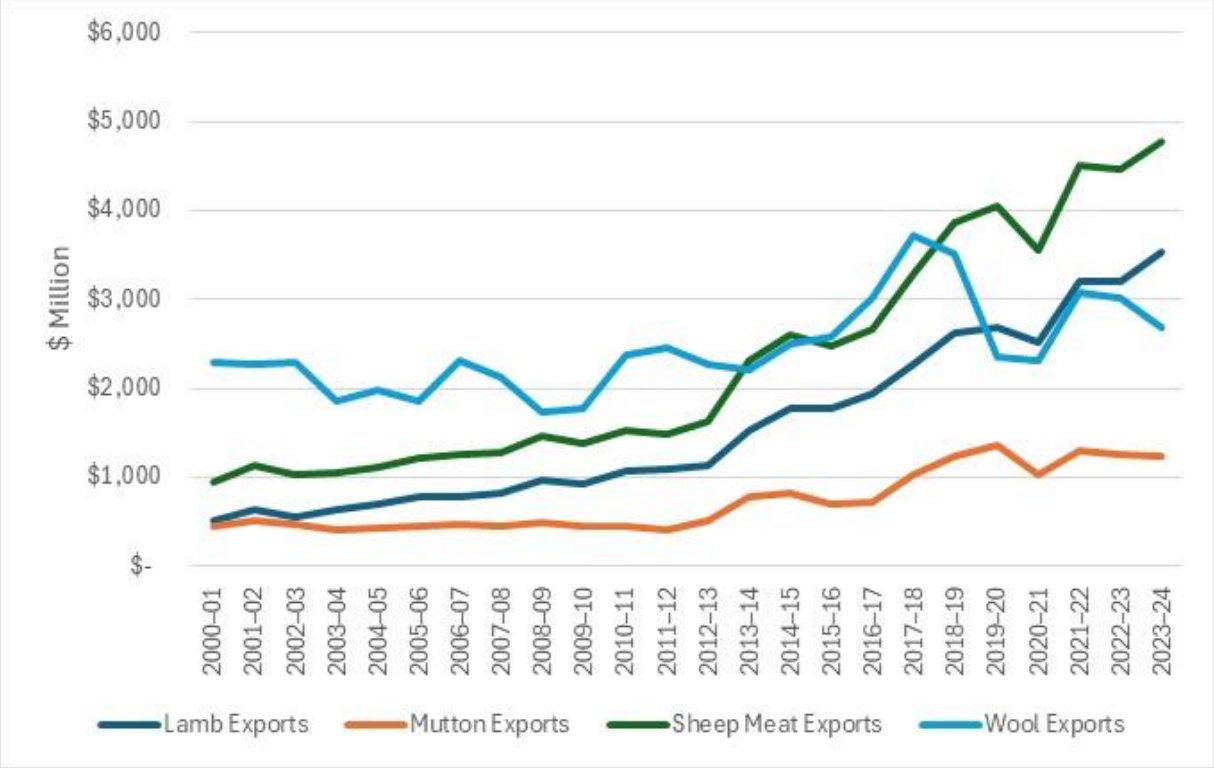
Source: ABARES (2024).

The major export markets for mutton are China, the Middle East and Malaysia (ABARES, 2024).

The farmgate value of lamb has now overtaken wool as the most valuable sheep product. Over the last 35 years, the farmgate value of wool has declined from $5.9 billion in 1988-89 to $2.8 billion in 2023-24, while over the same period the farmgate value of lamb has increased from around $400 million to $3.7 billion. This is outlined in Figure 7 below.

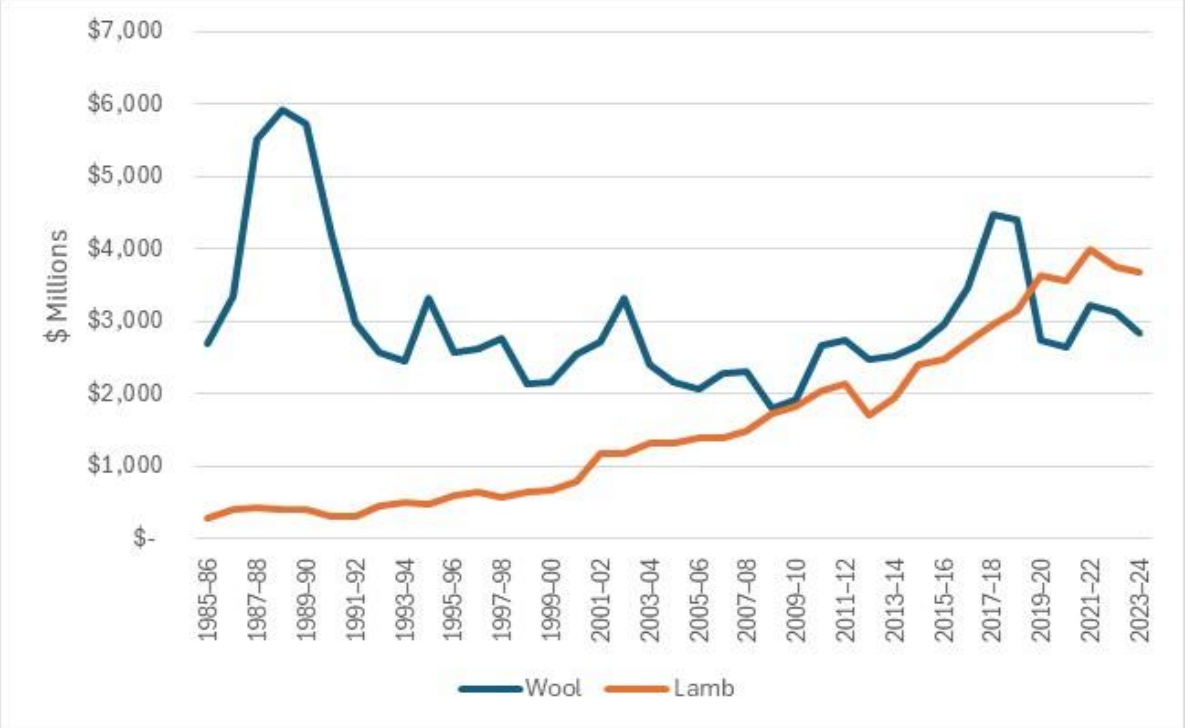
Sheep meat has also now surpassed wool as the most valuable export of Australia's sheep industry as of 2019–20 (Department of Agriculture, Fisheries and Forestry, 2024). This is outlined in Figure 8 below.

Figure 7: Value of Sheep Meat, Lamb, Mutton and Wool Exports – 2000-01 to 2023-24 ($ million)



Source: ABARES (2024).

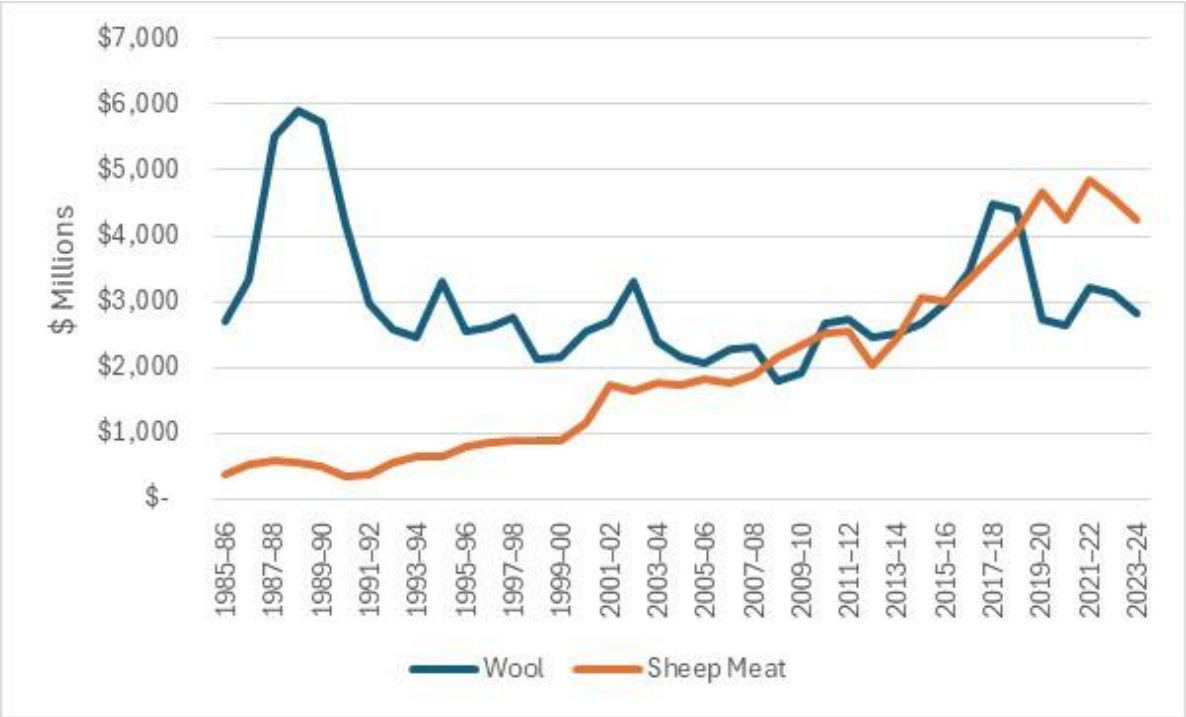
Figure 8: Value of Farmgate Production of Wool and Lamb ($ millions) – 1985-86 to 2023-24



Source: ABARES (2025a)

Thus, the lamb industry is no longer an add-on enterprise of the Merino wool industry but has now become the key driver of the sheep industry (Rowe, 2010, p. 992). If the farmgate value of mutton is combined with lamb, then the advantage that sheep meat enjoys over the total farmgate value of wool is even more pronounced as outlined in Figure 9 below.

Figure 9: Value of Farmgate Production of Wool and Sheep Meat ($ millions) – 1985-86 to 2023-24



Source: ABARES (2025a).

4. Flystrike and Mulesing

4.1 Flystrike

Cutaneous myiasis, more commonly known as flystrike, is the infestation of a wound by maggots and flies; it is a very painful condition and can result in death or significant morbidity in sheep (Johnston, Richardson, & Whittaker, 2023).

The most prevalent cause of flystrike in Australia is the sheep blowfly, Lucilia cuprina (RSPCA Australia, 2019, p. 4). Lucilia cuprina is not native to Australia (Norris, 1990) and is responsible for initiating over 90% of all flystrike (Levot & Casburn, 2016, p. 1). Gravid female sheep blowflies are attracted to lay their eggs in the wool of sheep by olfactory cues (Phillips, 2009, p. 113). The female sheep blowfly is particularly attracted to sheep with wool stained and wet from urine and faeces (RSPCA Australia, 2019, p. 6). The resultant damage or flystrike is mainly due to the mechanical and chemical effects of the feeding activity of the larvae (Phillips, 2009, p. 113). The maggots cause mechanical damage by feeding on the flesh of the sheep, and chemical damage due to the ammonia they excrete (RSPCA Australia, 2019, p. 6).

While Lucilia sericata (the common green bottle fly) is also known to cause flystrike and is the major sheep blowfly in many other countries, it has been reported to be a less common cause of flystrike in Australia compared to Lucilia cuprina (Anstead, 2020, p. 38). Strikes may also be initiated by number of species of brown blowflies, particularly in cooler areas (Kotze & James, 2022, p. 1).

Flystrike causes considerable pain and suffering within sheep (RSPCA Australia, 2019, p. 4). Flystruck sheep have increased rectal temperature, show rapid breathing, and suffer weight loss caused by loss of appetite (Broadmeadow, Connell, & O'Sullivan, 1984). Affected animals may eventually succumb to blood poisoning and die if left untreated (RSPCA Australia, 2019, p. 4). Flystrike is a seasonal issue, and individual sheep can experience recurring bouts of flystrike every year. Prime

(meat) lambs, because of their plainer bodies and the fact that they are slaughtered at an early age, have a significantly reduced risk of becoming flystruck.

Breech strike is the most common form of flystrike in most years, and occurs following urine staining or fouling of the breech with faeces, usually when sheep have diarrhoea (scouring) (Kotze & James, 2022, p. 1). Body strike occurs most commonly over the shoulders or along the backline, usually after the development of fleece rot or dermatophilosis. Body strike often becomes the predominant type of strike in wet years and during fly waves (sudden increases in fly numbers in response to a combination of favourable environmental conditions). Pizzle or belly strike is most common with wethers or rams when the belly wool becomes stained and dampened by urine. Poll or head strike occurs mainly in horned rams and can reach relatively high prevalences in some ram flock.

4.2 Financial Impact of Flystrike

Flystrike is a serious financial and animal welfare issue for the sheep industry (Kotze & James, 2022, p. 1). The economic cost associated with flystrike arises from mortalities, production losses of lost wool and reduced wool growth and value, weight loss, impaired reproduction in affected animals, treatment and prevention costs (Shephard, Webb Ware, Blomfield, & Niethe, 2022, p. 136).

Production losses associated with flystrike have been estimated at around $227 million per annum for the Australian sheep industry, with another $13 million per annum spent on treatment and $84 million spent on preventative measures (Shephard, Webb Ware, Blomfield, & Niethe, 2022, p. 140).

4.3 Vermont and the Legacy of Wrinkly Merinos

Flystrike was seldom a concern in Australian sheep farming between the arrival of the first migrants with their sheep in 1788 and the late 19th and early 20th Century (Phillips, 2009, p. 113). At this time, sheep were plain breeched, or without wrinkles and wool on their breeches.[2] However, this changed with the introduction of ten Vermont Merino rams into NSW and Tasmania in 1883, which had a pair of folds running vertically along each side of the perineal (Phillips, 2009, p. 114) and this genotype with its extremely wrinkly skin spread through the local population (Karlsson & Greeff, 2012, p. 106). According to the Joint Blowfly Committee in the early 1930s (Gilruth, Tillyard, Seddon, Gurney, & Mackerras, 1933, p. 7):

> *The blowfly pest has become an acute problem in Australia only since the beginning of the present century. This is due largely to the development about that time of a particularly susceptible type of sheep and to the accidental introduction and spread of certain species of primary blowflies (Lucilia), which are specially capable of developing on the living sheep.*

The Vermont Merinos differed greatly from the then Australian Merinos (Wertlieb, 2015). They grew a larger amount of what was a heavier, coarser wool that contained more lanolin, a natural oil produced by the sheep. The previous Australian Merinos lacked this trait, and grew a finer wool.

Vermont Merinos became popular in Australia in the late nineteenth century (Turner, 1977). This breed was characterized by an extensive skin development, the idea being that increased skin area would mean increased wool production. While it did increase the greasy weight of wool, it was through extra grease rather than extra wool (Turner, 1973, p. 291).

The Vermont Merinos came from a temperate area of the United States (Turner, 1977). When these 'super-wrinkly' sheep were bred with the Australian flock, they produced a Merino with increased

[2] The raised folds on the skin of Merino sheep and related breeds are variously called wrinkles, ribs, folds or pleats and the sheep carrying them are referred to as wrinkly, developed or pleated (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1551).

skin folds over most of the body with the moist, warm areas between the skin folds being especially attractive to flies (Townsend, 1987, p. 68).

The arrival of the Vermont Merinos coincided with the first reports of significant outbreaks of flystrike (Karlsson & Greeff, 2012, p. 106). The importance of breech wrinkle in determining susceptibility to flystrike was recognised early in the history of the sheep industry (James, 2006, p. 1). According to the Joint Blowfly Committee (Gilruth, Tillyard, Seddon, Gurney, & Mackerras, 1933, p. 20):

> *Vermont sheep carry several large folds about the neck, the sides of the body are thrown into a series of corrugations, chiefly vertical, the skin of the rump is so arranged that the tail is wide and flappy, with a marked central depression, and the skin of the breech … and crutch… is folded or wrinkled in a more or less irregular manner. Small wonder then that with fine, dense wool over the wrinkled breech and crutch, these sheep are frequently soiled in that area and consequently that such soiled areas are susceptible to blowfly attack.*

Due to the influence of the Vermont Merinos, Australian Merinos developed extensive wrinkling in the breech area and in particular a pair of medial folds that ran vertically along each side of the perineal area (James, 2006, p. 2). Once Australian farmers began breeding the wrinkled Vermont Merino sheep with the smooth-bodied Australian Merino sheep, it became difficult to remove the "wrinkled" trait later on (Wertlieb, 2015). While there was a swing back towards plainer sheep, heavy neck folds were still considered desirable, and this meant a certain amount of wrinkle on side and breech remained (Turner, 1973, p. 291).

According to Norris (1990, p. 38):

> *The history of the incidence of severe flystrike of sheep in south-western Australia reflects chiefly the progressive infusion of breeding stock of Vermont descent.*

According to Cottle (2010a, p. 10):

> *The American Vermonts represented a change from the earlier plain bodied sheep to a heavily wrinkled animals with low-yielding wool. Wool in America was sold on a greasy weight basis and hence yield was of no importance. Since many Australian stud breeders thought these sheep would improve wool cuts, their use spread rapidly, but they had lower, uneven wool quality, lower clean fleece cuts, higher fly-strike risk, lower lambing percentages and poorer constitution. Their introduction had a devastating effect on many famous fine-wool studs.*

In the late 1930s it was observed that wrinkles in Merinos were advantageous since it was commonly held that many desirable attributes of the fleece were associated with the presence of skin folds (Belschner, Carter, & Newton Turner, 1937, pp. 26-27). It would appear that attitudes amongst some wool producers have not changed much in the intervening period of almost 90 years, for as for the late Dr Jim Watts (2016a) observed:

> *Most of the Merino sheep in Australia have thick and wrinkly skins and have been that way since about 1880.*
>
> *There has been no concerted effort to remove this genetic fault, which brings with it the animal welfare concerns of mulesing, stressful shearing and too many lambs dying. It has made the Merino sheep unsuitable for thriving in the environment in which it lives.*

4.4 Mulesing

Mulesing is a surgical procedure that involves cutting away the skin around the tail and perineum, with the resulting scar tissue providing a bare surface that is resistant to flystrike (Edwards, Arnold, Butler, & Hemsworth, 2011, p. 170). It is most commonly performed using a sharp knife or mulesing

shears (Johnston, Richardson, & Whittaker, 2023). Mulesing seeks to reduce urine and faecal soiling or dag formation in the breech and tail wool and thus minimise susceptibility to breech and tail flystrike (Tim Harding & Associates and Rivers Economic Consulting, 2014, p. 41).

Mulesing was invented by John Hawkes William Mules, who was a breeder of Merino sheep with a small farm at Woodside in South Australia (Beveridge, 1980, p. 162). One of his Merino flock was a well-bred ewe that was very wrinkly and constantly being struck down by flystrike. In a letter Mules wrote:

> *I decided to settle the matter once and for all time and thought out the best way to relieve her of her wrinkles, which were obviously the cause of her trouble. I decided to first pinch the wrinkles and then cut them off, and I found that the operation was easy and a complete success. (Beveridge, 1980, p. 162)*

Mules subsequently performed the procedure on all of his ewe lambs and ewes in 1929 (Beveridge, 1980, p. 162). Some South Australian graziers adopted the technique but many were repelled by its apparent cruelty (Phillips, 2009, p. 114).

Before mulesing, attempts to control flystrike were through regular inspection, at least once a week, and crutching (Phillips, 2009, p. 114).[3] However, mulesing was shown to be a cheap, fast, and effective method of reducing the risk of breech strikes (Johnston, Richardson, & Whittaker, 2023).

The adoption of mulesing in Australia was slow at first but increased due to the vigorous promotion of the operation by Department of Agriculture extension officers in the 1960s and 1970s across the sheep growing states and the emergence of mulesing contractors (Fisher, 2011; Lee & Fisher, 2007, p. 89).

It has been speculated that mulesing was adopted by farmers only once contractors became available because farmers found the operation disturbing and difficult to undertake themselves (Lean, 2012, p. 413). While the operation is very effective at reducing the risk of breech flystrike, it is painful.

A survey by the Bureau of Agricultural Economics (B.A.E) estimated that only 31% of sheep were being mulesed in 1970 (B.A.E, 1970 from Jones A., 2001). However, the Australian Wool Corporation engaged in a persuasive campaign to encourage sheep farmers to adopt mulesing with the development of blowfly schools (Morley & Johnstone, 1984 from Phillips, 2009). One of the most compelling arguments used to persuade sheep farmers to take-up mulesing was that following the development of a successful mulesing program they could reduce the frequency of flock inspection, allowing them time to manage other aspects of their farming operations (Phillips, 2009, p. 114). Victorian sheep farmers who were less enthusiastic about mulesing than those in other states because they believed it to be cruel, were branded as 'ill-informed and conservative' (Morley & Johnstone, 1984 from Phillips, 2009). By 1979, while only 11% of meat-breed sheep flocks were mulesed, the rate of mulesing amongst wool flocks had risen to 56% (Morley, Mitchell, Napthine, Gillick, & Hass, 1980 from Lee & Fisher, 2007). By 1981-82, 71% of Merino flocks were being mulesed (Morley & Johnstone, 1984 from Lee & Fisher, 2007).

Mulesing usually accompanies 'lamb marking', routinely performed at the age of 6–10 weeks (Windsor & Lomax, 2013). Marking is a complex procedure, as it includes multiple vaccinations, ear tagging, castration of males and tail-docking. This complexity means there is a labour cost pressure to cease mulesing or only perform it in ewes, as marking is laborious and expensive for farmers.

[3] Crutching is the shearing of wool from around the tail and between the rear legs of a sheep (Australian Wool Testing Authority, n.d.). It can also refer to removing wool from the heads of sheep (wigging) or the pizzle area of male sheep. Crutching is usually performed one or two times per year between annual shearing events (Colditz, Cox, & Small, 2015, p. 31).

4.5 Animal Welfare Concerns with Mulesing

Public concerns regarding mulesing focus on the painful and stressful surgical procedure of mulesing used to prevent flystrike (Coleman G. , 2018, p. 16). According to Rothwell, Hynd, Brownlee, Dolling, & Williams (2007, p. 94):

> *The welfare issues associated with mulesing have been recognised for as long as the operation has been in existence and a search for less bloody and painful alternatives started in the 1930s.*

The 1989 Senate Select Committee on Animal Welfare (1989, p. 56) report on sheep husbandry provided the following commentary on mulesing:

> *Of all the issues that were raised by critics of the sheep and wool industry, the practice of mulesing was the one which attracted the most vigorous condemnation. Dr Auty referred to it as "the partial flaying" of the sheep and indicated that in his view, mulesing did not lie within the parameters of acceptable interference with animals. [The Australian and New Zealand Federation of Animal Societies] considered the mules operation "a crude and barbaric substitute for good husbandry" and quoted a Mr Douglass of the RSPCA (UK) who described mulesing as a "particularly abhorrent and quite unnecessary and unacceptable mutilation of an animal.*

Although mulesing can reduce the incidence of fly strike around the breech, it has many drawbacks, including:

- If the wound bleeds freely the lamb may die of shock
- Cuts that are too deep can permanently cripple the animal
- The wound may become infected and even when healed, the scar remains sensitive to sunburn with frequent development of skin cancer (Townsend, 1987, p. 68).

While sheep are mulesed to prevent breech strike, they can also remain highly susceptible to body strike in wet summers (Watts J. , 2016a, p. 9), with chemical treatments used for body strike prevention (Watts J. , 2016, p. 18).

Mulesing is a very painful procedure and involves a greater degree of tissue trauma than other surgical husbandry procedures such as castration or tail-docking (Tim Harding & Associates and Rivers Economic Consulting, 2014, p. 41). Mulesing can cause significant pain and distress associated with physical tissue injury, handling stress, and temporary separation from the dam (mother of the lamb) (Johnston, Richardson, & Whittaker, 2023).

Pain is apparent immediately following the procedure and persists for at least 2-3 days, and possibly up to 2 weeks, as reflected by changes in behaviour (Edwards, 2012). A substantial stress response occurs for 1–2 days following mulesing, and an acute phase response occurs for up to 7 days. Lambs consistently lose weight in the week following mulesing, and this has been associated with increased mortality rates under field conditions. Using these measures, it has been ascertained that mulesing poses a severe and sustained stressor for lambs, resulting in very poor welfare for a prolonged period of time.

Behavioural indicators of pain after mulesing include statue standing, hunched posture, reduced lying behaviour, longer time to mother up and feed, reduced grazing behaviours, and an aversion to the handler (Johnston, Richardson, & Whittaker, 2023). Lambs mulesed with no drug application exhibit large increases in plasma cortisol, reduced lying and increased standing with a hunched back compared with unmulesed lambs (Paull, Lee, Colditz, Atkinson, & Fisher, 2007).

Lambs consistently lose weight in the week following mulesing, and this has been associated with increased mortality rates under field conditions (Edwards, 2012). This weight loss may be attributed to reduced feeding behaviour and reduced availability of resources for growth due to healing.

Most states require lambs to be over 24 hours old before mulesing and recommend between two and twelve weeks of age (Johnston, Richardson, & Whittaker, 2023). In spite of the common recommendation for the procedure to be performed between 2 and 12 weeks, all states essentially allow the procedure in animals up to the age of 12 months, with WA having no upper cap on age.

The Australian Animal Welfare Standards and Guidelines for Sheep state that lambs must have analgesia for many common painful husbandry procedures from 6 months of age onwards (Cohen, Foss, Beths, & Musk, 2024). When lambs are under 6 months old, pain relief is not required but still recommended. Additionally, Livestock South Australia (an industry body), Victorian state regulations, and Tasmanian state regulations all mandate pain relief. Edwards (2012) has opined that:

> *Despite the considerable pain and welfare compromise that this procedure causes, mulesing remains a standard component of Merino husbandry because of the high efficacy of the procedure in combating breech strike.*

Mulesing has received global scrutiny for its negative impacts on animal welfare (Johnston, Richardson, & Whittaker, 2023) and has either been banned or not widely practiced in most other sheep wool producing countries except Australia.

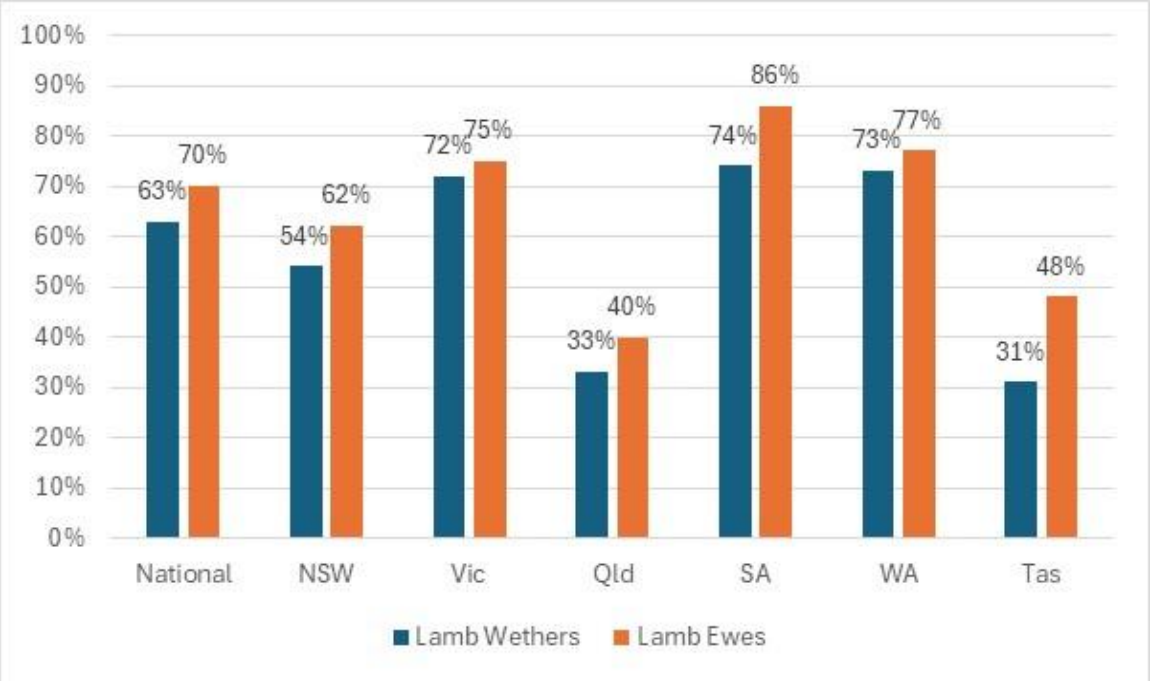
4.6 Incidence of Mulesing

The 2018 Survey of Husbandry Practices (Sloane, 2018, p. 19) found that:

- The overall percentage of sheep producers that mulesed their lambs in 2017 was 70% for ewe lambs and 63% for wether lambs.
- The overall rates of mulesing amongst sheep producers was much higher for South Australia, Western Australia and Victoria than it was for Queensland, Tasmania and NSW.
- The overall rates of mulesing for Merino lambs was much higher nationally, estimated to be 77% for Merino ewe lambs and 66% for Merino wether lambs.

Further details from the 2018 Survey of Husbandry Practices (Sloane, 2018, p. 19) are provided in Figure 10 below.

Figure 10: Percentage of Producers Choosing to Mules their Lambs in 2017



Source: Sloane (2018, p. 19).

The third Benchmarking Australian Sheep Parasite survey to benchmark the 2018 sheep parasite control practices of Australian woolgrowers found that:

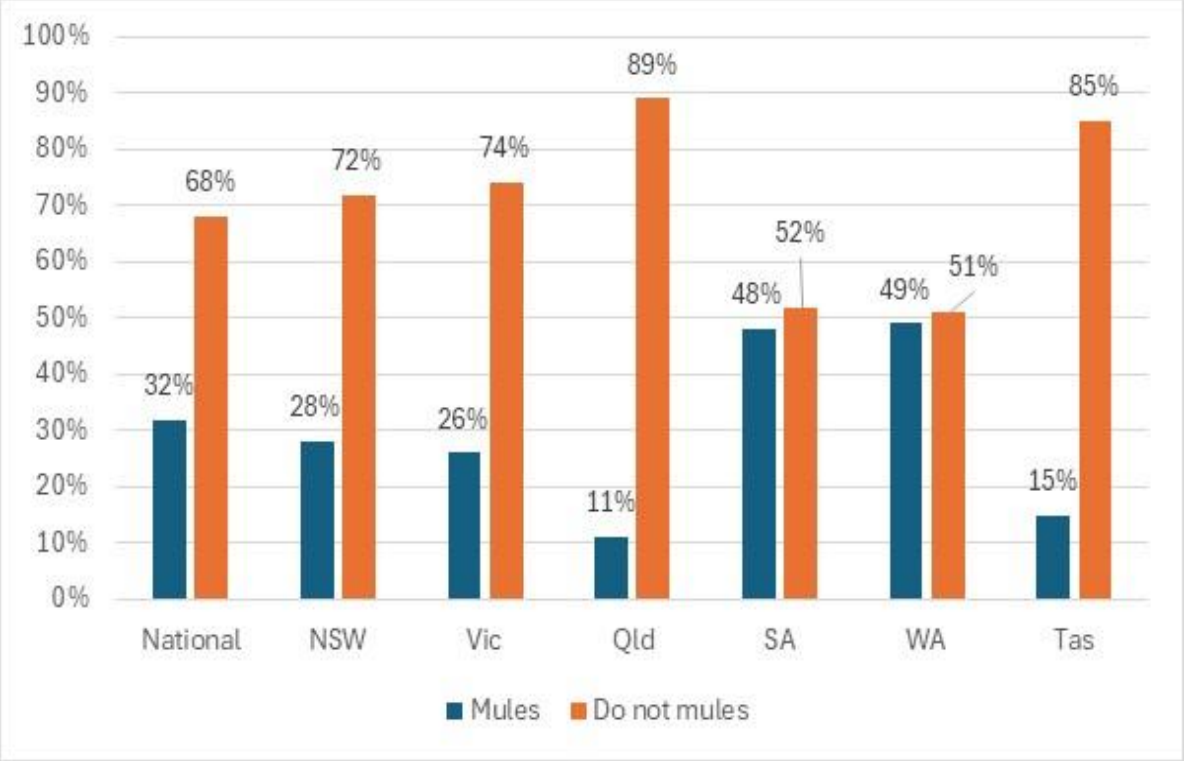
- The overall percentage of responding sheep enterprises that mulesed in 2018 was 46.8%, significantly lower than was recorded in 2003 where 91.8% of sheep enterprises reported mulesing (Colvin, Walkden-Brown, & Reeve, 2020, p. 4).
- Merino x Merino enterprises were significantly more likely to use mulesing (69.2%) while Merino x Other were less likely to mules (12.5%) and Meat x Meat were significantly less likely to mules (8.5%) (Colvin, Walkden-Brown, & Reeve, 2020, p. 3).

The 2023 National Sheep Producer Survey of Animal Husbandry Practices (Sloane & Walker, 2024, p. 54) found that

- 32% of sheep producers mulesed their ewe lambs in 2023 with 43% of ewe lambs being mulesed with significant variation across the states with mulesing less frequent in Tasmania, Queensland, Victoria and NSW while South Australian and Western Australian producers were significantly more likely to mules. This is outlined in Figure 11 below.
- Mulesing of ewe lambs was significantly higher among Merino producers (58%) than non-Merino producers (4%) and represented 61% of Merino ewe lambs and 7% of non-Merino ewe lambs being mulesed.
- 26% of sheep producers mulesed their male lambs in 2023 with the proportion of male lambs mulesed at 33% with significant variation across states, with mulesing less frequent in Queensland, Victoria and NSW while South Australian and Western Australian producers were significantly more likely to mules. This is outlined in Figure 12 below.
- Mulesing of male lambs was significantly higher among Merino producers (49%) than among non-Merino producers (1%) and represented 54% of Merino male lambs and 1% of non-Merino male lambs being mulesed.

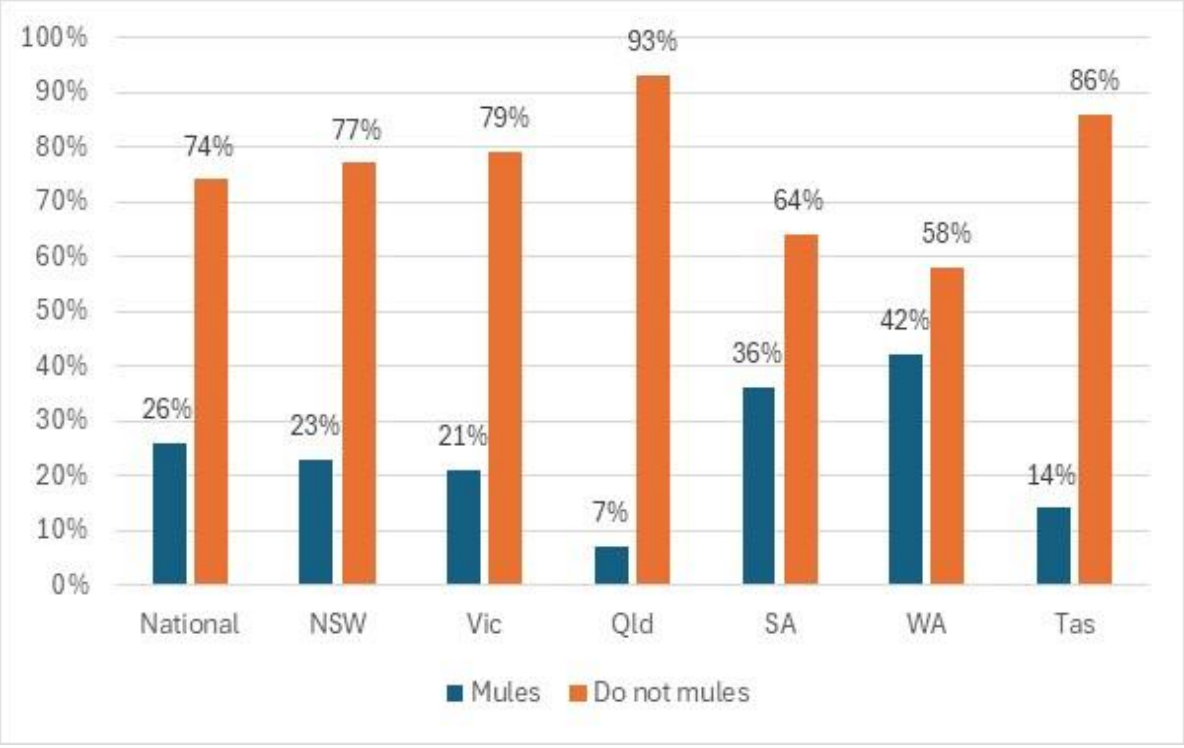
By way of comparison, the mulesing of ewe and wether lambs was practiced by 48% and 46% of sheep producers respectively in 2012 (Reeve & Walkden-Brown, 2014, p. 6).

Figure 11: Mulesing of Ewe Lambs by Sheep Producers in 2023



Source: Sloane & Walker (2024, p. 54).

Figure 12: Mulesing of Male Lambs by Sheep Producers in 2023



Source: Sloane & Walker (2024, p. 55).

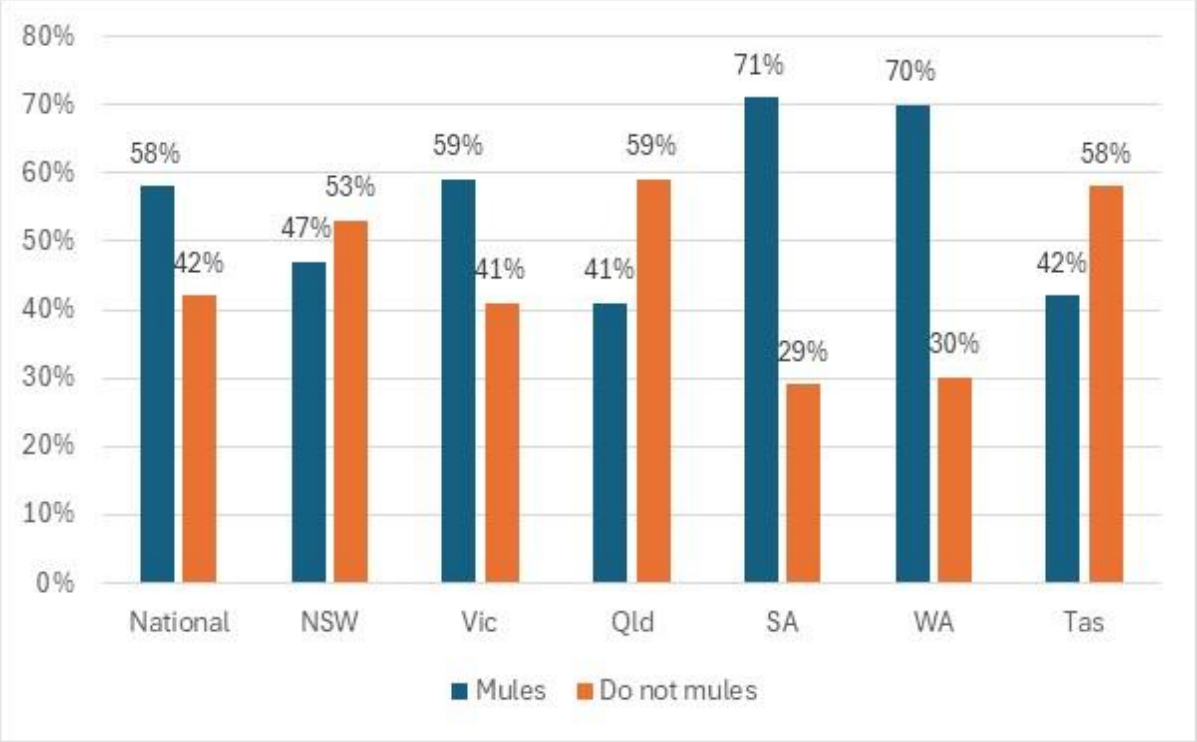
The 2023 Australian Wool Innovation (AWI) Merino Husbandry Practices Survey found that:

- At the national level, 58% of Merino producers mulesed their ewe lambs in 2023 with 61% of ewe lambs being mulesed with significant variation across states as outlined in Figure 13 below (Sloane & Walker, 2025, p. 58).

- At the national level, 49% of Merino producers mulesed their male lambs in 2023 with the proportion of male lambs mulesed at 54% with significant variation across states as outlined in Figure 14 below (Sloane & Walker, 2025, p. 58).

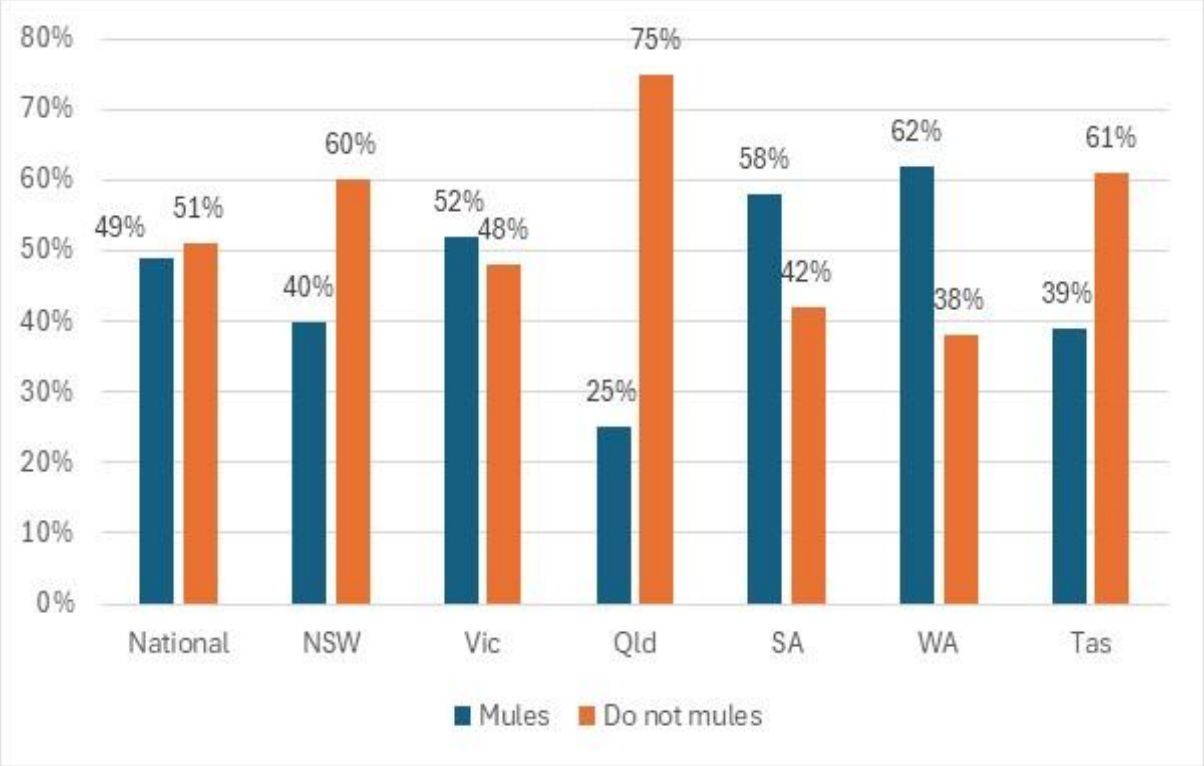
This contrasts with the Sheep CRC National Farmer Survey in 2014 which estimated that 83% of Merino ewe and wether lambs were mulesed (Colvin, 2022, p. 13) as well as the finding that only 9% of sheep producers did not mules their Merino lambs back in 2003 (Reeve & Thompson, 2005).

Figure 13: Merino Mulesing of Ewe Lambs by Merino Sheep Producers in 2023



Source: Sloane & Walker (2025, p. 59).

Figure 14: Merino Mulesing of Merino Male Lambs by Sheep Producers in 2023



Source: Sloane & Walker (2025, p. 59).

The overall incidence of mulesing appears to have declined as the relative importance of wool and the overall percentage of Merino sheep within the Australian sheep flock has declined. The percentage of pure Merinos in the breeding ewe population has fallen from 86% in 2004-05 to a current level of around 64% (Perrett, 2015; Intuitive Solutions, 2025) as the Australian sheep flock composition continues to shift toward breeds optimised for higher meat yield (as opposed to wool), as market incentives favour meat production (OECD/FAO, 2025, p. 88). The overall incidence of mulesing appears to have more than halved since the early 2000s when it was over 90%. Even amongst Merino flocks the relative incidence of mulesing has significantly declined since the early 2000s.

5. Economic Risks Posed by Mulesing

5.1 Social Licence to Operate

The concept of a social licence to operate describes the permission that society provides in the exploitation of a resource for private purposes (Martin & Shepheard, 2011, p. 5). Social licence is granted when industries behave in a manner that is consistent, not just with their legal obligations, but also with community expectations (Fernandes, Hemsworth, Coleman, & Tilbrook, 2021). A social license is granted if you are able to operate in a way that is consistent with the ethics, values and expectations of your stakeholders who include customers, employees, the community, regulators, legislators and the media (Arnot, 2008, p. 3).

Originally used to describe the social acceptability of mining operations, the term has since been applied to explore the willingness of communities to accept the activities of the forestry, agriculture and energy sectors (Moffat, Lacey, Zhang, & Leipold, 2016, p. 89). The agriculture sector is also subject to the social licence to operate as it requires access to natural resources, and the community has the power to reduce or place conditions on that access.

The existence of a social licence to operate implies that if industry violates community expectations about how it ought to operate, it is within the power of society to rein-in industry by a variety of means including legal constraints and market penalties such as consumer boycotts (Martin & Shepheard, 2011, p. 5). A social licence to operate can be tenuous, and if lost can decimate industries through loss of market access or legislative approval (Hampton, Jones, & McGreevy, 2020).

Failure to fulfill the obligations inherent to social license can lead to increased litigation, increased regulations, and increasing consumer demands all of which hamper the success of industries (Coleman G. , 2018, p. 647).

Once lost, social license is replaced with social control. Social control is regulation, legislation or litigation designed to compel you to perform to the expectations of your stakeholders (Arnot, 2008, p. 3). Operating with a social license is flexible and low cost, however, operating with a high degree of social control increases costs, reduces operational flexibility and increases bureaucratic compliance.

Community outrage will inevitably lead to a loss of social licence to operate in democracies, beginning with negative media and leading to political and regulatory bans (Hampton, Jones, & McGreevy, 2020). When public pressure, lobbying, and social media activism are strong enough, bans have been imposed by governments that are strongly affected by public perceptions in affluent and media-savvy jurisdictions.

Animal welfare issues, together with issues relating to climate change, water scarcity, and declining biodiversity, have all been recognised as potential threats to a farmer's social licence to operate (Fernandes, Hemsworth, Coleman, & Tilbrook, 2021). In turn it has been posited that animal welfare has recently become arguably the most crucial consideration underpinning the social licence to operate for Australian animal use industries (Hampton, Jones, & McGreevy, 2020).

The public and livestock producers often differ on their views of livestock welfare, and failure to meet public expectations may threaten the social license of livestock producers to operate, thereby increasing the cost of production and hampering the success of the industry (Coleman, Hemsworth, Hemsworth, Munoz, & Rice, 2022).

According to Kotze and James (2022, p. 1), mulesing is no longer a tenable method given its affecting the marketability of sheep products and the 'social licence' for sheep production into the future and has renewed pressure for the development of more effective and efficient methods to manage flystrike over long-term control.

According to a recent research report published by Meat & Livestock Australia (MLA), the statutory marketing and research and development corporation for the Australian red meat industry:

> *The practice of mulesing, to reduce susceptibility of sheep to breech flystrike, represents a significant welfare issue that is increasingly becoming less acceptable by retailers and consumers and poses risks to meat and wool markets. (Warn & Martin, 2024)*

Details on the public campaign against mulesing, that has arguably eroded the social licence of wool producers, is provided in Appendix 1.

5.2 Trade and Marketing Implications from Mulesing

Product standards are generally referred to as Technical Barriers to Trade (TBT) and constitute a substantial barrier to the increased international flow of goods (Du, 2007, p. 270).

TBT generally result from the preparation, adoption and application of different technical regulations and compliance generally needs to be confirmed (conformity assessment procedures) (World Trade Organization, 2020). If a producer in country A wants to export to country B, they will

be obliged to satisfy the technical requirements that apply in country B, with all the financial consequences this entails.

World Trade Organization (WTO) rules, including the General Agreement on Tariffs and Trade (GATT), and the Agreement on Technical Barriers to Trade, have often been seen as a major impediment to the adoption of stronger animal protection legislation around the world (Stevenson, 2015, p. 1). The fundamental obligation under the GATT is non-discrimination (Du, 2015, p. 396), while the TBT Agreement imposes significant caveats on national regulatory autonomy through obligations on nations to be non-discriminatory, least-trade-restrictive and the harmonise their product standards (Du, 2007, p. 275).

The conventional view is that while a WTO member country may prohibit the use of cruel farming practices in its own jurisdiction, it cannot restrict the import of products derived from these practices in other countries (Stevenson, 2015, p. 1). In effect this makes it difficult for any country to improve animal welfare as it runs the risk that its own farmers will be undermined by lower animal welfare standards, and hence cheaper products elsewhere through imports. Article 1 (non-discrimination), Article III (identical treatment for "like product", irrespective of processing or production method (PPM)), and Article XI (general elimination of quantitative trade restriction) of the GATT plus the TBT Agreement provisions regarding "like product," are relevant in this regard. In particular, the GATT does not permit distinctions to be made on the basis of the way in which products are produced (or their PPM).

Where a measure is found to be inconsistent with the trade obligations found in Articles I, III or XI of the GATT, a country may still be able to justify that measure under Article XX (General Exceptions). The Article XX exceptions most relevant in the case of animal welfare are:

- the protection of public morals (paragraph (a))
- the protection of human, animal or plant life or health (paragraph (b))
- the conservation of exhaustible natural resources (paragraph (g)).

The European Union has successfully invoked the public morals exception of Article XX to justify its ban on seal products on animal welfare grounds (World Trade Organization, 2014). This decision carries great systemic importance and could possibly open the door to legal justifications of trade restrictions for a wide range of animal welfare objectives (Serpin, 2016, p. 242). This decision has been applauded by animal welfare organisations for allowing animal welfare to be recognised as a legitimate reason for trade regulation, although concern remains as to whether it will be followed through in future animal welfare disputes (Neo, 2014, pp. 352-353). This precedent could potentially be used to exclude Australian wool from various markets around the world on the basis of mulesing.

However, a more immediate concern is that Australian wool could be boycotted by major processors, retailers and consumers due to mulesing. The pain inflicted upon sheep from mulesing threatens export markets for Australian wool, with international wool buyers being pressured into purchasing wool from un-mulesed sheep (Lomax, Sheil, & Windsor, 2009, p. 57).

Over 330 brands have publicly stated their opposition to using mulesed wool and have either completely ended their use of mulesed wool, or are working towards doing so (Reeves, 2024, p. 19). The list of brands and retailers opposed to mulesing include Adidas, ALDI, Big W, Country Road Group, David Jones, Esprit, H&M, Hugo Boss, Kmart, Mango, Myer, The North Face, Patagonia, IKEA, Nike, Target and Zara. Many of these brands are already seeking wool from suppliers outside of Australia.

According to a recent research report commissioned by MLA (2024) on sheep welfare challenge for Australian sheep product exports to the UK, the major risk lies within NGOs highlighting the graphic nature of mulesing with the public thereby generating widespread consumer concern. In turn, there is a fear Australian sheepmeat is likely to be associated with an animal welfare issue creating potential barriers to enter major UK retailers.

Australian Wool Innovation (AWI), the statutory body responsible for research and development and marketing of Australian wool, has often sought to downplay the impact of concerns over animal welfare in relation to mulesing and the associated market risks. In March 2020, the then AWI Chair Colette Garnsey declared:

> *AWI is not here to pick winners on mulesing or non-mulesing. (Griggs, 2020)*

Ms Garnsey commented further that:

> *The non-mulesing push is coming from the Europeans and driven by two (fashion) houses who are really trying to avoid having to deal with animal activists who are camping on their doorsteps. (Griggs, 2020)*

However, in responding to Ms Garnsey's comments, the then President of the Australian Council of Wool Exporters and Processors Matt Hand said demand for non-mulesed wool was far more extensive than just a small number of European brands and it was being consumer-driven.

> *The bottom line is that a long list of global brands are acknowledging their consumers have an appetite to move away from mulesing. (Sim, 2020)*

Mr Hand further commented:

> *Endless energy has been contributed towards convincing anti mulesing brands, retailers and consumers to somehow relinquish and accept what they've been vocally rejecting for over a decade.*
>
> *…*
>
> *It seems a little illogical for the entire supply chain to source and ultimately pay unarguable premiums for non-mulesed wool if the customers were not demanding it.*
>
> *…*
>
> *Arguing with a consumer who knows what they want and believe they are buying responsibly is just not an argument you can expect to win, they just shop somewhere else and buy a product they feel ethically happy with. (Sim, 2020)*

Market research commissioned by AWI consisting of a "comprehensive survey of 198 wholesale and retail users of wool across 27 countries" found that:

- Animal welfare and mulesing are mid-tier priorities. Animal welfare standards (46%) and using non-mulesed wool (45%) were comparatively less of a priority, although still a consideration for almost half the sample.
- Diversity of views around animal welfare and mulesing, with the highest concern being registered in Europe. While concerns were most pertinent for European wholesale and retail users of wool (especially in Germany), where the well-established animal rights movement has led to a number of anti-mulesing protests, by contrast most Asian markets (and Australia) were generally less concerned by the impact of animal welfare standards and the use of mulesed wool on their businesses. (Australian Wool Innovation and Pragmatic Research & Advisory Services, 2023).

However, WoolProducers CEO Jo Hall commented in relation to the market research:

> *To claim mulesing is a mid-tier priority when buried among a lot of other issues that wool growers have no control over and gloss over the fact that nearly half of respondents (45 per cent) identified mulesing as a priority is not helping growers. (Dowler, 2024)*

According to former Australian superfine wool supply coordinator and now European wool testing business owner Paul Vallely, global consumers of wool products have already made up their minds that mulesing, with or without pain relief, is unacceptable:

> *Buying behaviour surveys continually show this is the case.*
>
> *With this in mind, anyone with a basic understanding of marketing knows you don't tell a consumer they are wrong.*
>
> *Particularly when you attempt to justify imagery of mulesing with imagery of a sheep with flystrike.*
>
> *The consumer will simply respond by preferencing alternatives. Any debate on the degrees to which the sheep 'suffer' is irrelevant – it is still unacceptable to consumers. (Sim, 2025)*

However, the outgoing Chair of AWI, Mr Jock Laurie, commented in late August 2025 that:

> *There is not a line of wool that goes into the auction room that does not get sold because it is mulesed. The market is saying to growers, 'we are happy to buy that and can fit that into this order or that order'. (Myers, 2025)*

On the other hand, the market risk to Australian wool sales from mulesing may be far greater than suggested by Mr Laurie. There were press reports following the International Wool Textile Organisation (IWTO) Congress held in May 2025 in France that some Chinese buyers were expressing a growing preference for South African wool over Australian wool, with the country's prevalence of Responsible Wool Standard (RWS) certified clips driving the trend (Nugent, 2025b). At the congress, Nanjing Wool Market director Jiang Yali confirmed there was a strong market preference in China for South African wool, particularly RWS-certified wool. Ms Yali also indicated the entirety of South Africa's wool clip was non-mulesed, at a time when China and South Africa were growing increasingly close economically (Sinnott, 2025).

However, AWI has sought to downplay Chinese concerns, with AWI CEO John Roberts seeking clarification around the comments made at the IWTO congress by Nanjing Wool Market's Jiang Yali (Nugent, 2025). Apparently, Ms Yali told AWI that RWS wool or other certified wools are in high demand for export products, particularly to Europe, but the China domestic market does not require such certification. Ms Yali also commented that "[s]ometimes, for wool of the same fineness, RWS-certified Australian wool commands a higher price than RWS-certified SA wool", and that "[c]onsidering the cost, Chinese buyers prefer [South African] wool."

According to the National Council of Wool Selling Brokers of Australia (NCWSBA) President Rowan Woods, the message out of the IWTO Congress was that global customers prefer accredited wool, with the preferred schemes all including non-mulesed wool only:

> *There was a greater percentage of accredited wool in South Africa and New Zealand, which was why buyers were preferencing these markets over Australia.*
>
> *While wool brokers are not in the business of telling their woolgrowers what animal husbandry practices they should adopt, we would be derelict in our duty as advisers if we didn't convey the messages we receive from the global wool trade.*
>
> *Woolgrowers considering this decision need to have accurate and current information. (Nugent, 2025a)*

According to Wool Producers Australia chief executive Jo Hall, ignoring consumer concerns over mulesing would ultimately cost Australia its competitive advantage, with South Africa's wool industry gaining an edge in recent years (Sinnott, 2025). According to Ms Hall:

> *China is always going to be a major player in our industry, regardless of the size of it.*

> *China not only buys up to sort of 80 to 85 per cent at the moment, and they can consume 50 per cent of that domestically, but then they process and export further.*
>
> *Something I also hear within industry is that China doesn't care about animal welfare or mulesing specifically. China does care – well, China may or may not care, but their customers do– and I've been in a number of joint Australia-China wool working groups over many years, but certainly in the last two years, maybe it was 2023, when you have Chinese processors saying, when is Australia going to start producing more RWS-accredited, ie non-mulesed, wool. (Sinnott, 2025)*

Chinese textile manufacturers not only produce for their domestic market, but also produce high-end fabrics for European fashion houses as well as export consumer products (McGregor, 2022). China is also moving to increase its own wool production and reduce reliance on Australian Merino wool (Sier, 2024).

Uralla-based wool producer Michael Taylor, who is part of a new "informal support group" of ultra fine wool growers that want to differentiate themselves from AWI's past approach on mulesing, has commented:

> *We got sick of being told by brands, bluntly to our faces when we are overseas that they do not want Australian wool because we (Australia) mules. (Dowler, 2025)*

Mr Taylor has further commented:

> *If we want to grow wool demand we need to demonstrate the concerns of customers are met, and what their concerns are, is how do we know this wool has been produced in a sustainable way. (Dowler, 2025)*

Growing consumer concerns, as well as ethically sourced products, show the opportunities of differentiating into products with higher welfare standards (Wright & Stein, 2023). Moreover, media scandals and scrutiny, including the rise of social media, have added scrutiny to low animal welfare practices on farm. The indifference that large sections of the Australian wool industry has exhibited towards mulesing has provided a marketing opportunity for New Zealand wool producers that has been effectively exploited. Further details on this are provided in Appendix 2.

Following the decision by New Zealand to outlaw the practice of mulesing from the beginning of October 2018– joining South Africa, Uruguay and Argentina in banning the practice - Australia has become isolated in being the only major wool exporting nation that still permits mulesing (Neales, 2018).

The then Chief Executive of Cape Wools, the official industry representative organisation of the South African Wool Industry, Louis De Beer, has previously warned that Australia's failure to cease mulesing threatens the future viability of the entire Merino wool industry:

> *Consumers are telling us that they are concerned with the procedure which means we have to be concerned about it and find a collective solution – there is no point in being arrogant about it.*
>
> *"The people on the frontline dealing with consumers on a daily basis would like things sped up and see more action (from the Australian industry).*
>
> *"We have to be sympathetic to the consumers concerns and we have to understand that cash is king and they are buying our product. (Beale, 2016a)*

6. Australian Wool Industry Response on Mulesing

Despite the Australian wool industry committing to phase-out mulesing in November 2004 by the end of 2010, AWI announced in July 2009 that the industry would be reneging on this commitment (further details provided in Appendix 1).

Rather than seek to phase-out mulesing, the Australian wool industry has instead chosen to pursue two-pronged strategy to address the mulesing issue: (i) a system of voluntary declarations of mulesing practices in wool auctions; and (ii) pain relief for mulesed sheep.

6.1 National Wool Declarations

The Australian Wool Exchange (AWEX) (2014, p. 2) was founded in 1993 and provides the major industry framework for the exchange of ownership of wool in Australia through an auction system. The membership of AWEX includes wool brokers, exporters, private treaty merchants, processors, wool producers and associates. AWEX works to maintain industry standards, market information and compliance with regard to clip preparation and presentation for sale, thereby enhancing the quality and integrity of the Australian wool clip. As a general rule around 85% of the Australian fresh-shorn wool clip is sold at auction, although very little of the 12 to 14 micron wool finds its way to auction as most of it is sold privately (Woods A. , 2024).

From 1 July 2008 all wool being sold through the auction system has had the option of having an accompanying National Wool Declaration (NWD) (Tim Harding & Associates and Rivers Economic Consulting, 2014, p. 27). The declaration asks growers to indicate whether they have ceased mulesing or if individual mobs (or even the entire clip) have not been mulesed. It also allows growers to declare if they used a pain relief treatment when mulesing. The function of the NWD is to enable woolgrowers to promote their animal welfare practices (i.e. Mulesing Status) (Australian Wool Exchange, 2020).

The sale lot mulesing status codes used are provided in Table 1 below.

*Table 1: Mulesing Status Codes used in the National Wool Declaration Sale Lots**

Sales Lot Mulesing Status	Name	Definition
NM	Non Mulesed	Sheep in this mob have not been mulesed or treated with liquid nitrogen.
CM	Ceased Mulesing	No lambs born on this property in the last 12 months have been mulesed. No mulesed ewes or wethers have been purchased in the last 12 months.
LN	Liquid Nitrogen	Sheep in this mob have been treated with liquid nitrogen
AA	Mulesed with Analgesic/ Anaesthetic	Sheep in this mob have been mulesed with the use of an analgesic and/or anaesthetic product.
M	Mulesed	Sheep in this mob have been mulesed without the use of an analgesic and/or anaesthetic product.
[ND]	Not Declared	This sale lot contains wool sourced from sheep/mobs where no mob declaration has been made.

Source: AWEX (2023).

The National Wool Declaration - Integrity Program (NWD-IP) is an extensive program of Desktop Audits/Verifications and On Farm Inspections conducted by the AWEX (2023, p. 10), which was designed to build wool pipeline and consumer confidence in Australian wool. Declarations of NM, LN, AA or CM are all eligible to be randomly selected for an NWD-IP Desktop Audit, Verification or On Farm Inspection, as per the following:

- Desktop Audit – Validate that the correct Mob mulesing status is published ~1,500 Declarations p/a.
- Desktop Verification of LN or AA – Validate mobs declared as LN or AA ~450 Verifications p/a. Alternatively, LN may be validated through an On Farm Inspection.
- On Farm Inspection – Validate mobs declared as NM or CM (or LN) ~225 Inspections p/a.

6.2 Pain Relief

Across Australia, the vast majority of producers who mules use pain management (94% of producers for both ewe lambs and male lambs) (Sloane & Walker, 2024, p. 56). The proportion of ewe and male lambs being mulesed with pain management is similar at 95% and 94% respectively. Nationally, of sheep producers who use pain management products at mulesing, virtually all (93%) use anaesthetic and antiseptic spray at the surgery site such as Tri-Solfen®.

Tri-Solfen® is sprayed onto the mulesing wound (RSPCA Australia, 2019, p. 14). The gel-like nature of the product ensures it adheres to the wound and provides a barrier to help keep the wound clean and promote healing. Pain relief provided by Tri-Solfen® may last up to 24 hours largely due to the protective barrier of the gel following mulesing (Lomax, Sheil, & Windsor, 2013, p. 166). However, as

Tri-Solfen® is not administered until after the skin has been cut away, the pain felt during the procedure is not diminished (RSPCA Australia, 2024, p. 14).

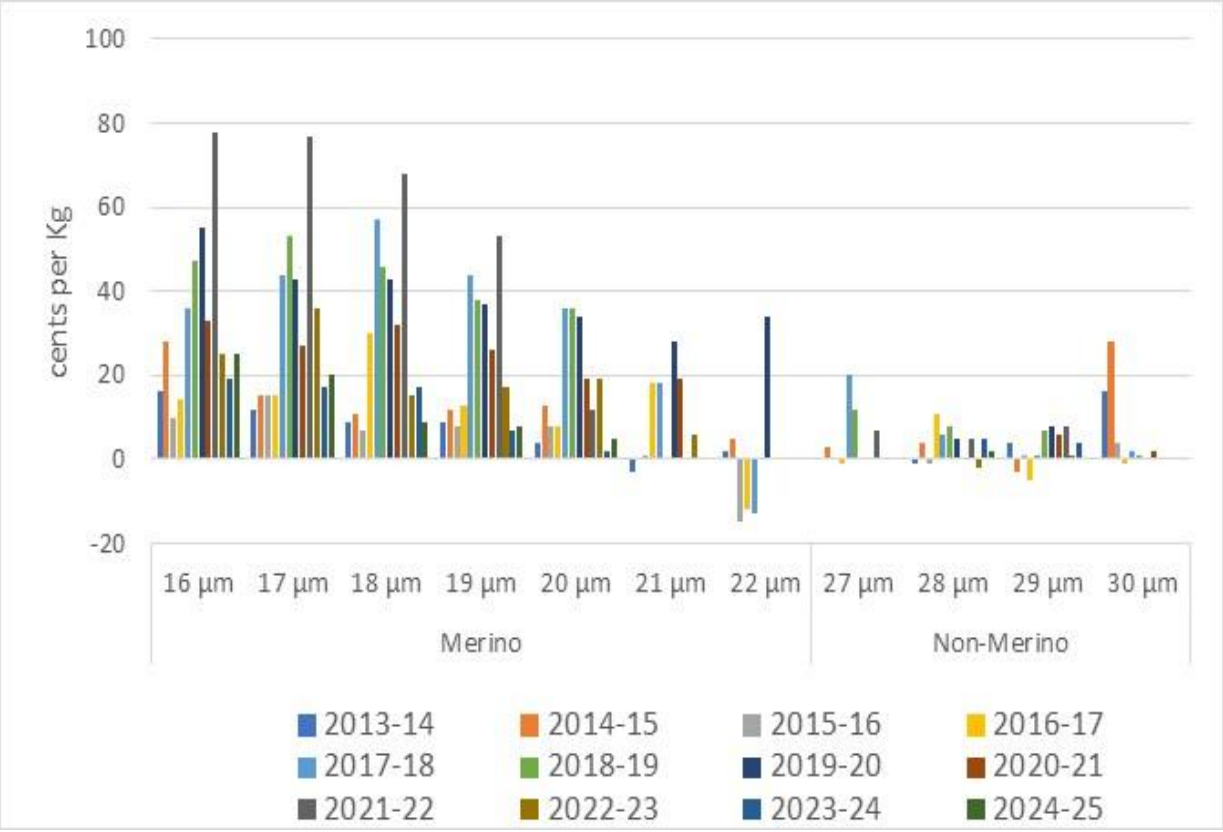
In 2016, an oral analgesic product (Ilium Buccalgesic® OTM) became available to producers, with a second similar product, Butec OTM now also available (RSPCA Australia, 2024, p. 14). Both products are applied against the inside of the sheep's cheek (buccal administration) via a dosing gun immediately prior to the mulesing procedure. The active ingredient in these oral pain relief products is meloxicam, a non-steroidal anti-inflammatory drug that is quickly absorbed in the blood stream within 15-20 minutes of administration, reaching maximum concentration after 2.6 hours (RSPCA Australia, 2024; Small, Marini, Dyall, Paull, & Lee, 2018). Injectable forms of meloxicam for sheep are also now available (RSPCA Australia, 2024, p. 14). While meloxicam reduces the pain associated with inflammation, it can do little to address the acute pain felt during mulesing.

While most producers use a local anaesthetic (Tri-Solfen®) for pain management following mulesing, most do so without also applying a longer acting analgesic (Colvin, 2022, p. 4). Only 8% of producer use a combination of an analgesic and an anaesthetic for pain management.

6.3 Price Premium for Non-Mulesed Wool

Up until 2021-22, price premiums received non-mulesed Merino wool had generally been increasing in trend terms. However, since 2022-23 and onwards the prices premiums received for non-mulesed Merino wool appear to have fallen and stagnated. This is outlined in Figure 15 below.

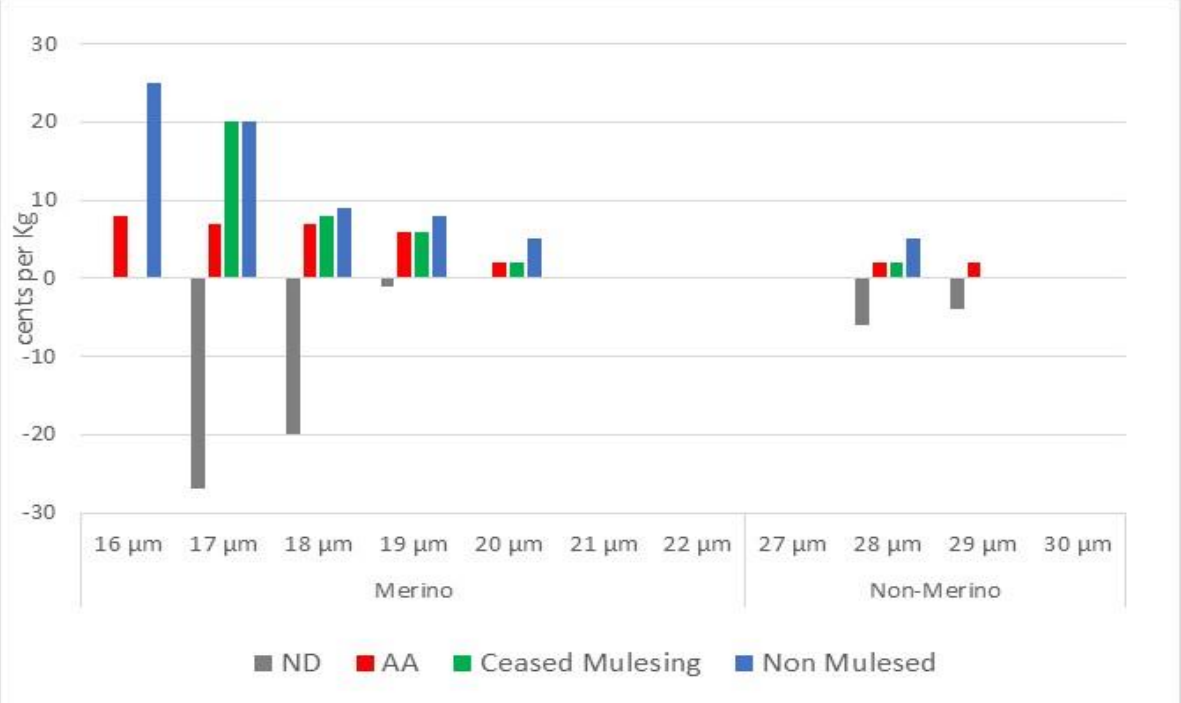
Figure 15: Premiums for Auctioned Non-Muleses Wool on the Australian Wool Exchange – 16 µm to 30 µm (cents for Kg clean wool)



Source: Australian Wool Exchange Ltd.

Despite this, the premiums received for non-mulesed wool are generally higher across the board than for other categories. This is outlined below in Figure 16 that compares the premiums and discounts received by mulesing status in 2024-25.

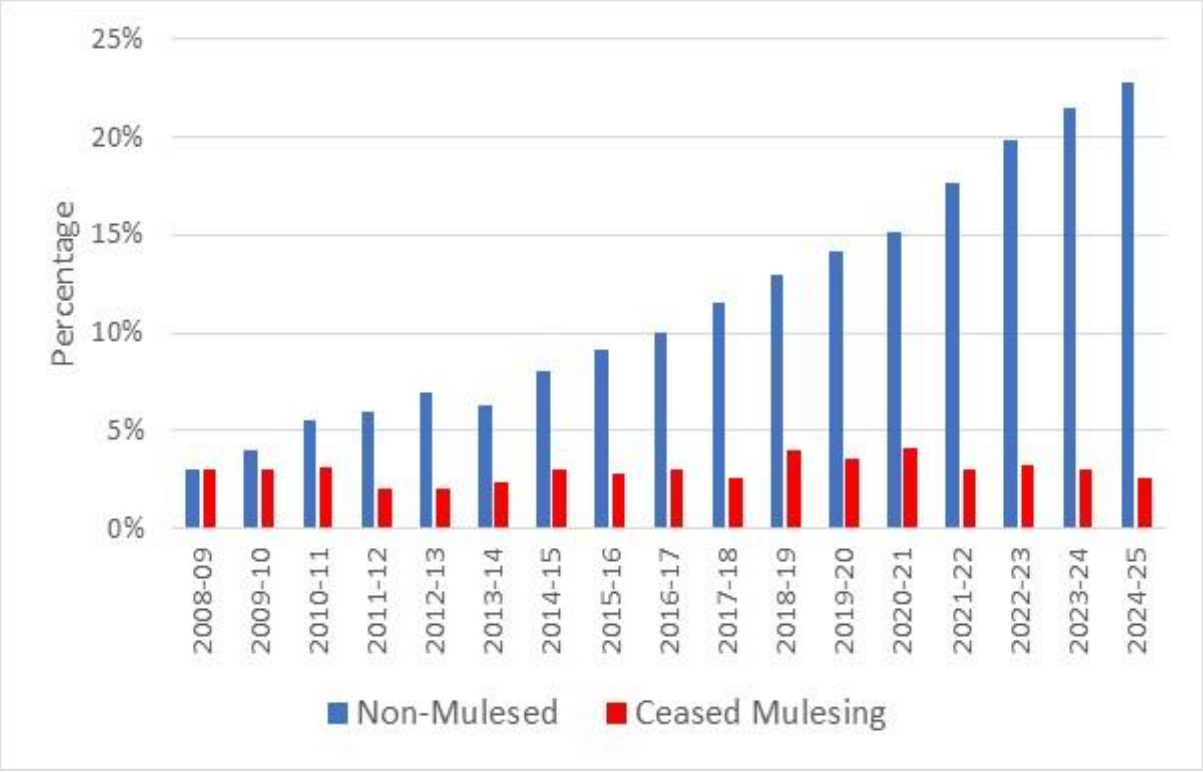
Figure 16: Comparison of Premiums Received by Mulesing Status in 2024-25 on the Australian Wool Exchange – 16 µm to 30 µm (cents for Kg clean wool)



Source: Australian Wool Exchange Ltd.

In turn, the amount of non-mulesed wool being sold through AWEX has generally been steadily increasing since 2008 and has now reached almost 23%, while the amount of wool from farms that have ceased mulesing is now at almost 3%. This is outlined in Figure 17 below.

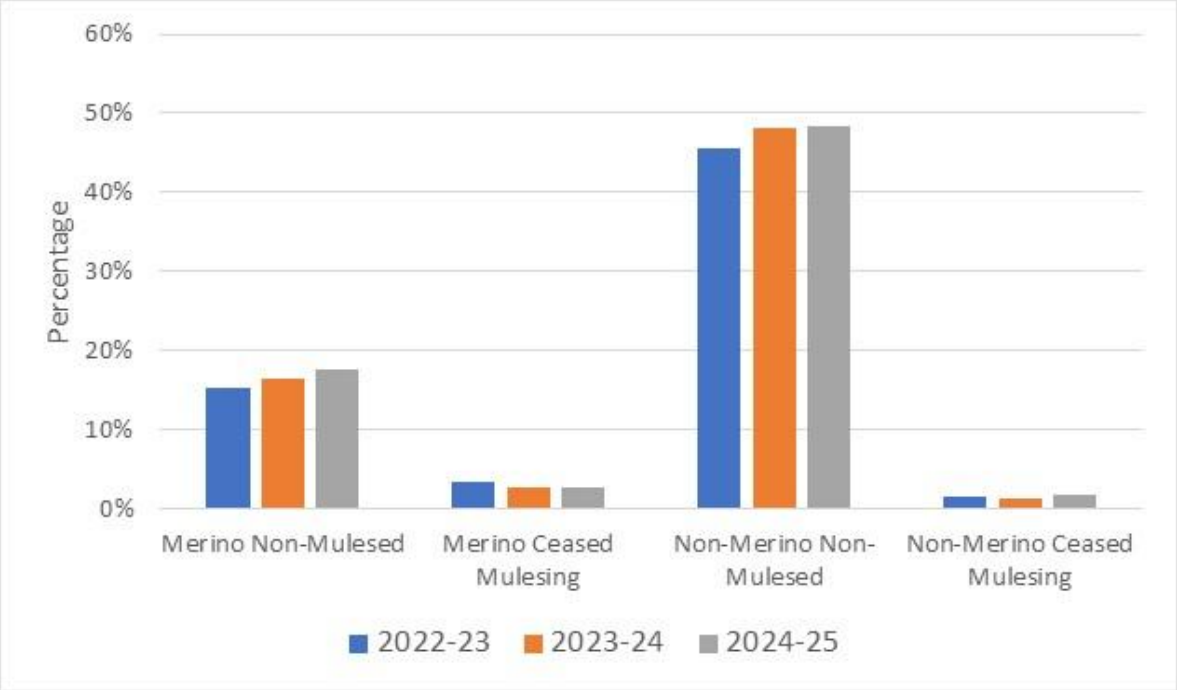
Figure 17: Percentage of Non-Mulesed Wool Sold (NM) and Percentage of Wool Sold From Farms that have Ceased Mulesing (CM) on the Australian Wool Exchange– 2008-09 to 2024-25



Source: Australian Wool Exchange Limited.

Looking at the breakdown between Merino and non-Merino wool, the amount of non-Merino wool that is non-mulesed is approaching 50% while the amount of non-mulesed Merino wool is approaching 20%. This is outlined in Figure 18 below.

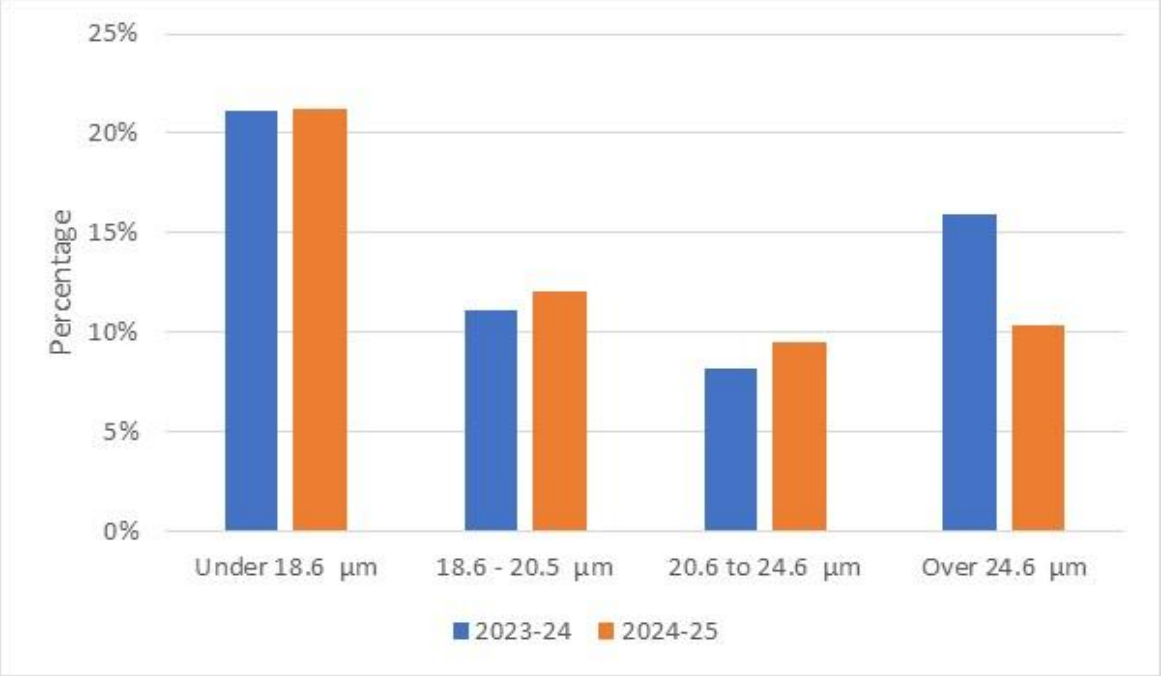
Figure 18: Percentage of Non-Mulesed Merino and Non Merino Wool Sold (NM) and Percentage of Wool Sold From Farms that have Ceased Mulesing (CM) on the Australian Wool Exchange– 2022-23 to 2024-25



Source: Australian Wool Exchange Limited.

However, wool less than 18.6 µm has a relatively higher proportion of non-mulesed wool and a corresponding high level of ceased mulesing than compared with other microns indicating a higher propensity to transition away from mulesing (Graves & Hansford, 2020, p. 3). It has been suggested this is likely due to the strong connection these growers have with their market. This is outlined in Figure 19 below.

Figure 19: Percentage of Non-Mulesed Wool Sold on the Australian Wool Exchange– 2023-24 to 2024-25



Source: Australian Wool Exchange Limited.

6.3.1 Wool Accreditation Schemes and Price Premiums

The raw data on price premiums related to non-mulesing may not reveal the whole story as even higher price premiums appear to be available for participating in wool accreditation schemes. The Responsible Wool Standard (RWS) is an international, voluntary standard that addresses animal welfare in sheep farms and chain of custody of wool from certified farms to the final product (Textile Exchange, 2021, p. 5). Individual sites are certified by independent third-party certification bodies using annual audits. Material is tracked from the farm to the final product using transaction certificates. The Responsible Wool Standard is owned and managed by Textile Exchange, a global nonprofit that seeks to create leaders in the sustainable fibre and materials industry. Under the RWS, mulesing is prohibited while farms with Ceased Mulesing status are accepted (Textile Exchange, 2021, p. 25). However, Liquid Nitrogen status (referred to as freeze mulesing/Steining) is also prohibited by the RWS. Another wool accreditation scheme is the Authentico Integrity Scheme run the Schneider Group (2024) that also prohibits mulesing but permits Ceased Mulesing status.

RWS premiums burst onto the Australian market in late 2021, at the time Cape Wools started to publish weekly premiums from the South African auction market (Woods A. , 2025a). RWS premiums across time show significant variation. Premiums in 2021-22 were high and applied to wool generally without regard to quality. In 2022-23, premiums shrank and remained low through 2023-24. However, in 2024-25, premiums began to increase again. Recent analysis by Mecardo has suggested that in the period from April to June 2025, the median RWS premium was around 100 cents per clean kg across all categories for Merino and non-Merino wool (Woods A. , 2025a).

There was effectively no RWS-accredited wool prior to 2020-21 (Woods A. , 2025). However, in 2021-22 it reached 1.9%, jumping to 6% in 2022-23 on the back of big premiums in 2021-22, before stabilising around 6% in response to smaller price premiums from mid-2022 to mid-2024. In 2021-22 the premiums were in the order of AUD300-400 cents, without much regard for wool quality (Woods A. , 2025b). From mid-2022 to mid-2024 the premiums shrank down to around 30-50 cents and became far more sensitive to wool quality. Since mid-2024 the premiums have begun to increase.

According to Episode 3 analysis, current premiums for certified non-mulesed wools range from 9 to 13%, and premium for cross-bred certified non-mulesed wool in the 23 microns and above have been even higher, ranging from 10 to 18% (Nugent, 2025).

The proportion of RWS accreditation is non-uniform across micron categories along with the non-mulesed proportion (Woods A. , 2025). Basically, the proportion of non-mulesed and RWS wool falls as the Merino fibre diameter increases. Fourteen-micron wool (which accounts for only 0.05% of the Merino clip) had 62% declared as non-mulesed and 35% accredited to RWS. Eighteen-micron, the largest category, accounting for 24.5% of sales, had 18% declared non-mulesed and 5.4% RWS accreditation. Twenty-one-micron, accounting for 6% of the Merino clip, had 11% declared non-mulesed and 1.6% RWS accreditation. However, there is little relationship between micron and the proportion of non-mulesed wool sold for non-Merino. At the very fine end of the non-Merino micron distribution, there is a higher level of RWS accreditation, but this covers only 2% of the volume sold. Otherwise, there is little relationship between micron and the level of RWS accreditation, although it falls off at the very broad end of the distribution, which accounts for only 1% of non-Merino sales.

7. Alternatives to Mulesing

7.1 Insecticides

Dipping, the immersion of sheep in water containing insecticides, has previously been declared as the most cost-effective means of protecting sheep from flystrike (Heath, 1994, p. 30). Alternatively, insecticides can be applied using jetting equipment, hand-wand or by a spray-on method (Department of Primary Industries and Regional Development, Western Australia, 2024, p. 8). Traditionally, either an automatic jetting race (AJR) or hand-jetting have been the more commonly used methods of application of preventative fly treatments.

Insecticides have been used for many decades to treat flystrike; however, their excessive use has led to issues with chemical residues in the fleece and resistance in the blowfly *Lucilia cuprina* with warnings that it is only a matter of time before the blowfly develops resistance to all available classes of insecticide (RSPCA Australia, 2019, p. 13). Resistance has led to some compound classes no longer being effective as prophylactic treatments (organophosphates and benzoyl phenyl ureas) (Kotze & James, 2022, p. 2).

According to the results from the third Australian national survey on control practices for internal and external parasites of sheep in 2018, the most popular active ingredients used in insecticide products by sheep farmer were dicyclanil (40%), followed by cyromazine (24%), ivermectin (12%) and spinosad (12%) (Colvin, Walkden-Brown, & Reeve, 2020, p. 4).

7.2 AWI Research and Development

Historically, AWI has invested heavily in research and development of breech modification procedures as an alternative to mulesing in order to improve the lifetime resistance of sheep to flystrike (Peachey, 2020, p. 3). However, the various non-surgical alternatives to mulesing have been trialled with little or no improvement in welfare or flystrike prevention over the surgical mulesing technique (Johnston, Richardson, & Whittaker, 2023). The wool industry has spent tens of millions of dollars on research into alternatives to mulesing and blowfly research (Rothwell, Hynd, Brownlee, Dolling, & Williams, 2007, p. 94). According to AWI (2021; 2025), it has spent $48.5 million on combating flystrike and trying to find alternatives to mulesing since 2005.

A great deal of work to develop a vaccine for flystrike was undertaken by CSIRO and the University of Melbourne in the late 1980s, the 1990s, and early 2000s, however, no vaccine was commercialised (Kotze & Hunt, 2023, p. 327). More recent efforts at these same institutes have not yet reported

progress toward developing a vaccine that can provide any protection against flystrike. According to an AWI publication in September 2024:

> *Researchers have completed a four-year, AWI-funded preliminary project into the development of a commercial vaccine aimed at helping protect sheep from the Australian sheep blowfly. Results, whilst encouraging, were mixed, with more research needed to advance development.*
>
> *…*
>
> *The results from the project were highly variable with a range of potential vaccine antigens investigated. The laboratory in vitro larval assessments of the two lead vaccine formulations were encouraging with up to 75% efficacy in reducing larval growth. This is an excellent result and well within the range of a successful vaccine if it can be translated to on-sheep efficacy. However, repeat in vivo testing on sheep showed a much lower indication of efficacy (<25%) in reducing larval growth on sheep. (Anon., 2024)*

In 2007 Australian Wool Innovation patented use of clips as an alternative to mulesing (Lloyd, Sergeant, Evans, & Lawton, 2010). Plastic occlusive clips partially replicate the effects of mulesing without creating an open wound (Edwards, 2012). The clips are attached to flaps of skin that would be removed during mulesing (Australian Wool Innovation, 2006). The clip closing pressure on the flap of skin prevents blood flow to that part of the skin. The lack of blood supply causes the flap of skin to wither and both the clip and the skin flap typically fall off within a couple of weeks to leave a closed linear scar. There is no open wound at any time during the process. Clips must be applied by trained operators to ensure correct use (RSPCA Australia, 2019, p. 11).

While studies have shown that clips provided substantial animal welfare benefits over mulesing in the short term, it has also been demonstrated they do not provide the same degree of protection from breech strike as surgical mulesing (Edwards, 2012).

Clips have been available to wool growers since 2009 (Australian Wool Innovation, 2016, p. 1). However, adoption of clips was low due partly to poor results on sheep with heavy wrinkle and heavy dags (while clips appear to be more effective on sheep with lower breech wrinkle, lower breech cover and less dags) (RSPCA Australia, 2019, p. 11). Biodegradability of the plastic clip was also a concern as producers were reluctant to find plastic clips strewn among their paddocks, and double handling of the sheep is required to remove the clips before they drop off in the pasture. Clips are no longer available on the market.

SkinTraction® is sodium lauryl sulphate (SLS), an anionic surfactant commonly used in toothpaste, shampoos, cosmetics and food (Australian Wool Innovation, 2014). A needleless applicator delivers a measured dose of the SLS intradermal in the skin not through the skin. This results in breech modification without an open wound. The damaged skin forms a hard scab after about six days. After about 14 days, the scab starts to dislodge, and after about seven weeks the scab is fully dislodged. Between 2008 and 2013 AWI funded Cobbett Technologies to develop SkinTraction® to tune of $2.2 million (Lindon, 2016).

The Australian Pesticides and Veterinary Medicines Authority (APVMA) in May 2015 registered Cobbett Technologies' SkinTraction® as a one-off treatment for sheep kept for wool production that are one-year-old or older and with a liveweight of 30 kg-plus (Sim, 2015). A key concern for the APVMA was the risk of SLS moving through the skin and into underlying tissue, including muscle (RSPCA Australia, 2019, p. 12).

SkinTraction® has been deemed a disappointment, with woolgrowers complaining about the long list of restrictions on its use (Locke, 2016). The product's restrictions mean it can't be used on lambs when they are most commonly marked, and can only be used on 12 month old sheep weighing over

30 kilograms. The restrictions imposed by the APVMA on the use of SkinTraction® severely limited its use and made it effectively unviable for most producers (RSPCA Australia, 2019, p. 12).

AWI has also supported Steinfort Agvet Pty Ltd to develop a cryosurgical alternative to mulesing (the Liquid Nitrogen Process, LNP) using liquid nitrogen to achieve a full-thickness freeze of excess skin has also been developed (Small & Lee, 2018, p. 4). The cryogenic effect of liquid nitrogen freezes skin cells when applied topically (Australian Wool Exchange, 2014). In this case, liquid nitrogen is used to freeze sheep skin around the breech (Somerville, 2019). An AWI published study concluded that:

> *In terms of LNP, a significant advantage over surgical mulesing (other than it is a bloodless method) was not identified … (Small & Lee, 2018, p. 5)*

Similarly, a study funded by Steinfort Agvet Pty Ltd concluded that:

> *We conclude that we were unable to detect major behavioural differences between Freeze Branding and the Mulesing treatments when both were accompanied by pain relief. … Over the longer term, the slightly better weight gain and the described differences in wound healing, suggest that the Freeze Branding application may provide these animal welfare benefits over surgical mulesing. (Jongman, Webb-Ware, & Fisher, 2021)*

AWI (2016, p. 1) has also funded early scoping studies for the use of laser epilation as used un humans to permanently reduce wool around the edge of the tail and either side of the breech that were not successful. Laser treatment induces death of hair follicle cells though the process of selective photothermolysis in which laser energy absorbed by structures within the skin is converted into heat (Colditz, Cox, & Small, 2015, p. 33). Melanin is the primary target enabling selective laser energy absorption by human hair and the absence of melanin in the uncoloured wool of the Merino sheep may have contributed to the failure of laser treatment to kill wool follicles.

AWI has also funded research into the odour of Merino wool, and the biology of insect olfaction and its role in fly–sheep interactions (Yan, et al., 2024). Lucilia cuprina uses odours to detect and locate potential hosts over long distances, to guide orientation and landing behaviour, and to select egg-laying sites. It has been found that Lucilia cuprina is attracted by several compounds in Merino wool, including octanal, nonanal and dimethyl trisulfide. It has also been found that the wool levels of octanal and nonanal are heritable in Merino sheep, suggesting that these compounds might be useful as traits in selection for flystrike resistance. Another possibility is that these olfactory-active compounds might guide efforts to modify the genome of sheep, or perhaps even Lucilia cuprina.

According to an AWI research report (Small, Fisher, Lee, & Colditz, 2020, p. 11):

> *Other than genetic selection or gene editing approaches, all forms of physical modification of breech conformation will be associated with some degree of discomfort or pain.*

The then AWI chief executive officer Stuart McCullough admitted in October 2018 that despite AWI undertaking research into clips, lasers, SkinTraction® and liquid nitrogen as mulesing alternatives, “we haven’t cracked it” (Sim, 2018).

7.3 Research on Genetic Selection

There would appear to be agreement that it is possible to selectively breed Merino sheep to be resistant to breech strike that would not require mulesing within the academic literature as well as within AWI and MLA and amongst some wool producers.

According to Richards and Atkins (2010, pp. 1057-1058):

> *There are a range of options available to prevent and treat flystrike, but the best long-term solution is to breed animals that have natural resistance to flystrike; that is plain breeches, as breech strike is the most common form of strike in unmulesed sheep. This genetic approach*

> *provides a permanent solution, which will reduce labour and management costs as well as the risk of contamination of wool from additional chemical application for prevention and control of fly strike.*

According to the late Andrew Fisher (2011), formerly the Director at the Animal Welfare Science Centre at University of Melbourne:

> *The genetic selection of Merino sheep that do not require post-birth modification to their breech skin, in combination with a strategic [integrated pest management] program, would appear to provide the most sustainable approach to managing breech flystrike in the Australian Merino. Such a breeding program requires a sustained commitment over at least a 10-year period, and is not helped by attitudes of some within the industry that conventional mulesing does not have a finite lifespan as a flystrike control option.*

Similarly, Bridget Peachey (2020, p. 2), the then AWI Program Manager Sheep Health and Welfare, opined:

> *Breeding sheep naturally resistant to all forms of flystrike is a long-term solution to managing the risk of flystrike.*

According to a research report published by MLA last year concluded that:

> *Genetic approaches such as incorporating traits for barer breeches, reduced dag and worm resistance into sheep breeding programs will ultimately overtime remove the need for mulesing. This will also have benefits of reduced reliance on preventative chemicals and drenches, reducing costs and the risk of chemical resistance. (Warn & Martin, 2024)*

Genetic selection for flystrike resistant sheep is not a new idea and a large amount of work was completed in the 1930s, 1940s and 1950s on genetic selection for resistance to breech strike (Smith J. , 2019). It was found as far back as the early 1930s that sheep were not struck by chance by breech strike, but determined in the great majority of cases by the condition of the breech, with the degree of wrinkling being the determining factor (Seddon, Belschner, & Mulhearn, 1931). It was also demonstrated an inherited predisposition to breech strike, correlated with inheritance of a wrinkly breech and that resistance could be improved through selective breeding. In other words, trying to breed out the genetic legacy of the Vermont Merinos.

However, with the development of mulesing in the 1930s and its ability to provide a high level of protection against the breech strike, momentum in breeding breech strike resistant animals was lost and research became more focussed on improving techniques of mulesing and tail treatments (Kotze & James, 2022, p. 9). The widespread adoption of the mulesing operation in the mid-to-late 20th Century as a successful method of protecting against flystrike meant that few other methods were researched, (Phillips, 2009, p. 115).

With mulesing coming under scrutiny due to social and ethical concerns, in 2005 the Australian wool industry through AWI rekindled its support for finding genetic solutions to controlling flystrike and breech strike (Brien, Walkom, Swan, & Brown, 2020, p. 346). According to Kotze and James (2022, p. 9), it was not until the establishment of AWI's Breech Strike Research Development and Extension program conducted by CSIRO Livestock Industries in the summer rainfall environment at Armidale in NSW, and by the Department of Agriculture and Food Western Australia at Mt Barker in the winter rainfall (Mediterranean) climate of Western Australia (WA) that significant further research into breeding for resistance to breech strike resumed.

Recording the incidence of flystrike, including in the breech is not normally part of phenotyping in ram breeding flocks and is not part of current national genetic evaluation in Australia (Brien, Walkom, Swan, & Brown, 2020, p. 346). One of the main limitations to phenotyping is that the incidence of flystrike is often low or intermittent and is routinely suppressed by management interventions for economic and welfare reasons (Kotze & James, 2022, p. 9; Brien, Walkom, Swan, &

Brown, 2020, p. 346). As a consequence, indirect selection based on breech indicator traits rather than direct selection has been relied upon for achieving genetic reductions in incidence of breech flystrike (Brien, Walkom, Swan, & Brown, 2020, p. 346).

There have also always been reservations about including reducing breech wrinkle in breeding programs among sections of the wool producing industry because of the long time frame required for progress and the expectation that it would not be as effective as mulesing (Richards & Atkins, 2010, p. 1057). It is also believed that selecting to reduce breech wrinkle will reduce wool production.

While selection for breech wrinkle alone would compromise wool production, if included in a carefully designed breeding program then breech wrinkle can be reduced with little loss in the potential gains of production traits (Richards & Atkins, 2010, p. 1057).

7.4 Practical Application of Genetic Selection

According to the 2019 review of the genetic components of AWI's Breech Strike Research Development and Extension program:

> *The key findings are that genetic gains can be made in reducing susceptibility to breech flystrike by selecting sheep on scores for breech wrinkle, breech cover, dag and urine stain and that these gains can be made simultaneously with improvement in the major production traits, fleece weight and fibre diameter. (Brien & James, 2019, p. 1)*

Sheep Genetics was established in 2005 to deliver a nationally consistent across-flock genetic evaluation platform to the Australian sheep industry, generating information relevant for terminal, maternal and Merino sheep (Brown, et al., 2007, p. 187).

Sheep Genetics (2023, p. 3) delivers the national genetic evaluation services for the Australian sheep and goat industry. An Australian Sheep Breeding Value (ASBV) is an estimate of the genetic potential a sheep will pass on to its progeny and these values are available for a range of economically important traits and are designed to be used by commercial sheep producers in conjunction with visual selection (Sheep Genetics, 2023, p. 4). MERINOSELECT is a genetic evaluation service overseen by Sheep Genetics that analyses pedigree and performance recorded information on animals submitted by members to generate ASBVs to provide objective information available on Merino genetic trends (Lindon, 2020, p. 2).

With the wide availability of ASBVs for breech traits and publication of accurate genetic parameters for breech flystrike incidence, breech wrinkle, dag and breech cover scores and their correlations with production traits, there is scope to predict gains in reducing breech flystrike incidence from selection indexes incorporating indirect selection criteria based on the available breech indicator traits of breech wrinkle, dag and breech cover scores (Brien, Walkom, Swan, & Brown, 2020, p. 346).

It has been suggested there is substantial genetic reductions in flystrike incidence that can be achieved after 10 years of selection based on modified ASBVs in well recorded flocks that utilise records of breech wrinkle, dag and breech cover scores as indirect selection criteria, in addition to selection criteria for productivity traits (Brien, Walkom, Swan, & Brown, 2020, p. 360). In turn it has been predicted that rates of genetic gains for reductions in flystrike incidence in ram breeding flocks could reduce average flystrike incidence to low levels after 10–20 years in a Mediterranean winter rainfall environment and within 10 years in a summer rainfall environment (Brien, Walkom, Swan, & Brown, 2020, pp. 360-361).

While ASBVs are available for breech traits, they are not currently available as part of any index aimed at increasing flystrike resistance and have to be used independently (Brien & James, 2019, p. 6). The 2019 review of the genetic components of AWI's Breech Strike Research Development and Extension program recommended:

- *To facilitate more widespread adoption and efficient selection of sheep for lower susceptibility to breech strike and to improve genetic gains, there is a need to formally include breech strike resistance in breeding objectives for different environments and flock types, preferably as options available in MERINOSELECT, but also as customized breeding objectives for individual breeders.*
- *The provision of genetic trends for breech traits by Merino sheep type on the MERINOSELECT/Sheep Genetics website should be encouraged, as it would allow ram breeders, commercial wool producers and other wool industry stakeholders to more readily assess industry progress towards breeding sheep less prone to breech flystrike. (Brien & James, 2019, p. 7)*

However, AWI has exhibited some antipathy towards Sheep Genetics, withdrawing its funding in July 2016 and expressing the view that after 11 years of operational funding that it needed to run on a user pays basis (Australian Wool Innovation, 2018, p. 32). Earlier, the then Chair of AWI, Mr Wal Merriman, is reported to have said in May 2012 that science could not teach Australian growers much that was new about breeding better Merino sheep and that he believed an over-reliance on ASBVs to produce bigger plainer and quicker-maturing fine wool Merinos, had the potential to backfire (Lush, 2012).

There is one approach that has already proven successful for Merino wool sheep farmers wanting to make the conversion over to non-mulesed wool through selective breeding with the then AWI CEO Stuart McCullough reluctantly conceding as much:

> *There's a breeding technique you can use, but it's a very, very complex and hard thing to solve. (Sim, 2018)*

Perhaps the unwillingness of AWI to embrace this particular approach is because it has been developed without its participation and outside of its control, as well as runs counter to the interests of Merino stud operators that are heavily invested in 'wrinkly' Merino genetics.

While most Merino sheep in Australia are wrinkled, a plain-bodied (low wrinkle) Merino sheep does exist and is called the SRS® Merino (SRS stands for soft rolling skin) (RSPCA Australia, 2024, p. 6). This Merino type has been bred in Australia since the late 1980s and comprises about 7% of the Australian Merino sheep flock.

Rather than relying on wrinkle (i.e. large skin surface area) to obtain high fleece weights, the SRS® Merino has a loose and supple skin that is closely associated with high fibre density and length (i.e., more wool per area of skin) and wool of high quality (Watts, Jackson, & Ferguson, 2017 from RSPCA Australia, 2024, p. 6). The loose, supple, non-wrinkly skin of the SRS® Merino dries rapidly, ensuring these sheep are resistant to fleece rot and flystrike, and do not require mulesing (RSPCA Australia, 2024, p. 6).

The SRS genetic principles were developed by veterinarian and former CSIRO scientist the late Dr Jim Watts (Robinson, 2019). Dr. Watts began selectively breeding sheep to create the SRS Merino, seeking out sheep for particular objective and subjective traits, often relying on the look and feel of a sheep as an indicator of its offspring's body type (Barega Merino, 2016). He first implemented the SRS breeding system, the breeding of plain bodied sheep, in Australian Merino flocks back in 1988 (Watts J. , 2016a, p. 10). The Merino studs, Gowandale and Wallaloo Park in the Wimmera district of Victoria, Australia, were among the first to engage.

Don Mudford, a co-principal of the Parkdale SRS Poll Merino Stud farm near Dubbo has commented:

> *The SRS system has the capacity to breed enough rams in the 12 to 20 micron range for the entire Merino flock in Australia. We can be blowfly resistant within two generations. (Duce, 2019)*

AWI (2018a, p. 8) has previously observed that as more enterprises move to non-mulesed, the demand for productive, low strike sheep types is increasing and ram breeders are responding to the demand.

According to Dr Watts (2016), the transition from a sheep that is wrinkly and requires mulesing to a sheep that is plain bodied and does not require mulesing can be less than 5 years, and in some cases as rapid as 3 years.

In a survey report commissioned by the Humane Society International (Aust.) and FOUR PAWS, woolgrowers were asked how long it took to transition to a plain-bodied non-mulesed farm enterprise (BG Economics, 2020, p. 17). The report found 42.7% of growers transitioned in two years or less and 34.8% in three to five years. One in five growers took six to ten years to transition while very few growers took longer than ten years (3.4%). It also found the vast majority of growers surveyed (83.5%) considered it not costly to make the transition aways from wrinkly type sheep towards plain-bodied sheep with only 15.5% of growers considering it to be somewhat costly.

This suggests that transition to a non-mulesing mob is possible within about a 5-year timeframe, around half the time that has been suggested in research funded by AWI.

8. Economic Costs and Benefits of Transitioning from Mulesing

8.1 Cost-Benefit Analysis

AWI (2018) has published research on the findings of case studies and interviews conducted with 40 sheep farmers who had made the transition over to non-mulesed wool. In these case studies, AWI (2018a, p. 12) found the additional cost varied, but growers quoted figures of around $2-3 dollars per head per year or 50c/kg greasy wool per year for husbandry costs. However, there was also a perception amongst sheep farmers that there were offsetting production benefits from making the transition:

> *There was a general view that the increased animal health costs and a large part of the direct labour cost was offset by the improved husbandry and higher condition score, but a much larger survey is required to evidence this view. (Australian Wool Innovation, 2018a, p. 12)*

A detailed analysis associated with ceasing mulesing in Prime lamb and Merino enterprises commissioned by MLA developed a cost-benefit analysis model with assumptions used based on both current on-farm management practices and findings from a producer survey (Munoz, et al., 2022, p. 4). This study found that over a seven year period:

- For prime lamb enterprises transitioning to non-mulesing compared to continuing mulesing indicated there would be a positive cash flow (ranging from $0.33 to $2.19 per dry sheep equivalent (DSE), depending on rainfall areas)[4]
- For Merino enterprises, the case scenarios modelled indicated a positive cash flow of $1.58 per DSE in winter rainfall areas (assuming a 6.6% wool premium over a 7-year period), and a negative cash flow of $-4.29 to $-9.08 per DSE in summer and uniform rainfall areas, respectively (Munoz, et al., 2022, p. 32).

In both Prime Lamb and Merino enterprises, the extra chemical control for flystrike is a contributor to the cost of transitioning to a non-mulesed flock (Munoz, et al., 2022, p. 32). In a Merino

[4] Dry sheep equivalent (DSE) is used as a method standardising an animal unit and is the amount of feed required by a two year old, 50 kg Merino wether to maintain weight (Meat & Livestock Australia, n.d.).

enterprise transitioning to a non-mulesed enterprise, crutching is also a contributor to the cost (with the exception of uniform rainfall enterprises), however, the major contributor is dags, due to an increase in the loss of wool from dags and a larger crutch area.

Major cost savings from ceasing mulesing or both Prime Lamb and Merino enterprises comes from not performing mulesing coupled with not having to provide of pain relief (Munoz, et al., 2022). Additional income was also recorded in the case of a winter-dominant and summar-dominant rainfall Merino flock from a price premium received on the sale of non-mulesed wool, but this was not received in the case of a uniform rainfall Merino wool flock.

Utilising the cost-benefit analysis model developed by Munoz, et al., (2022) and applying it to a plainer and non-wrinkled Merino wool flock that would not require or have (i) additional crutching, (ii) additional chemical/insecticde use, and (iii) wool loss from increased dag score and crutching coupled with the assumption of no price premium from the sale of non-mulesed or ceased mulesing wool, it was found there would be a positive cash-flow benefit over a 7-year period of:

- $3.25 per DSE for a winter-dominant Merino wool flock
- $4.14 per DSE for a uniform rainfall Merino wool flock
- $9.17 per DSE for a summer-dominant Merino wool flock.

Extrapolating these results across the country suggests that Merino sheep growers would collectively be around $120 million better off over a 7-year period through adopting plainer and non-wrinkled Merinos. On this basis, the development of a plainer and non-wrinkled Merino wool flock should be cash positive for Australian wool producers.

8.2 Economic Impact from Plainer and Less Wrinkled Merino Sheep

Conversion to a plainer and less wrinkled Merino sheep also carries a number of additional economic benefits that will potentially reduce costs and increase the income of wool sheep producers.

While the classic wrinkly Merino sheep has been selected for large skin surface area as the means of increasing fleece weight, it is a myth that wrinkly Merino sheep are needed to produce high fleece weights (Watts J. , 2016a, p. 9). The available evidence suggests that plain bodied Merino sheep produce almost as much wool as wrinkly Merino sheep. In a study comparing wool from relatively plain stud Merino ewes (A type) and wrinkled (C type) stud Merino ewes from the 1930s, it was found that:

> *… contrary to opinions frequently expressed, there was very little difference between the wool production of the two types. The only positive advantage held by the C type was a slight but significantly greater weight of greasy fleece per head. This difference, while still evident in the estimated clean scoured weight of fleece was much reduced in degree by the significantly lower "yield" of the C type. (Belschner, Carter, & Newton Turner, 1937, p. 16)*

In terms of wool quality, it has been shown that fibre diameter of wool from the Merino progeny of smooth rams is 0.1 µm finer than that from the Merino progeny of ribby/wrinkly rams at shearing, and that of the halfbred progeny of smooth rams was 0.4 µm finer than for ribby/wrinkly rams, although these differences were shown not to be statistically significant (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1553).

It has also been found that there is more variability in fibre diameter amongst lambs sired by ribby/wrinkly rams than smooth rams as measured by the standard deviation and coefficient of variation of fibre diameter (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1553). The coefficient of variation of fibre diameter is a measure of the amount of variation there is between individual wool fibres within a fleece (Sheep Genetics, 2015, p. 12). Processors tend to favour wools with a lower coefficient of variation of fibre diameter because of improvements in processing and improved wearability of garments made (Sheep Genetics, 2015, p. 14).

Donnelly ((1979) as cited by Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1555) calculated greater returns from smooth ewes despite producing 0.5 kg less greasy wool than wrinkly ewes. The improved financial returns were obtained without considering the reduced requirement for labour during lambing or shearing smooth sheep (Baillie (1979) as cited by Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1555). While Merino sheep with fewer wrinkles exhibit a slight reduction in fleece weight and little or no change in wool characteristics, this facilitates potential improvements in labour costs and animal welfare (Scobie, Young, O'Connell, & Gurteen, 2005, p. 177). Neither Donnelly (1979) nor Baillie (1979) took into account the financial worth of the cumulative genetic gain with more lambs available for selection (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1555).

More time is required for shearing wrinkly sheep than plain-skinned sheep (Rather & Ahanger, 2022, p. 322). It has been found that the time required to shear each animal increases not only with how wrinkled it is (wrinkle score), but was also by live weight and greasy fleece weight (McGuirk, et al., 1981). Thus wrinkly Merinos will take longer to shear than plainer Merinos because they have a higher wrinkle score and produce a greater weight of greasy fleece per head on average.

It has been observed that smooth sheep are 15% faster to shear on commercial farms, and that this would also reduce the cost of shed-hands ((Baille, 1979; Donnelly, 1979) taken from Scobie, Young, O'Connell, & Gurteen, 2005, p. 183). It has been suggested that SRS® Merinos are easy to shear with virtually no skin cuts and that shearing tallies per shearer improve by about 30% compared with shearing traditionally bred Merinos (SRS Genetics, n.d.). According to shearer/contractors Warren Long from Wellington NSW:

> *From a shearers perspective, SRS® Sheep are far superior to shear than traditional sheep. This is due to less wrinkled skin which results in less skin cuts and less struggling of the sheep and the shearer. The shearer's comb travels through the fibre a lot easier because they are not intertwined. This means the shearer can shear more sheep through less effort, and there is more wool in the fleece lines instead of under the table as locks. (SRS Genetics, n.d.)*

Smoother and plainer Merino sheep also display better reproductive properties. Smooth sheep generally have higher conception rates, more twins and lower mortality of ewes and lambs at birth, and their better performance in Australia tends to be highlighted during drought conditions (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1555). Numerous research trials dating back as far as the 1950s have shown that wrinkly Merino ewes have fewer lambs and lose more lambs than plain bodied Merino sheep (Watts J. , 2016a, p. 13). Australian research has shown correlations between wrinkles and reproduction with smooth rams having superior fertility and semen quality (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1555). This was particularly noticeable in environments that were hot prior to mating owing to the improved ability of smooth sires to regulate their testis temperature.

The progeny of smooth sires grow faster and are heavier on average than those sired by ribby/wrinkly rams (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1554). It has been found that smooth-sired progeny gain liveweight more rapidly and, therefore, reached slaughter weights earlier, regardless of breed, including pure Merinos (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1555). In turn, Scobie, Young, O'Connell, and Eythorsdottir (2005, p. 1556) found that smooth Merino rams produce lambs that grow faster with greater liveweight, more than offsetting any reduction in wool production:

> *Whether breeding Merino lambs for replacements, or halfbred lambs for replacements or slaughter, faster growing lambs (from ewes mated to smooth rams) with greater liveweight and better reproductive performance more than offset the minimal difference in wool weight. Scientific literature suggests that smooth sheep produce more and faster growing lambs that are less likely to get flystrike.*

The weight of the skin of wrinkly Merino sheep averages around 15% of the liveweight of the sheep as compared 11% for non-Merino sheep, with the difference likely due to the presence of skin folds or pleats, characteristic of Merino sheepskin, which increases the superficial skin area, and hence weight, when compared to the plain-bodied non-Merino sheep (Meat & Livestock Australia, 2024a, p. 41). The pelts of Australian Merino lambs have been shown to carry more ribs, and tend to exhibit worse scarring from shearing and more processing damage from the slaughter process than crossbred lamb pelts, making Merino skins the least desirable for production of lamb nappa (Holst, Hegarty, Fogarty, & Hopkins, 1997). In the pelt trade, ribs on 'ribby' pelts are thought to be caused by the skin folds on the live animal that are retained through processing and into the final leather although there are no scientific papers demonstrating this relationship (Scobie, Young, O'Connell, & Eythorsdottir, 2005, p. 1551). The most ribby pelts are actually referred to as "Merino" in the pelt trade to denote their poor quality. In turn, poor quality pelts bring low prices. There have also been reports in recent years of meat processors charging livestock producers a dumping fee for their sheepskins and lambskins (Berlage & Verley, 2023), presumably when they have no commercial value for use as leather products.

While studies of the quality of meat from Merinos have found that Merinos produce meat that rates highly in terms of flavour, tenderness and overall acceptability (Warner, et al., 2006), wrinkly Merinos will be at a considerable disadvantage as compared to plain Merinos for meat production due to the heavier skin weight. This is because as skin mass increases, the carcass yield and dressing percentage is reduced (Rather & Ahanger, 2022, p. 324). This is on top of the available evidence that smooth-sired progeny gain liveweight more rapidly and, reach slaughter weights earlier.

For these various reasons, Scobie, Young, O'Connell, & Eythorsdottir (2005, p. 1556) arrived at a rather harsh conclusion in relation to wrinkly Merino sheep:

> *Whether breeding Merino lambs for replacements, or halfbred lambs for replacements or slaughter, faster growing lambs (from ewes mated to smooth rams) with greater liveweight and better reproductive performance more than offset the minimal difference in wool weight. Scientific literature suggests that smooth sheep produce more and faster growing lambs that are less likely to get flystrike. When all aspects are considered, wrinkles on a lamb, ewe or ram would seem a good indicator for its immediate slaughter.*

8.3 Why the Opposition?

Given the overwhelming weight of evidence against the propagation of wrinkly Merino sheep on economic grounds, the obvious question arises as to why there is such vehement opposition towards phasing out mulesing within sections of the Australian wool industry and engaging in a more concerted effort towards genetic selection and development of a Merino sheep that doesn't require mulesing. The answer may lie in the fact that development of a plainer Merino would leave those Merino stud operators that have invested heavily in and sell wrinkly Merino genetics with what would effectively become stranded assets. Stranded assets are assets that have suffered from unanticipated or premature write-downs, devaluation or conversion to liabilities (Caldecott, Dericks, Pfeiffer, & Astudillo, 2017, p. 04). In agriculture, stranded assets can include physical assets such as animals (Caldecott, Howarth, & McSharry, 2013, p. 12).

Asset stranding has always been part-and-parcel of the creative destruction seen in any market economy (Caldecott, Dericks, Pfeiffer, & Astudillo, 2017, p. 07). Physical assets often become stranded in the face of technological change, rendering them economically obsolete. However, in recent years, the issue of stranded assets caused by environmental factors, such as climate change and society's attitudes towards it, has become increasingly high profile (Caldecott, Dericks, Pfeiffer, & Astudillo, 2017, p. 04).

Asset stranding may be driven by a range of risks across the economic, environmental, geopolitical and societal domains which can alter the operating paradigm for business (Caldecott, Howarth, &

McSharry, 2013, p. 14). Risk and exposure to stranded assets is often compounded because of the problems of path dependency and short-term decision-making biases. These forces describe the tendency of firms and decision-makers to invest in reinforcing and protecting their existing asset base and business models, rather than adapting to a new forward looking strategic environment.

There is a wide range of risk factors that can have an impact on asset values and drive incidences of liability in different sectors of the economy (Caldecott, Dericks, Pfeiffer, & Astudillo, 2017, p. 06). The main societal risks are government regulation, technological change, evolving societal norms and consumer behaviour, and litigation and changing statutory interpretation.

Concerns have previously been expressed that decisions by AWI to withdraw funding in relation to sheep genetic programs have been driven by the stud breeder interests on the AWI board. According to a newspaper article back in August 2012:

> *Accusations are flying that elitists and traditionalists, including some of the wool industry's oldest families and wealthy stud breeders, are deliberately hampering the advancement of modern genetics in the industry for fear it will harm their own businesses.*
>
> *The row has worked its way to the top of the tree, with the chairman of the woolgrower-funded Australian Wool Innovation corporation, Wal Merriman, accused of making national funding decisions driven by bias and self-interest. (Neales, 2012)*

9. Conclusions

Mulesing threatens the social licence of Australian wool producers and the sustainability of Australia's export markets for wool that could also cause collateral damage and fallout for Australian sheep meat export markets. Wool processors, major brands and consumers could potentially render wool from wrinkly Merino sheep requiring mulesing as obsolete, in turn stranding the wrinkly Merino genetic stock and rendering it worthless. Such developments would be a disaster for the Australian wool industry comparable to the collapse of the Reserve Price Scheme for wool in the early 1990s.

There is a feasible alternative to the propagation of wrinkly Merino sheep requiring mulesing. This is the development of a plainer and less wrinkly Merino sheep through selective breeding that the available evidence suggests would perform better on a range of economic criteria including the return on wool. Contrary to popular mythology, plain bodied Merino sheep can produce almost as much wool as wrinkly Merino sheep and of a more consistent quality.

The ongoing propagation of a wrinkly Merino sheep that requires mulesing is a deliberate choice on the part of some sections of Australian wool producers even though customers have expressed a clear preference for non-mulesed wool. Author and sheep farmer Massey (2011) has observed the long-running mulesing debate reveals that wool industry leaders and AWI still nourish the old agri-political belief that holds that the customer is the enemy.

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Appendix 1 – Public Campaign against Mulesing

In 2004, the organisation People for the Ethical Treatment of Animals (PETA) launched an international retail and consumer campaign called ‘‘Save the Sheep’’ against the Australian sheep industry (Sneddon & Rollin, 2010, p. 372). PETA engages in advocacy through a range of activities including public education, cruelty investigations, research, animal rescue, legislation, lobbying, special events, celebrity involvement, and protest campaigns (boycotts) (Bowmar & Gow, 2009). Prior to PETA’s campaign, mulesing had failed to spark public interest (Bromberg, 2021, p. 294).

PETA threatened to incite an international boycott of Australian wool products if the Commonwealth Government did not stop both live sheep exports and mulesing (Mitchell, US protest over Australia's treatment of sheep, 2004a). PETA’s tactics included an extensive radio, TV and print media campaign, public protests, and the use of well-known celebrities, such as Pamela Anderson and Pink, to draw negative attention to the Australian woolgrowers for their mulesing practices (Bowmar & Gow, 2009).

In mid-October 2004 a leading American fashion retailer, Abercrombie & Fitch, banned the use of Australian merino wool in its products following threats by PETA to wage a campaign against the retailer (Mitchell, 2004). Abercrombie & Fitch's decision followed three months of talks with PETA, conducted against a background threat of protest action against the store if it did not support the boycott (Yallop, 2004). PETA was also targeting more than 20 other high-profile US retailers (Mitchell, 2004).

As overseas consumer concerns grew and media visibility increased, J Crew, New Look and Timberland all quickly followed suit and joined the boycott (Bowmar & Gow, 2009). Numerous other companies also later joined the boycott, including major retailers and branded manufacturers such as H&M, Perry Ellis, HUGO BOSS, Gap, Liz Claiborne, Nordstrom, Haggar Clothing, Coppley Apparel, Austin Reed, Carter's, C&A Europe, Bestseller A/S, Matalan Retail Limited, Nike, Lindex, Marks & Spencer, and Adidas, among others.

A split quickly emerged in the Australian wool industry over how it should respond to escalating attacks by PETA, with the breakaway Australian Wool Growers Association (AWGA) criticising the industry for refusing to negotiate with PETA, arguing wool producers risked losing vital markets in Europe and North America (Breusch, 2004). According to AGWA President Chick Olsson (2004):

> *Defending the practice of mulesing is an inherently difficult task. The story lends itself to tabloid television. The nuances of balanced veterinary opinion will be easily lost in the emotion of urban viewers (consumers) watching defenceless sheep have large chunks of their skin carved out of their bodies, without pain relief, for profit.*
>
> *The lack of progress to date in changing industry practice reflects, not a lack of economic alternatives to mulesing, but a lack of will to unsettle entrenched orthodoxy in the face of a real and growing external threat to our prosperity.*

In response to the PETA campaign, AWI formed an industry working group to consider a coordinated industry response to the mulesing issue (Bowmar & Gow, 2009). This group initially consisted of representatives from AWI, Australian Wool Industries Secretariat (AWIS) / Federation of Australian Wool Organisations (FAWO), International Wool Textile Organization (IWTO), The Woolmark Company (TWC) and Wool Producers. The group later expanded to include the National Farmers’ Federation (NFF), Meat & Livestock Australia (MLA), Sheepmeat Council of Australia (SCA), LiveCorp and the Australian Government, when PETA included live sheep exports in its campaign. The entity was referred to as the Wool and Sheep Industry Taskforce.

On 8 November 2004 the Wool and Sheep Industry Taskforce made a public commitment to retailers to phase out the current practice of mulesing by 31 December 2010 (Bowmar & Gow, 2009). In

March 2008, the then Chairman of AWI, Ian McLachlan, reiterated the commitment of the Taskforce to phasing out mulesing by the end of 2010:

> *I think a lot of this concern arose out of the idea that maybe we would walk or maybe Australia was walking away from its commitment to phase out mulesing by 2010. I can tell you that that commitment, which was given to the retailers of the world, virtually, in 2004, but certainly in North America and the UK and all the rest, are aware of it... that commitment is absolute. So nobody's walking away from that commitment. And at AWI, which is the research vehicle, we are absolutely flat-out trying to come up with new solutions, existing and new solutions to give the growers every opportunity to meet that commitment. (McLachlan, 2008)*

Concurrent with the announcement by the wool industry of its commitment to phase out mulesing, AWI launched legal action under the secondary boycott provisions of the then Trade Practices Act.[5] AWI eventually settled their case against PETA out of court in June 2007 when PETA agreed to a moratorium on activities against Australian woolgrowers until 31 December 2010 (Sneddon, 2011). In return AWI agreed to fast-track alternatives to mulesing. Both AWI and PETA claimed victory as a result of the settlement of the case.

In February 2008 Swedish retailer H&M, taking the position the Australian wool industry was taking too long to phase out mulesing, decided to buy only mulesing-free merino (Bowmar & Gow, 2009). Following H&M's announcement, 17 other major Swedish retailers made the same pledge and a coalition of 31 European retailers announced that they were considering or had decided to stop using wool from mulesed sheep. PETA (2008) claimed this amounted to the cancellation of orders of some 550,000 bales of wool from Europe alone in 2008.

In late June 2009 AWI confirmed that it would abide by the previous decision to phase out mulesing by the end of 2010 (Australian Broadcasting Corporation, 2009). However, a little over a month later in late July 2009 AWI said the Australian wool industry would not be able to meet the 2010 deadline to phase out mulesing (Australian Broadcasting Corporation, 2009a). This announcement came shortly after Australia's largest wool buyer, China's Sunshine Group, had demanded Australian wool growers abandon mulesing in mid-July (Clancy, 2009).

In early 2011, six major US apparel companies representing big-name brands, clothes retailers and importers, including Gap, Macy's and Liz Claiborne Inc, expressed "great disappointment" over AWI's decision to walk away from the Australian wool industry's commitment to phase out mulesing (Jopson, 2011). According to the letter:

> *As the face of Australian wool around the world … AWI's withdrawal now calls into question whether the industry is capable of providing any kind of response and represents, in our view, a considerable setback to any potential progress …' (Jopson, 2011)*

[5] Secondary boycotts refer to boycotting actions taken against an organisation or company that does business with another organisation with whom the primary dispute exists (Cornell Law School, n.d.).

Appendix 2 – New Zealand Experience on the Cessation of Mulesing

Sheep farming in New Zealand is extensive by nature with sheep being farmed on pasture all-round the year, with no housing and mostly with no supplementary feed (Morris, 2017, p. 25). There are few specialised sheep or beef cattle farms in New Zealand with most farms running sheep and cattle together. New Zealand is the largest exporter of lamb and the fourth largest exporter of wool. Most of the wool produced is strong crossbred wool (greater than 31 µm) while fine wool (less than 25 µm) accounts for only around 10% of New Zealand's wool production (Morris, 2017, pp. 25-26).

In stark contrast to the Australian wool industry, the New Zealand wool industry, although late to respond on the mulesing issue, were able to implement a coordinated proactive response that had the effect of totally diffusing the issue in New Zealand and with their international customers (Bowmar & Gow, 2009, p. 4). Arguably, mulesing was an easier issue for New Zealand to address as it was only ever practiced on a very small number of Merino and Merino-cross New Zealand sheep (Wallis, 2005). Merino sheep only account for around 5% of the New Zealand's sheep flock (Beef and Lamb New Zealand, 2023, p. 9).

The New Zealand Merino Company (NZMC), was established as a joint venture company between the New Zealand Merino growers and PGG Wrightson (a publicly listed farming services company in New Zealand) (Bowmar & Gow, 2009, p. 24). The NZMC markets the overwhelming majority of the New Zealand Merino clip. It performs as both a traditional wool broker but increasingly as an integrated marketing facilitator assisting the international clients (branded retailers and clothing and fabric manufacturers) to create sustainable mutually beneficial brand partnerships with New Zealand Merino growers and provide access to appropriate R&D, processing , procurement and marketing support.

Like the Australian wool industry, the NZMC adopted a policy of a December 2010 deadline for the phase out of mulesing, but only after the Australian industry had publicly announced their intentions (Bowmar & Gow, 2009, p. 25).

In April 2005 US sock and garment business SmartWool announced that it had entered into $NZ40 million supply deal with NZMC for a seven year deal to sell 600 metric tonnes of wool a year – equivalent to half of the 23 micron wool clip (Australian Associated Press, 2005). Under the supply deal, SmartWool said that it would pay New Zealand wool growers a price premium to end mulesing by the end of 2005.

According to NZMC chief executive John Brakenridge, the company's move away from the mulesing practice was driven by consumer demand:

> *Ultimately, the end user votes with their wallet.*
>
> *They also have the luxury of having many alternative choices to wool for their apparel and textile needs if wool can not meet their expectations.*
>
> *In an increasingly sophisticated global marketplace, end users are highly sceptical of unvalidated claims. (Beale, 2016b)*

The negative market publicity and resulting retailer and manufacturer responses created by the boycott of Australian wool over mulesing proved to be the catalyst for the NZMC to develop and implement an ethically, social and environmentally responsible and sustainable private standard program under the ZQ brand (Bowmar & Gow, 2009, p. 26).

In 2006 NZMC developed ZQ Merino and ZQ Premium Wool brands to identify high quality wool components (Textile Exchange, 2017). The brands are backed by an independently audited and

traceable accreditation program that validates the quality and ethical standards to which the fibre is produced. In addition to addressing animal welfare and land management, ZQ also addresses social responsibility, fibre quality, education, and has a significant portfolio of research to continue to refine and improve standards over time.

The ZQ branding underwrites the quality and attributes of the fibre produced by all farmers contracted to the company, by requiring adherence to specified animal and land management practices (Pawson & Perkins, 2017, p. 265). It enables brand partners to make explicit claims about the ethical sourcing of their fibre and to deliver clear messages about this to consumers.

The practice of mulesing is not permitted on ZQ accredited farms (Denend & Shiv, 2011, p. 10). During farm audits, sheep are inspected to ensure their condition indicates adherence to these requirements. The ZQ Merino program has become the world's largest ethical wool brand (Australian Wool Network, 2018). The ZQ Merino accreditation program requires woolgrowers to adhere to strict standards regarding animal welfare, environmental integrity and social responsibility. The program is audited by 3rd party auditors to confirm compliance. In late July 2018 Australian wool company Australian Wool Network (2018) entered into an agreement to supply the New Zealand Merino Company's ZQ Merino program. Since 2018 NZMC has been sourcing additional wool for its customers from Australia, and there are reports that it has about 130 Australian woolgrowers on the books, providing the business with 15% of its wool needs (Smith L. , 2023). In order to qualify for a supply contract with NZMC, woolgrowers are required to cease mulesing.

The ZQ label has been adopted by a number of premium performance wear brands such as SmartWool, Ibex and Icebreaker (Beale, 2016b). The development of the ZQ label is an example of ethical marketing which relies on consumers caring about ethical components of products, such that their concern leads to financial implications for firms (Bucic, Harris, & Arli, 2012, p. 113).

The development of ZQ brand and the move away from mulesing prompted PETA through their NZ affiliate SAFE to offer the NZMC an award for best practices in animal welfare, although the NZMC declined the offer as they preferred to fly below the radar and did not want to fuel the debate any more (Bowmar & Gow, 2009, p. 28).

Mainly through industry-led initiatives, mulesing had been largely phased out in New Zealand by 2010 (Munoz, et al., 2022, p. 36). By 2016 the New Zealand Government sought out public comment on a number of proposed changes to its animal welfare laws, including a proposed a probation on mulesing altogether (Office of the Associate Minister of Agriculture, 2018). New Zealand subsequently banned mulesing through regulation as from October 2018.

The approach adopted by New Zealand on the issue of mulesing stands in marked contract to that adopted by the Australian wool industry that has largely refuted PETA's claims, counter-arguing that it would be detrimental to animal welfare to prevent farmers from mulesing their sheep, as this is the most effective way to prevent flystrike (Sneddon, Lee, & Soutar, 2010).