# Addressing Mortality in New Zealand Lambing Systems

## Kellogg Rural Leadership Programme

## Course 49 2023

Richard Dawkins

I wish to thank the Kellogg Programme Investing Partners for their continued support.


**Disclaimer**

In submitting this report, the Kellogg Scholar has agreed to the publication of this material in its submitted form.

This report is a product of the learning journey taken by participants during the Kellogg Rural Leadership Programme, with the purpose of incorporating and developing tools and skills around research, critical analysis, network generation, synthesis and applying recommendations to a topic of their choice. The report also provides the background for a presentation made to colleagues and industry on the topic in the final phase of the Programme.

Scholars are encouraged to present their report findings in a style and structure that ensures accessibility and uptake by their target audience.

This publication has been produced by the scholar in good faith on the basis of information available at the date of publication. On occasions, data, information, and sources may be hidden or protected to ensure confidentially and that individuals and organisations cannot be identified.

Readers are responsible for assessing the relevance and accuracy of the content of this publication & the Programme or the scholar cannot be liable for any costs incurred or arising by reason of any person using or relying solely on the information in this publication.



Scholar contact details may be obtained through the New Zealand Rural Leadership Trust for media, speaking and research purposes

# Executive Summary

The New Zealand sheep industry has become increasingly productive in recent decades. This has been achieved primarily through the fecundity and improved feeding of modern sheep breeds. While impressive, this world-leading production has created unintended consequences in the form of excess mortality rates. This is most notable in triplet-bearing ewes, mated hoggets, their offspring, and all lambs in adverse weather conditions.

New Zealand farm systems have a reputation for being free-range and pasture-based. Currently, consumers are unaware of, or accept a certain level of death as a natural outcome of this free-range system. However, the industry must consider whether the increasingly conscientious customers and consumers will accept high mortality levels in sheep flocks, particularly if they understand the inflated death rates following storm events and the regular wastage in higher-risk animals.

This project explores how New Zealand sheep farmers can improve livestock survival during the lambing season. Information was gathered through literature reviews, 10 expert interviews, 10 farmer surveys and three case studies. Key findings were:

- Death rates in triplet-bearing ewes and their lambs are significantly higher than in other stock classes and the majority of these deaths occur during the lambing period
- Industry experts and farmers unanimously agreed that lamb mortality is a problem and needs to be addressed, but few have management solutions for triplets, and a portion of farmers actively ignore the issue
- There is a minority of top-performing farmers with management plans in place who achieve far below industry-average death rates
- For improved welfare, mated hoggets require intensive management through the lambing period
- There is a lack of collaboration between government and industry in funding applied science and performance-based studies to innovate further solutions
- Farmers believe Beef + Lamb NZ should increase investment in research and development and extension work
- While there are no market signals that current wastage is an issue, there was unanimous agreement that it could be a trade barrier. Comparisons should be made to bobby calves and future legislation being superseded by industry requirements
- To drive behaviour change and improved outcomes, a culture shift amongst farmers is required where animal welfare is viewed as paramount through the lambing season and high wastage rates are frowned upon and considered unacceptable by peers

These key findings were evaluated and recommendations were made to the industry. These are summarised below:

1. Conduct market research to assess perceptions of wastage in NZ lambing systems and the risk this could pose in accessing premium markets
2. Investigate and understand the extent of wastage in New Zealand lambing systems and subsequently innovate solutions to reduce mortality. The sector

should increase investment in research and development and explore opportunities for collaboration between MPI and the science community
3. Identify innovators who are achieving industry-leading survival rates, and analyse their systems to gauge financial implications and the potential for broader uptake
4. Improve extension services with an increased focus on wastage. Teach best practice management and distribute new innovations. The rapid development of extension modules and ready-to-present workshops specifically focusing on improving survival are required
5. Empower industry experts and incentivise further interaction with farmers to promote discussion and make this issue front of mind for farmers

*12.0 Recommendations for Industry, Pg 48 explores these recommendations in more detail.*

# Table of Contents

# 1.0 Limitations

The number of farmers surveyed was limited to 10. While significantly more surveys were distributed, garnering responses proved difficult. Worth considering is that farmers motivated to be involved could provide skewed data or implement different management systems than others.

10 industry experts were interviewed from differing backgrounds and experiences. While some perspectives were unanimous it is essential to recognise that results are indicative only.

The literature reviewed had limitations as most were historical in nature, and finding recent studies relating to triplet ewes and their offspring specifically was difficult.

Case studies were limited to three farm businesses. While these three systems were vastly different, they do not represent the sector as a whole.

Any data provided by farmers was not audited and while all care was given to ensure accuracy, it should be taken at face value.

# 2.0 Conflicts

Given the integrated nature of the New Zealand agricultural sector, most respondents were associates of mine. Additionally, Case Study A, 'The Pyramid', is my home farm which I now lease and Chris Dawkins (Case Study A and industry expert) is my father. Given the wealth and reliability of data across several lambing systems at The Pyramid, this conflict was shelved for the benefit of the research project.

# 3.0 Acknowledgements

Compiling this research report has been a monumental team effort. Firstly, thank you to my wife Jess for your patience and for keeping the home fires burning in my absence and on those late nights when I was occupied in the office. Also, thank you to my parents Chris and Julia for keeping the farm productive during my time away.

I must give recognition to the team at Rural Leaders NZ: Lisa Rogers, Annie Chant, Scott Champion, Matt Hampton, Chris Parsons and Hamish Gow. Your enthusiasm and effort in running the Kellogg course exemplify a high-performing team achieving outstanding results.

Thank you to all my contributors who didn't hesitate to lend their time and expertise.

- Mike Petersen, Farmer and Company Director
- Greg Sheppard, Farm Management Consultant, SheppardAg
- Jeff Sewell, retired ultrasound sheep pregnancy tester, 1993 – 2019
- Dr Scott Champion, Founding Partner, Primary Purpose
- Dr David Stevens, Senior Scientist, AgResearch
- Dr Derrick Moot, Professor of Plant Science, Lincoln University
- Dr Ken Geenty, Research and Development Consultant
- Sam Houston, Livestock Rep, Silver Fern Farms
- Greg McSkimming, National Agribusiness Manager, Silver Fern Farms
- Trevor Cook, Vet and Farm Consultant
- Toby Williams, Meat and Wool Chairman, Federated Farmers
- Greg Hamill, CEO, Maui Milk
- Anne Ridler, Associate Professor, Massey University
- Chris Dawkins, Sheep and Beef Farmer, Case Study A, The Pyramid
- Matt and Lynley Wyeth, Sheep & Beef Farmers, Case Study B, Spring Valley Enterprises
- Farmers surveyed and anonymous Case Study C.

Also worth highlighting is the body of work produced by the animal science team at Massey University. Several papers compiled by the team proved to be valuable resources. Clearly, this topic is a shared passion, and I hope we can collaborate in the future.

Beef + Lamb NZ was also a valuable source of information and assisted in collaborating with case study farms.

To Cohort 49, thank you for the past six months which have been thoroughly enjoyable and enlightening. I look forward to seeing where your careers take you and when our paths may cross again.

Finally, recognition must be given to Dr Patrick Aldwell for his enthusiasm and seemingly unlimited wisdom in helping shape this project.

# 4.0 Glossary

BCS: Body Condition Score. A measure of how much fat cover is on the backbone and ribs of a mature sheep

Culled: animal identified as undesirable and sold

Dam: a female sheep with offspring

Extensive management: farm system where the terrain is often challenging and ewes are not shepherded through the lambing period

Fecund: producing or capable of producing an abundance of offspring; highly fertile

Hogget: sheep generally younger than twelve months and prior to the permanent eruption of its first two teeth

Intensive management: primarily implemented on more accessible land classes with higher fecund flocks. Lambing beats and shepherding are undertaken.

Lambing mortality: deaths of ewes and/or lambs during the lambing season

MA Ewe: Mixed-age. A female sheep, at least 3 years of age. Sometimes includes two-tooths.

Orphan lambs: lambs removed from their dam and bottle fed

Post-natal mortality: lamb death after birth

Reproductive wastage: deaths of ewes and/or lambs between conception and weaning of the lambs

Triplet ewe: a mixed-age ewe which is pregnant or lactating and feeding three lambs. For the purpose of this project, a “triplet” will refer to a ewe with three or more lambs. In fecund flocks, ewes can become in-lamb with three, four or more lambs

Triplet lamb: normally, a lamb born as a set of three. For the purpose of this project, triplet lambs will refer to offspring which is part of a litter of three or more lambs

Two-tooth: a sheep having two permanent teeth erupted, usually happening around 12 months of age

Wastage: synonym for mortality

# 5.0 Introduction

*"Excessive mortality will be an issue sooner rather than later. Lamb wastage is our dirty dairy thing, but we still control the narrative. It will most likely be a market access issue and be used as a non-tariff barrier"- Toby Williams, Meat and Wool Chairman. Federated Farmers*

A free-range and pasture-based grazing system is fundamental to New Zealand farming. The ability to have animals grazing naturally outdoors gives the New Zealand sheep industry a point of difference and a competitive advantage in the marketplace (Beef + Lamb NZ & Meat Industry Association, 2023).

This free-range perception has overcome welfare implications from weather-related deaths in the past. One such incident occurred in Southland in 2010, when an estimated 250,000 to 1,000,000 lambs were lost in a spring snowstorm. One million new born lambs were thought to be at risk during the 10-day-long storm, with farmers' lambing loss estimates ranging from 30 to 50 per cent of their potential drop (Hotton, 2010).

Another issue presenting welfare challenges is the increased productivity of the NZ sheep flock. Since 1990 the sheep industry has improved lambing percentages and produced heavier carcass weights (Kenyon et al. 2019). Genetics are the key driver, combined with the required nutrition and subsequent ewe body condition. A consequence of this production is a higher proportion of triplet-bearing ewes, while hoggets are also being mated more frequently, with around 30% of ewes being mated as hoggets (Ferguson et al. 2014). While potentially very productive, these two stock classes also have the highest mortality rates, with most of these deaths occurring during the lambing season (Kenyon et al. 2019).

With no market premiums relating to lamb mortality specifically, it appears consumers view lamb deaths as a natural outcome of a pasture-based system (Houston, Personal Communication, June 6th 2023). This is despite a national average lamb death rate of around 24% (Flay et al. 2021) with higher mortality for twin and triplet lambs than singles (Kenyon et al. 2019). Finding a consistent average national lamb death rate is challenging although farmer surveys showed lamb death rates ranged from 10% to 40% farm-wide.

Considering NZ exports 94% of its sheep meat into premium markets (Meat Industry Association, 2020), one must question at what level does this mortality stop being 'natural' and it becomes a problem for the ever-increasingly conscientious consumer?

Industry experts interviewed and farmers surveyed unanimously agreed that with increasing scrutiny around animal welfare, mortality in New Zealand lambing systems is problematic. The majority agreed that the industry is in a period of grace where this potential issue can be addressed and farmers must enhance survival before legislation or market requirements change, particularly in high-risk animals such as triplets and hoggets.

Fortunately, these higher-risk animals are also potentially the most profitable on farms. Farmers can improve their world-leading productivity by reducing mortality and in turn improve welfare outcomes, social licence, carbon efficiency, farmer morale and their financial bottom lines.

*"Mortality is always topical and I feel we have gone over the top with fertility. When scanning over 200%, we are seeing some horrific losses and it is an elephant in the room. Too much focus is put on scanning percentages. While it is nice to have the potential, potential doesn't pay the bills; lambs sold do."- Dean Rabbidge, Southland Farmer*

This research report will address mortality in New Zealand lambing systems and identify methods for farmers to improve survival during the lambing season.

# 6.0 Project Purpose

This project identifies how New Zealand sheep farmers can improve livestock survival during the lambing season. To achieve this, it explored:

- the range of livestock management systems implemented during lambing and their level of success at improving survival

- current mortality rates, causes of death, the accuracy of on-farm data and what mortality is considered acceptable by both farmers and consumers

- how management before lambing impacts survival, barriers preventing the adoption of more effective management strategies and the different methods for driving behaviour change on farm

This information was evaluated and recommendations were made to the industry to answer:

"How can New Zealand farmers improve survival during the lambing season?"

# 7.0 Methodology

Existing information, perspectives and new data were accessed through multiple methods. These comprised of:

- Literature reviews: scientific studies provided data of high integrity whereas the accuracy of on-farm data is less reliable.

- Farmer surveys and expert interviews: 10 farmer surveys and 10 interviews of industry experts were undertaken to explore existing knowledge and add recent data, when most existing studies reviewed were historical. Experts interviewed were rural professionals with extensive knowledge in sheep systems including retired farmers, consultants, scientists, sheep scanners, vets and industry advocates.

  Farmer surveys provided current data relating directly to triplets and hoggets in a New Zealand context. Farmers surveyed ranged from the north and south islands, easy to steep land use classes and intensive to extensive management systems.

- Case Studies: three farms were studied to identify their methods for reducing mortality in their lambing systems. These case studies revealed different forms of lambing management, their level of effectiveness and also provided up-to-date data.

  **A:** 'The Pyramid', Marlborough. Chris Dawkins had a highly fecund composite flock and implemented different management systems through lambing, including indoor and intensive management outdoors.

  **B:** 'Spring Valley Enterprises', Wairarapa. Matt and Lynley Wyeth run a highly fecund flock and have previously utilised indoor lambing for triplets but are now using an outdoor system.

  **C:** 'Anonymous', Romney Stud in the Tasman region, scan conservatively in ewes and mate hoggets with intensive outdoor lambing management to reduce wastage.

A mind map (Figure 5.0) summarised responses and thematic analysis revealed five key themes. For full details of the thematic analysis process, see the six steps outlined by Braun and Clarke (2006). This broad scope of data was compared, contrasted and evaluated. Recommendations were distributed to contributors using the Delphi Method and after minor alterations, Recommendations for Industry were finalised, detailed in *12.0 Recommendations for Industry, Pg 48.*

*Copies of interviews, surveys and case study templates are included in 14.0 Appendix, pg. 55.*

# 8.0 Literature Review

Historically, lambing mortality was of limited concern in New Zealand; however, in the early 1990s ultrasonic pregnancy scanning was adopted and farmers could quantify their flock's potential performance and subsequent mortality (Nicoll et al. 1999). This ability to scan ewes and measure their foetal burden has become increasingly important, with scanning percentages rising and the subsequent numbers of triplets (Kenyon et al. 2019).

To understand the scale of lambing mortality, it is essential to consider the breeds of sheep, their population, their relative fecundity, and their death rates.

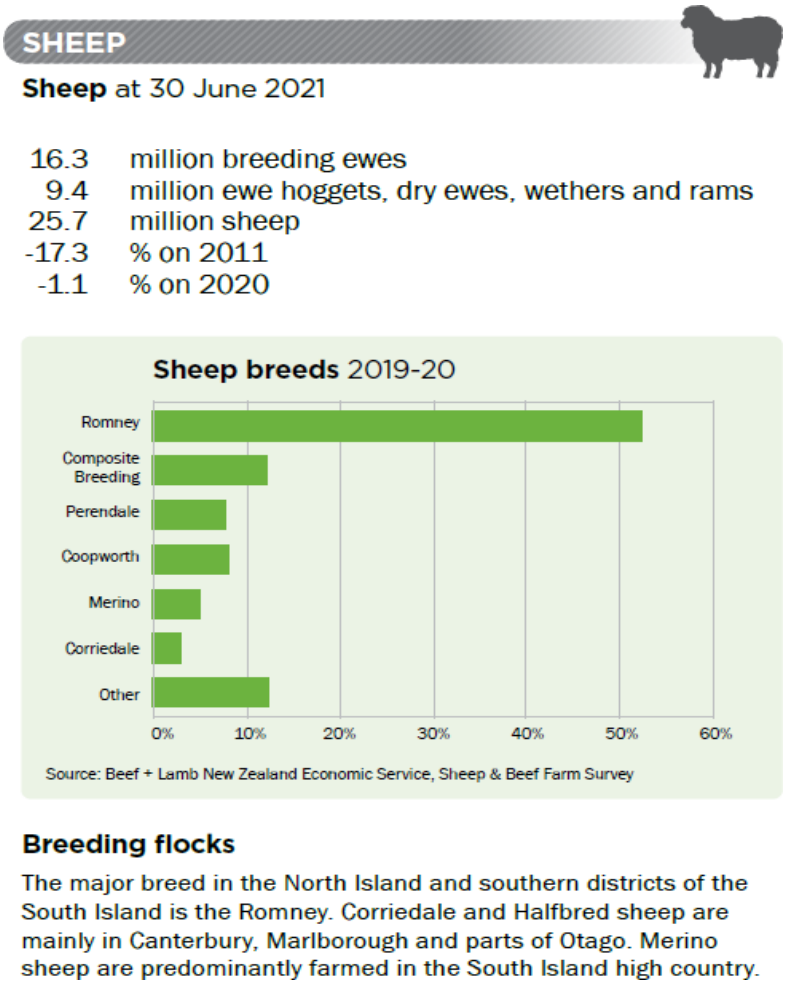


*Figure 1.0: NZ sheep population by breed (Beef and Lamb Compendium 2022).*

Moot and Davison (2018) explained that the number of breeding ewes has decreased from 40.4m in 1990/1991 to 16.6m in 2020/2021. Remarkably, the productivity of the sheep industry has increased over this period. The lambing percentage has increased from 100% to 132% (*Figure 2.0*), and lamb carcass weights at slaughter have increased 32% from 14.4 to 19.0 kg.

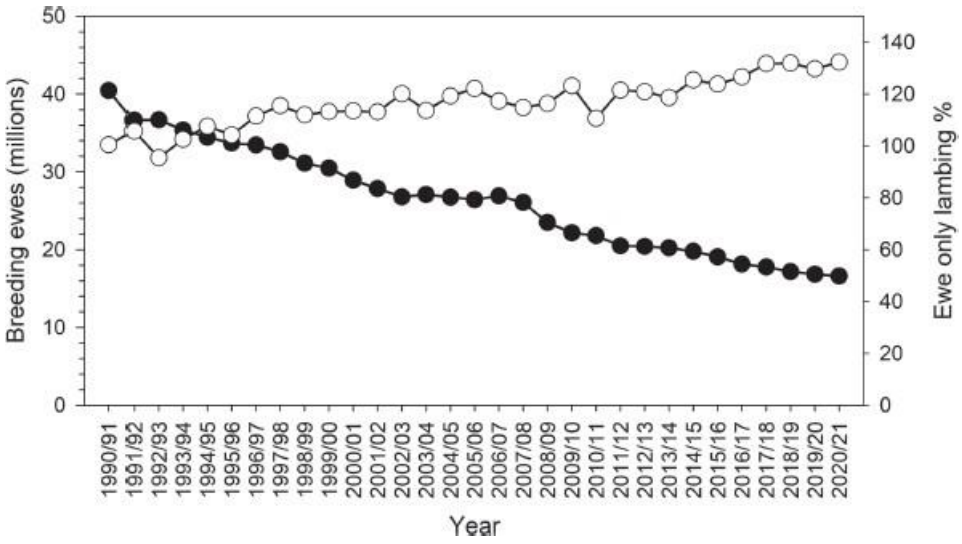


***Figure 2.0:*** *Change in the total number of breeding ewes (two-tooth and over, put to ram; ●) and ewe lambing percentage (○) from 1990/1991 to 2020/2021. (Source: Moot & Davison 2021)*

*Table 1.0* shows estimates of current breed populations and their average lamb wastage. It then forecasts the number and value of 3% reduced lamb death rates. This illustrates the significant financial opportunity in improving survival across the NZ sheep flock. The additional value excluded is wool produced, reduced ewe wastage and the value to the wider economy.

*Table 1.0: A sample of sheep breeds and wastage modelling (Source: populations estimated from Figure 1.0. Table created for the purpose of this project and uses estimated breed wastage. In reality, major fluctuations occur between flocks).*

| | Ewe population | Scanning (%) | Lamb death rate (%) | Reduced death rate (3%) | Lambs saved | Value of saved lambs (@$150/hd) |
|---|---|---|---|---|---|---|
| **Romney** | 8,500,000 | 160 | 18 | 15 | 408,000 | 61.2m |
| **Composite** | 2,000,000 | 200 | 30 | 27 | 120,000 | 18.0m |
| **Merino** | 650,000 | 130 | 28 | 25 | 25,350 | 3.8m |
| **All** | 16,300,000 | 170 | 24 | 21 | 831,300 | 125m |

The three main issues relating to reproductive wastage are detailed below.

## 8.1 Financial Implications

Ewes can leave a farm prematurely for two main reasons; death and being culled for possessing undesirable traits. Premature death comes at a significant cost to the farmer before fulfilling the ewe's productive lifetime (Flay et al. 2021).

This cost is measured in the value of the dead animal, its potential offspring, the opportunity cost of the feed it has consumed and the cost of raising or buying a replacement animal. Whatever the death rate may be, the equivalent number of replacement animals must be raised on the farm or capital stock purchased to keep stock numbers consistent. A study across multiple farms of 13,142 ewes by (Flat et al. 2021) showed that 50.4% and 40.0% exited their respective flocks due to premature culling and on-farm dead/missing, respectively. Annual mortality incidence ranged from 3.5 to 40.2%.

Raising replacements is costly due to providing high-quality feed, shearing costs and different animal health treatments. This investment is required before the replacement reproduces lambs as a hogget or two-tooth, thus providing the farmer income.

*Table 2.0* calculates the cost of the death of a triplet-bearing two-tooth prior to lambing, labelled as #85 for the purpose of this model. This equates to $650 in her and her offspring's potential value and $805 in feed (kgDM) consumed and replacement costs, for a total of $1455 per dead triplet two-tooth.

*Table 2.0: model created for the purpose of this project. No such table was readily available online. Values are estimates only.*

| Event | Date | Feed value calculation/commentary | Value |
|---|---|---|---|
| Dam weans lamb | Nov 2020 | 0 | 0 |
| Dam recovers through summer, is mated and pregnancy scanned | Dec 20 – May 21 | 151 days x 2kgDM = 302kg x 10c (value of summer feed) | $30 |
| Priority fed pre-lamb and through lactation (#85 born) | June – Nov 21 | 182 days x 3kgDM = 546kg x 50c (value of winter/spring feed) | $273 |
| #85 weaned, grown out until mating as a two-tooth | Dec 21 – Feb 23 | 454 days x 1.5kgDM = 681kg x 25c (average value of feed) | $170* |
| #85 mated and fed till scanning. Scans in-lamb as a triplet | March-May 23 | 91 days x 2.0kgDM = 182kg x 10c | $18* |
| #85 Priority-fed pre-lamb then dies from cast | June – Aug 15th 23 | 75 days x 3.0kg = 225kg x 50c | $113* |
| A replacement animal must be raised (#86) | Dec 23 – Aug 15th 24 | Same feed requirements as #85 from weaning till lambing (*) | $301 |
| Cost of animal health treatments for #85 & her replacement #86 | | Shearing, drenching, vaccinations, dipping, ear tagging, labour etc | $50 |
| Two-tooth value (#85) | | 33kgCW x $6.06/kg | $200 |
| Triplet lambs value (inside #85) | | $150/hd x 3 | $450 |
| Weaning value of the replacement | | | -$150 |
| **Cost of Wastage** | | | **$1,455** |

Therefore, the total modelled cost of wastage of #85 triplet two-tooth is $1,455, based on:

- Feeding her dam since she last weaned a lamb
- Feeding #85 as a ewe lamb, hogget and two-tooth
- Animal health treatments for #85 and her replacement #86
- The cost involved in feeding the replacement (#86) from weaning onwards as opposed to selling it prime for $150

## 8.2 Animal Ethics and Consumer Perceptions

Ferguson et al. (2014) explained that societal demands for sustainable and ethical animal production systems and practices will continue and therefore, sheep meat industries in Australia and New Zealand must remain proactive and continue their efforts to ensure sheep welfare. In support of this, a study by Greer et al. (2015) showed that farmers rated twin/triplet management and improved lamb growth and survival as essential areas needing research.

In NZ, The National Animal Welfare Advisory Committee (NAWAC) provide independent advice to the government minister responsible for animal welfare. An outcome of these recommendations is the Codes of Welfare. "Lambing Recommended Best Practice" states:

> *e) "If a dam is unlikely to successfully raise one or more of her offspring, the offspring should be fostered onto other dams or if possible, hand-reared* ***or killed humanely."*** (National Animal Welfare Advisory Committee, 2018).

This recommended best practice is interesting when compared with calf management:

> *"Calves may be kept and reared on the farm or sent elsewhere for rearing (usually for beef), or sent for slaughter, or* ***killed on the farm****.* ***Humane destruction on the farm*** *as a routine procedure needs to meet the same animal welfare expectations as routine killing in other situations"* (National Animal Welfare Advisory Committee, 2019).

This is a relevant comparison as recently Fonterra notified suppliers that beginning in 2023, all bobby calves should be raised for beef or slaughtered for calf veal. Anne Douglas, Group Director of Fonterra's Farm Source Programme, explained "*We can't afford to be complacent as consumers here and around the world become more interested in how their food is produced. Other countries and companies have already introduced policies and assurance schemes that provide consumer guarantees about the on-farm treatment of calves"* (Mead, 2023).

This illustrates that while farm practices may meet welfare standards, consumer or processor requirements could force change before policy does.

## 8.3 Missed Opportunities

Moot & Davison (2021) showed that meat production in NZ has improved through increased lambing percentages, resulting in a reduced environmental footprint and higher productivity per head. Gascoigne et al. (2022) explained that there is also an emotional barrier and stigma considering lamb losses, with clear impacts on farmers' mental health. Genetic gain is another opportunity to consider when improving the survival of productive animals. Thompson et al. (2015) explained that genetic gains lead to the need for fewer capital animals per hectare due to faster growth rates and being sold earlier at heavier live weights.

# 9.0 Analysis

## 9.1 Case Studies

Three farm businesses were studied to identify their methods for reducing mortality in their lambing systems. These case studies revealed different forms of lambing management, their level of effectiveness and also provided up-to-date data.

Key Points:

- Triplets were identified as the highest risk for wastage on each property
- Hogget mating was viewed as an opportunity but required intensive management
- Each farm business was concerned about mortality through the lambing period and actively addressed it
- Indoor lambing had been implemented with success at The Pyramid and Spring Valley
- Despite improved survival of triplets through indoor lambing, Spring Valley have transitioned back to an outdoor system
- 2/3 of the farmers viewed triplets as an opportunity, and the third managed their flock to limit triplet numbers
- One farm was scanning conservatively to reduce mortality and ease the workload at lambing time
- Recording and understanding of data was excellent on all three properties

Figures supplied were ballpark, based on long-term averages; they do not relate to specific seasons.

### 9.1.1 Triplet Lamb Wastage

Triplet management through the lambing period varied between properties:

A. The Pyramid: lambed indoors
B. Spring Valley: lambed on hills and checked with a drone
C. Farm C: boxed in with twins and checked daily

*Table 3.0: Triplet lamb mortality across three case study farms*

| | |
|---|---|
| Industry Average* | 33% |
| The Pyramid | 17% |
| Spring Valley | 30% |
| Farm C | 33% |

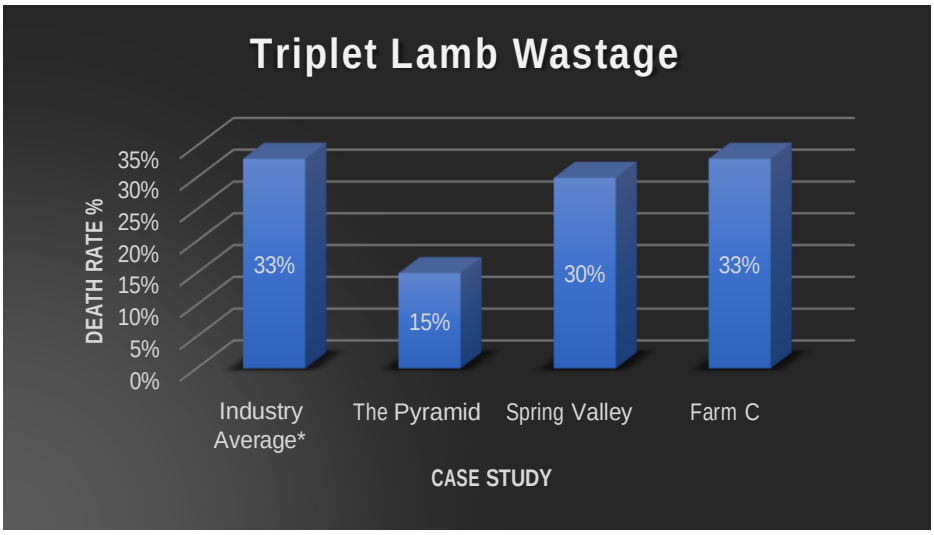


*Figure 2.0: Triplet lamb mortality across three case study farms*
**Industry Average: while it is impossible to pinpoint an exact average triplet lamb death rate industry-wide, 33% has been used based on data supplied in farmer surveys.*

## 9.1.2 Triplet Ewe Wastage

*Table 4.0: Triplet ewe mortality across three case study farms*

| | |
|---|---|
| Industry Average* | 15% |
| The Pyramid | 2% |
| Spring Valley | 8% |
| Farm C | 10% |

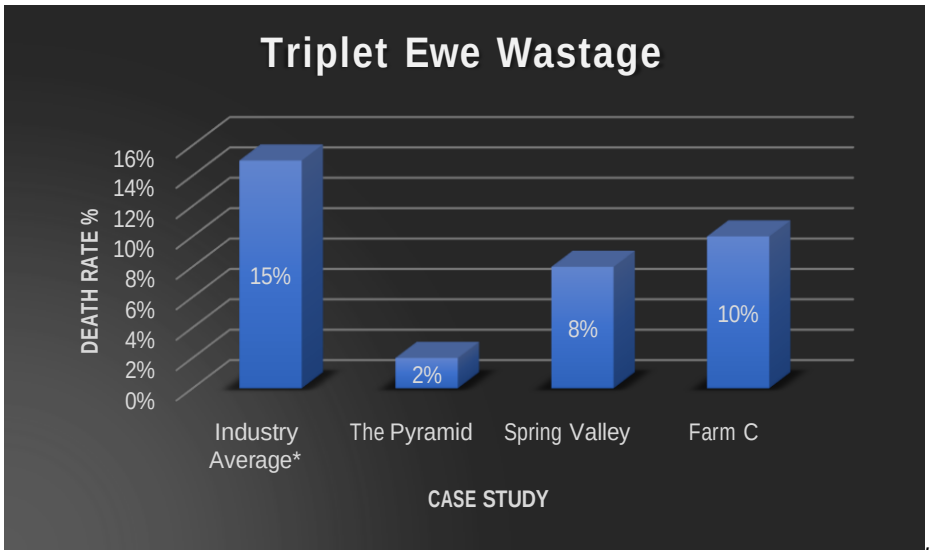


*Figure 3.0: Triplet ewe mortality across three case study farms.*
**Industry Average: while it is impossible to pinpoint an exact average triplet ewe death rate industry-wide, 15% has been used based on data supplied in farmer surveys*

## 9.1.3 Farm-Wide Lamb Wastage

Farm-wide management through the lambing period varied between properties:

A. The Pyramid: indoor lambing of triplets and singles. Best-practice set stocking of twins with outdoor lambing beats. Ram harnesses for targeted feeding and monitoring.
B. Spring Valley: best-practice set stocking, lambing beats and checks with drones on more challenging terrain.
C. Farm C: scan conservatively to reduce mortality. Best practice set stocking and lambing beats.

*Table 5.0: Farm-wide lamb mortality across three case study farms. *Industry average 24% based on Flay et al. (2021).*

| | |
|---|---|
| Industry Average* | 24% |
| The Pyramid | 15% |
| Spring Valley | 26% |
| Farm C | 15% |

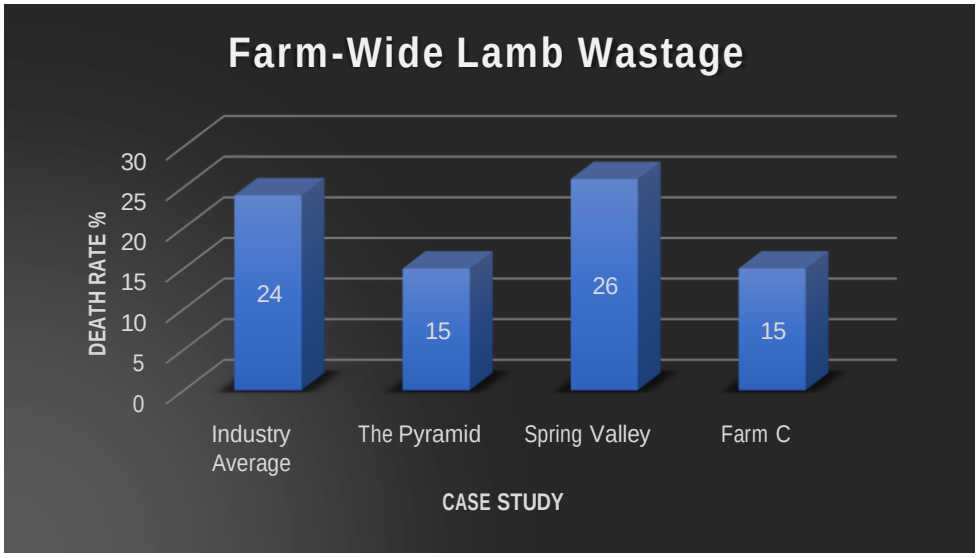


Figure 4.0: *Farm-wide lamb mortality across three case study farms.*

## 9.1.4 Case Study Summary

The Pyramid achieves significantly lower than industry average death rates in all three categories: triplet lambs, farm-wide lambs, and triplet ewes. This is despite average scanning percentages being around 200%, which is higher than Farm C but lower than Spring Valley. While this lower death rate could be attributed to the indoor lambing system, it is paired with excellent pre-parturition management with lambing being treated “as the tip of the spear”.

The Dawkins started indoor lambing in 2017, and interestingly their previous death rates when lambing outdoors were similar to the current Spring Valley mortality of 30% of triplet lambs and 26% farm-wide. Additionally, Spring Valley have only recently moved away from indoor lambing, where indoors, their survival was typically better than that at The Pyramid.

Spring Valley has moved back to a traditional outdoor system due to a lack of skilled labour and the questionable economics of its indoor system. This contrasts the Dawkins, who say "*there is no going back*" to outdoor management of those high-risk animals. Furthermore, the Dawkins note that half of their 15% triplet lamb death rate is embryonic loss, abortion or stillbirth. They explained that very few lambs perish that could be saved. This is financially rewarding and boosts morale as well.

Spring Valley have significantly more scale than The Pyramid, which explains the extra labour requirements. Additionally, the climate of the Wairarapa could make animal health issues indoors more challenging, compared with the warmer climate of the Marlborough farm. Lambing facilities were not compared, although the Dawkins note their shed is well-ventilated and receives sunshine at 7.30 am through the winter. The Dawkins composite sheep are handled often and farmed intensively, making them comfortable being handled indoors during lambing.

Farm C minimises the triplet conundrum by intentionally scanning at low rates and boxing any triplets in with their twins at lambing time. Daily lambing beats are undertaken, but they accept there are significant levels of wastage in the triplets, however, they only scan around 2 – 3% in lamb with triplets so it is perceived as a minor issue.

Hoggets are considered an opportunity in all case study farms and were all mated. Each property intensively shepherded its hoggets through lambing, with dystocia and bearings being the main issues to deal with. The significant number of lambs saved are not clearly reflected in their overall survival, with each property losing around 30% of their scanned hogget lambs. This is due to the majority of losses being to abortion or embryonic loss, which with best practice vaccination programmes in place, there is very little other preventative action to take.

Each business is mindful of lamb wastage and different management systems have been implemented. The most notable findings were:

1. Success of indoor lambing of high-risk animals at The Pyramid
2. Transition back to outdoor lambing of triplets by Spring Valley, despite significantly improved survival indoors
3. Deliberate conservative scanning percentages at Farm C, with the outcome being excellent survival rates
4. The importance of intensively shepherding hoggets through lambing to assist with bearings and dystocia and the need for research into abortion and embryonic loss across hogget flocks
5. Use of drone technology at Spring Valley and the ability to monitor remote stock efficiently and safely

*Further analysis of The Pyramid indoor lambing is detailed below in Table 6.0 and Table 7.0*

*Table 6.0: Pyramid indoor lambing performance.*

| | 2017 | 2018 | 2019 | 2020 | 2021 | Long Term Ave (outdoors) |
|---|---|---|---|---|---|---|
| **Triplet lamb survival to sale (%)** | 246 (320/390) | 239 (564/708) | 249 (325/391) | 240 (369/462) | 240 (288/360) | 200 |
| **Triplet lamb death rate (%)** | 17 | 18 | 20 | 20 | 20 | 33 |
| **Triplet ewe death rate (%)** | 4 (5/130) | 3 (7/232) | 5 (7/129) | 2.6 (4/152) | 5 (6/120) | 10 |
| **Farm-wide lamb death rate(%)** | 13 | 15 | 14 | 14 | 15 | 24 |
| **Singles death rate (%)** | Born outside | Born outside | Born outside | Born outside | 2 (4/198) | 10 |
| **Hogget death rate (%)** | Born outside | Born outside | Born outside | 9 (28/310) | 9 (19/215) | 20 |

*Table 7.0: Pyramid Indoor lambing economics *Projected farm-wide profit is based on a historical 24% death rate farm-wide with a 10% triplet-ewe death rate. Average lamb values at weaning were used to calculate the farm-wide profit in extra lambs.*

| | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|
| **Supplements ($/ewe)** | 19 | 8.45 | 8.20 | 8.86 | 7.52 |
| **Labour @ $25/hr ($/ewe)** | 54 | 25 | 24 | 10.43 | 9.30 |
| **Overall, includes misc. ($/ewe)** | 86.40 | 45.70 | 39 | 22.24 | 19.10 |
| **Total cost ($/ewe)** | 11,236.40 | 10,610 | 5,029 | 8,742 | 8,766.90 |
| **Indoor profit ($)** | -1,456.40 | 7,270 | 6,101 | 3,368 | 7,083.10 |
| **Farm-wide profit* ($)** | 20,088.60 | 30,070 | 33,022 | 29,208 | 32,243.10 |

Without a control mob at The Pyramid, it is difficult to determine whether the farm-wide reduction in death rates directly results from indoor lambing, given the number of variables within a farm system.

When asked about using a control mob and lambing outdoors, Chris Dawkins explained *"After 50 years of trying to make progress outdoors, I'd had enough. The improved results are clear to see." He went on to further explain "In regards to triplet management, I used to avoid the issue when raised by Sainsbury's and Tesco during audits, however with the recent implementation of the indoor system, it is something we can discuss with pride and satisfaction."*

## 9.2 Interviews and Farmer Surveys

*"I think mortality is a very good topic to be addressing, especially given how people view farming at this time, including the way we treat the land and our stock." – Nigel Bishell, Marlborough Farmer*

The information gathered from farmer surveys and industry experts has been combined and summarised in two sections. Section 9.2.1 provides the responses in a mind map and subsequent themes were identified through thematic analysis. Section 9.2.2 explains these themes and summarises the new information gathered.

*Interview and survey templates are included in 14.0 Appendix, pg. 55.*

## 9.2.1 Interview and Survey Mind Map

## 9.2.2 Thematic Analysis

The most common responses and subsequent themes are highlighted below.

- Markets view wastage as an acceptable outcome of the NZ farm system
- Farmers stick to traditional methods
- Farmers prefer to implement what is easy and practical
- Not all deaths are preventable = **NZ farm systems, a level of acceptance**
- Wastage is underplayed and not fully understood
- There is a lack of understanding regarding the amount and cost of wastage
- Farm record keeping is poor
- Wastage needs more discussion = **Lack of information and understanding**
- Potential to be a significant problem
- European market and high-end US consumers pose significant risk = **Problematic**
- Social licence is important
- Bobby calves are a good comparison = **Market risks**
- There is a financial opportunity but not all drivers need to be economic. It can be values and ethics, morale, carbon efficiency, genetic gains = **Opportunities**

<u>The five main themes were:</u>

1. A culture of acceptance of wastage due to it being a symptom of NZ outdoor farming systems
2. A lack of understanding of the quantity of wastage occurring, the cost and the need for more focus on the issue
3. Wastage being highlighted as problematic for the industry
4. Markets and social licence being at risk
5. Opportunities identified

The most common management practices on farms to reduce wastage were priority feeding and nutrition, body condition scoring, animal health treatments, shelter/paddock selection, mob size and conservative scanning percentages. Half of the farmers surveyed employed an easy-care approach at lambing, and half shepherded in an intensive system.

Farmers explained that the biggest improvement in survival over their careers had been from an improvement in genetics and feeding. Barriers identified to implementing improved lambing systems were primarily a lack of knowledge or engagement, specialist skills, labour, challenging terrain, climate and the capital outlay required.

100% of farmers were pregnancy-scanning sheep, with 8/10 identifying triplets and quadruplets. On most farms, triplets were managed specifically through extra feeding and condition scoring, intensive shepherding, lower stocking rates, mindful paddock selection and bottle-feeding orphan lambs. Interestingly, there were two farms mixing triplets in with twins to lamb, although there were minimal numbers of triplets in those flocks. One farmer was selling his triplets at scanning and explained that selling them then is a 100% guarantee they will provide an income, and there wasn't a huge welfare issue to deal with at lambing time.

Hoggets were mated on half of the farms due to the financial opportunity they present. The remaining farms were primarily merino flocks or didn't have the quality pastures available to grow out a large hogget for mating. Hoggets were also managed specifically by priority feeding, intensive management and more suitable paddocks through lambing.

Despite feeding and nutrition being unanimously accepted as the most important strategy to improve survival, only 1/10 farmers were using ram harnesses at mating, with most preferring foetal ageing instead. Ram harnesses provide a more accurate lambing date so that feeding can be efficiently allocated and they also improve lambing beat efficiency. Foetal ageing is generally preferred as it is less work than ram harnesses through mating and during winter shearing when raddle colours need to be remarked.

The value of pasture saved by using a ram harness for targeted feeding is outlined in *Table 8.0*. This is a model created for the purpose of this project and uses estimates for feed value and days flushing (priority feeding). The table does not calculate the stock performance benefits of the targeted feeding, nor has a measure for improved monitoring at lambing time.

*Table 8.0: a model for the value of feed saved using ram harnesses and targeted nutrition vs foetal ageing. Source: table created for the purpose of this project; data sets are estimates only.*

| Window identified for lambing | Ave. days pre-lamb flushing / ewe | Cost of feed (3kgDM / day x $0.50 = $1.50 / day) | Value of feed saved | Value of feed saved per 1000 ewes |
|---|---|---|---|---|
| **17 Days (Foetal ageing)** | 26 | $39 | 0 | 0 |
| **10 days (harness)** | 19 | $28.50 | $10.50 | $10,500 |
| **5 Days (harness)** | 14 | $21 | $18 | $18,000 |

Indoor lambing was viewed positively, with benefits being shelter, feeding and the ability to monitor animals closely. Negatives were the perceived capital outlay required, labour intensity, questionable economics, risks of disease spread and the system contrasting New Zealand's free-range image. The majority agreed that the systems could be modified into a NZ environment, such as one specifically targeting high-risk animals. 8/10 farmers were interested in learning more about intensive lambing systems and 7/10 were interested in indoor lambing specifically. Predictably, in most cases, it was mentioned that the system must be profitable.

In driving behaviour change, the majority of respondents agreed with three sentiments:

1. Legislation is poor at achieving the desired outcomes and would be difficult to enforce
2. Market incentives are an effective driver of change but don't currently exist for lamb welfare specifically
3. Education and extension work is the most effective driver of change

Other key drivers were the need to explain the commercial benefit of improved survival, tapping into people's values and 'doing the right thing' and focusing on positive frameworks when discussing the issue.

Record-keeping was considered poor by 80% of experts, however, 90% of farmers thought record-keeping was important and they detailed various KPIs they track, including 100% of farmers calculating ewe and lamb mortality. Methods of data storage were farm diaries, spreadsheets and online programmes. This contrast in opinion could be explained by the fact that farmers who felt motivated to complete the survey are more engaged and likely to take records on the farm. The second explanation could be that industry professionals and farmers have different opinions on the level of record-keeping required.

Farmer surveys revealed lamb wastage ranging between 10% and 40% farm-wide with triplets up to 40%. However, some respondents were not monitoring triplet performance at all and simply boxing them in with twins. Hogget offspring were identified as having no worse than average lamb death rates. This is in direct contrast to literature studies and farm case studies which showed a high incidence of embryonic mortality and abortion. The accuracy of farm survey data and if it is measured from scanning until weaning should be questioned.

Ewe deaths farm-wide ranged from 2% - 9%. However, triplet ewes through the lambing period were unanimously identified as the highest risk for wastage and likely to be significantly higher than farm-wide averages. 7/10 farmers were concerned with their death rates and wanted to seek improvement. The three unconcerned farmers had industry-leading performance and actively managed for the best possible outcomes.

Respondents unanimously agreed that lambing mortality could be a major welfare issue; some added that there is a risk of it becoming a non-tariff barrier to trade. 80% of farmers were concerned about their death rates and 70% wanted more discussion as an industry.

Most experts suggested that industry research and development has become too environmentally focused, and the pendulum has swung too far away from research which drives productivity and profitability. The sentiment was that environmental work is important and must continue; however, the lack of applied science and productive research is a handbrake on the industry. When considering research funding, one contributor noted one pillar of sustainability is economic viability.

There was a sentiment from experts that there is a lack of awareness and knowledge of wastage, and this was confirmed in the farmer surveys by inaccurate wastage calculations. All ten farmers calculated the wastage of a triplet bearing two-tooth differently. 1/10 respondents were in the ballpark figure for the true cost of wastage; therefore 9/10 were inaccurate in value and calculations.

18/20 respondents agreed that farmers learn best from other farmers and that ideas must be practical. The vast majority agreed that current industry extension work needs improvement and there were numerous suggestions that rural professionals could play an important role in driving discussions. 8/10 farmers said they often

discussed lamb wastage. Additionally, 7/10 said more discussion was required as an industry.

100% of respondents identified nutrition and body condition scoring as a key management tool. Subsequently, five farmers wanted increased investment in this area of extension by Beef + Lamb NZ, with a further two wanting a focus on assistance with implementing existing knowledge. 6/10 did not support paying more levies, but four of these would prefer reallocating existing resources toward extension and education. Interestingly 7/10 farmers suggested a reduction in policy expenditure from Beef + Lamb NZ could fund this increase in extension work.

Regarding animal husbandry, 10/10 farmers indicated they knew how to perform a lambing beat, but all lacked significant detail. Similarly, 10/10 could describe the process of lambing a ewe but again detail was lacking. This may not be an accurate reflection of skill level but more an indication of filling out a survey and time pressures. 7/10 had not seen a post-mortem diagram.

Experts interviewed explained there are multiple additional benefits to improving survival:

- Increased carbon efficiency due to more product produced per kg of feed consumed
- Increased productivity per head, increasing income and reducing farm working expenses
- Lower environmental impact with fewer animals per hectare
- Improved genetic gain due to increased survival of the most productive animals
- Mental health benefits and morale boost from seeing fewer deaths and thriving animals
- Improved welfare outcomes, leading to improved social licence

The below sentiments from industry professionals further summarise their positions:

*"How seriously does the industry take its own wastage? Not seriously enough. If they did, it would be the number one focus that would help solve all those other problems. We would be so much more productive per head. What would increasing eco-efficiency mean to environmental impact?" – Dr David Stevens, Senior Scientist, AgResearch*

*"People are beginning to view triplet management through an animal welfare lens, but it's also an economic opportunity. We need better extension and education in this area; there is a lack of conversation around this" – Dr Scott Champion, Founding Partner, Primary Purpose*

## 9.3 Mortality Rates and Causes of Death

### 9.3.1 Mixed-Age Ewes and Lambs

Kenyon et al. (2019) and Geenty (1998) note that numerous issues cause livestock mortality during the reproductive period. Before birth, the foetus faces several challenges in simply surviving to full term. As the ewe's ovulation rate (fecundity) increases, so does the likelihood of embryonic loss. There is also contagious abortion such as campylobacter and toxoplasmosis to consider and animal health issues relating to the dam, such as becoming cast or suffering from milk fever and subsequent sleepy sickness. Through labour, there is a risk of dystocia, and once born the lambs face death from starvation, exposure and misadventure.

Major causes of lamb death are dystocia in singles and starvation/exposure mostly in multiples. Combined, these account for about 60% of all lamb deaths (Beef + Lamb, 2013).

Triplet lambs have higher death rates for multiple reasons:

- Dams are more prone to animal health problems and death, causing lamb death
- Smaller birth weights, increasing the risk of hypothermia
- Increased chance of dystocia, causing death or leading to starvation and exposure
- Increased chance of mismothering, leading to starvation and exposure
- Starvation in the weeks following birth due to competition for the dam's milk

Contributors unanimously agreed that death rates were highest in triplets, followed by in-lamb hoggets and their offspring. Lamb death rates ranged from 10% to 40% across all flocks surveyed. Triplet lamb losses were as high as 40% and triplet ewe deaths reached 20%.

### 9.3.2 Hoggets

Ridler et al. (2021) found in a study of 297 dead hogget lambs that the reproductive performance of ewe hoggets is poorer than that of mature-age ewes due to producing fewer lambs with poorer survival. It was recommended that management practices be introduced *"to increase ewe hogget lambs' birthweights and supervision of ewe hoggets at lambing time."*

Young et al. (2010) found that in a study of 880 ewe-hoggets, after three days lamb mortality was 20%, but 28% by weaning. The primary cause of death was dystocia, followed by starvation, mismothering and exposure. Lamb survival to three days of age was 10% lower in lambs born to hoggets than in a similar study carried out on mixed-age ewes by Everett-Hincks and Dodds (2008).

Each case study farm noted the high risk of lambing hoggets, with each mob being intensively managed. Even with intensive management, lamb losses were as high as 50%. However, it was highlighted that high rates of abortion and embryonic loss were the biggest contributors towards these deaths. Bearings and dystocia were the

next biggest issues. Case Study A, 'The Pyramid' now lamb hogget singles indoors due to the high dystocia rates, assisting 15 – 20% of hoggets giving birth with a 98% survival rate of single lambs.

The need for supervision was also highlighted in Case Study C: "*Hoggets are intensively managed; we check them multiple times a day. People say hoggets should be easy care. However, we earn more than lawyers during lambing time by checking hoggets and their subsequent survival. These animals are big enough and are 60kg by lambing time. Deaths must be unbelievable in some places, being unmonitored."*

## 9.4 Management Pre-parturition

"*Part of the problem is farmers concentrating on interventions during lambing. By the time you get to lambing an intervention might not be successful because management through pregnancy wasn't correct." – Dr David Stevens, Senior Scientist, AgResearch*

Genetics, nutrition, animal health and body condition are the key drivers of sheep performance in New Zealand. Geenty (1998) explained that the foundation is suitable genetics, considering climate, terrain and management systems. Subsequently, by having adequate feed covers, access to quality water, the correct lambing date and sheep in an acceptable body condition, farmers have put themselves in a strong position to enhance survival. Some 70% of lamb deaths can be prevented by better nutrition and preventive measures (Beef + Lamb NZ, 2013).

Genetic gains have accelerated in recent decades in breeding "easy care" and "low input" sheep, which require minimal monitoring or intervention at lambing time. However, according to industry experts, genetics are not a complete solution and must be matched with adequate management.

"*Stud farmers have become quite efficient and very good at breeding. Now is the time to harness the potential. We have got the genetics and management comes next." – Matt Wyeth, Case Study B, Spring Valley Enterprises.*

Identifying light-condition ewes and those with high foetal burden means these animals can be fed appropriately, increasing lamb survival (Beef and Lamb NZ, 2010). The importance of ewe body condition score is also highlighted by Flay et al. (2021), who explained that ewes with higher pre-mating body condition scores have lower odds of wastage.

*"There are so many gains that could be made by improving ewe and lamb survival, but it is multi-factorial with different issues happening on different farms. I totally agree that getting the basics/those low-hanging fruit right on many farms would be a good start." – Anne Ridler, Associate Professor, Massey University.*

## 9.5 Lambing Management

Contributors explained that management through the lambing period differs depending on the farm's land class, genetics, infrastructure, labour availability and

the farmer's knowledge and personal values. The best approach must be taken on a farm-by-farm basis; however, "*at higher lambing percentages planning and management need to be more finely tuned"* (Geenty, 1998).

*"It's difficult to make individual recommendations, but the point is the basics need to be well researched. Consider shelter and where to put it, genetics, feeding, pasture covers at lambing, lambing date and grass/clover curve, feed quality, stocking rates to allow space and time for lambing and bonding, and level of disturbance. How does all of this fit into your individual farm system?" – Mark Zino, Canterbury Farmer*

*"An Individuals all-round management skill is perhaps the biggest influencer on reducing wastage" – Greg Sheppard, Farm Management Consultant, SheppardAg*

Most crossbred genetics are found on easier land use classes, where hogget mating and instances of multiples are more common. Several management strategies through the lambing period and their effectiveness are evaluated below.

### 9.5.1 Shelter, Aspect and Paddock Selection

There is a lack of studies measuring the impact of shelter on triplet lamb survival, although numerous studies have shown the importance in singles and twins. Effective shelter protects lambs from wind, rain and snow and allows lambs exposure to the sun. Outdoor shelter should be well dispersed to encourage ewes to isolate from other sheep at lambing. Scattered dense shelter within paddocks such as tussocks, forage grasses, or shrubs will likely increase lamb survival and possibly growth rates (Pollard, 2006).

100% of farmers surveyed indicated shelter was one of their main considerations when selecting lambing paddocks. However, in Case Study A, The Pyramid, Chris Dawkins explained that in 2022 during a southerly weather event, even with sheltered paddocks, every lamb born outside that day perished. The triplets indoors had nil losses from hypothermia. These deaths have been seen on a far larger scale historically, one example was in 2010 when a southerly storm followed by days of rain left an estimated 250,000 to 1,000,000 lambs dead in Southland (Hotton, 2010).

Several historical studies focused on lamb survival and paddock slope. In multiples, Dalton et al. (1980) found 34% mortality in hill country whereas Johnson et al. (1982) found 24% under flatter conditions. Knight et al. (1983) found a large increase in lamb deaths when born on slopes in excess of 30deg. This increase was mainly due to lamb slippage resulting in the mismothering of new-born lambs.

McMillan & Knight (1985) ran two trials, where lambs were born in flat paddocks and then shifted to steeper paddocks through lactation, and found losses were only 10% by weaning. They concluded that lambs can be successfully reared in steep paddocks from a young age. However, where possible, lambs should be born in easy-contoured paddocks and then shifted.

The impacts of slope on triplet lamb survival has not been examined. However, given the poor ability of the triplet ewe to communicate and reunite with its missing lambs, it might be expected that an increased slope will have an even higher negative impact on survival.

Case studies and farmer surveys show mixed opinions on paddock selection and slope. Some farmers prefer set stocking multiples on hill country, where there is sufficient shelter and room to spread out and lamb in isolation. Another benefit was being dryer underfoot than being in wetter, lower-lying country. Further study is required into the effects of gradient on triplet lamb survival, although with many variables at play, it will be difficult to measure exact causes and outcomes.

### 9.5.2 Stocking Rates

Survey data collected from commercial sheep producers in Victoria found that the survival of single and twin-born lambs increased by 1.4% and 3.5% from decreasing their mob size by 100 ewes (Lockwood et al. 2019). A similar outcome was found by Langlands et al. (1984) who found that a stocking rate of 20 sheep/ha was associated with greater mortality of ewes and their lambs than the lower stocking rate of 10 sheep/ha. Survival of twins to weaning was 42% at the high stocking rate and 72% at the low. Corresponding values for singles were 73 and 87%.

More recently, Robertson et al. (2011) compared stocking rates of 16 and 30 ewes/ha. The survival of lambs born alive at the high stocking rate was 63% compared to those at the low stocking rate at 83%. The main cause of the extra deaths was starvation, mismothering or exposure.

While these studies do not focus on triplets, the inference is that stocking triplets in smaller mobs again would be a step toward improved survival. Farmers surveyed who intensively shepherded supported this sentiment, stocking triplets at lighter rates than their twin mobs, although no data were provided to support this theory.

### 9.5.3 Birth Weights

Oldham et al. (2011) lists birthweight as the single greatest influence on lamb survival with the ideal range being between 3.5 and 6 kg. Refshauge et al. (2015) found that lambs born at lower body weights are more likely to be stillborn, dead in utero or die from starvation, mismothering or exposure. This result was also found by Ridler et al. (2022) in hogget wastage studies where lighter birth weights directly correlated with high wastage. Conversely, larger lambs are more prone to dystocia and birthing-associated injury (Hinch and Brien, 2014).

Beef + Lamb NZ (2013) recommends optimum lamb birth weight for best survival is 4.2-7.4kg for singles and multiples.

### 9.5.4 Shearing Policy

Morris et al. (1999) explained the direct financial advantages of winter shearing, which include: higher quality wool, lower shearing costs through the elimination of pre-lamb crutching, less wool lost through ewe deaths over the lambing period and a reduction in cast ewes. Morris et al. (1999) also ran a large field trial measuring the effects of winter shearing on lamb survival. The trial studied 1002 twin-born lambs and they found a reduction in mortality rate from 18 to 15% in lambs born to ewes shorn at day 67 of pregnancy compared with lambs born to unshorn ewes. They

found the best time to shear ewes was likely to be pregnancy day 50 to 100, finding increases in lamb birthweight by up to 1.0 kg.

Kenyon et al. (2002) explained that for this birthweight response to occur, lambs would have had to be destined to be below optimal weights through inadequate nutrition.

Shearing closer to lambing is believed to encourage the ewe to seek shelter during lambing, thus increasing lamb survival. However, this is infrequently adopted due to the metabolic risks of having ewes off feed and shearing stresses in late pregnancy (Hinch and Brien, 2014).

### 9.5.5 Non-shepherding or Easy-care

On steeper land classes, where intensive management is more difficult, farmers generally prefer an 'easy-care' system. Given that more fecund composite sheep make up just 12% (*Table 1.0*) of the total sheep population in NZ, the majority of farm systems have lower scanning percentages and an easy-care approach.

The management strategies detailed above of paddock selection for shelter and aspect, shearing policy and stocking rates, pre-parturition management, combined with suitable genetics reduce excessive wastage rates. Fisher (2002) described hill country farmers' rapid gains with low-input Marshall Romneys and the subsequent minimal wastage, with just 1 – 2% death rates in Marshall Romney ewes unshepherded through lambing. The paper did not include a figure for lamb death rates.

Given that the national average for lamb wastage is estimated to be 24% (Flay et al. 2021) and the majority of flocks are unshepherded through lambing, assumptions can be made that even in easy-care sheep, losses can be significant.

*"Lambing beats are not generally done on the steep country. A good result there is scanning 180% and dock 140 – 150% with no labour over lambing time. 180% scanning means low numbers of triplets, and a lower input flock" – Greg Sheppard, Farm Consultant*

*"It's difficult to enhance survival, but easier to avoid the problem in the first instance. Those with previously high scanning percentages are aware of wastage and some are actively addressing it by keeping scanning percentages down, particularly if their system doesn't allow for intensive management" – Chris Dawkins, Case Study A, The Pyramid*

### 9.5.6 Lambing Beats

A lambing beat is an intensive management where ewes and lambs are checked frequently and assistance is given where required. This allows the farmer to assist with dystocia, stand up cast ewes and rescue lambs who have become mis-mothered. It also allows the farmer to assist ewes with udder infections or enlarged teats which the newborn lamb struggles to suckle.

While the benefits of a lambing beat seem obvious, some argue against its effectiveness due to the disturbance of ewes and lambs, leading to separation. Dwyer et al. (2016) explained that the behaviour of the lamb soon after birth is critical for determining survival. The lamb must stand up, find the udder and suckle. Additionally, the ewe must groom the lamb and remain present in the first few hours to successfully establish the ewe-lamb bond. Fisher and Mellor (2002) concluded that overall, there was no evidence to indicate shepherding ensured either easier births or integrity of the ewe-lamb contact; equally, they found no clear support for shepherding being harmful.

This result from Fisher and Mellor (2002) appears more relevant in extensive situations where ewes are bred for easy care and are not accustomed to intensive management. Lambing beats are generally undertaken on easier land use classes and in higher fecund flocks that are more prone to lambing issues.

Farmer surveys indicated that as fecundity increased, so did the intensity of the shepherding due to the number of animals it saved.

### 9.5.7 Orphan Lambs

Given the high rates of post-natal mortality in triplet lambs, some farmers elect to 'orphan' one lamb and bottle feed it, leaving the ewe to feed the remaining two. Other options for the third lamb are 'mothering on' to a spare ewe that has lost its lambs or 'wet mothering' where single-bearing ewes have their lamb removed, and two orphan lambs are fostered on. Each method comes with different challenges including labour requirements, specialist skills, infrastructure, and the cost of milk powder.

The most efficient way to raise a triplet lamb is on its mother. However, the ewe's milking ability isn't always sufficient to sustain three lambs until their rumens are developed to survive on pasture alone. There are multiple guides for rearing orphan lambs online, although a robust analysis of the economics has not been undertaken (Beef + Lamb NZ, 2020).

Sheep milking operations such as Maui Milk remove lambs at birth and raise them in a mass-rearing facility, which requires skilled labour and capital investment. This is a necessary practice to raise replacements and stud ram lambs in their situation. While the economics of orphan lamb-rearing systems is questionable, the need to focus on the quality of life and overall welfare may trump the need for it to be a purely economic venture.

*"These days our i's must be dotted and t's crossed regarding animal welfare. At some point we will come under the spotlight and we have to make sure we are happy with what we do" – Greg Hamill, CEO, Maui Milk*

### 9.5.8 Indoor Lambing

*"Interventions at lambing time do not compensate for inferior management prior to lambing! If all other boxes are ticked, then indoor lambing could be warranted" – Dr David Stevens, Senior Scientist, AgResearch*

*“If you view the most important thing as natural systems then you might accept some level of lamb mortality. Whereas if you are less worried about naturalness and welfare is a concern you’d prefer indoors. It is a challenge as we address singular issues and paint them in silos.”– Dr Scott Champion, Founding Partner, Primary Purpose*

Most farmers surveyed agreed that indoor lambing systems could be modified into a NZ environment, such as a hybrid system or one specifically targeting high-risk animals. 8/10 farmers were interested in learning about intensive lambing systems if the economics could be demonstrated and 7/10 were interested in indoor lambing specifically. Experts Interviewed detailed the pros and cons of indoor lambing systems:

Pros:

- Improved ewe and lamb survival
- Satisfaction and morale boost for the farmer
- Positive welfare story
- Accurately monitor feed intake
- Shelter and warmth
- Intensive monitoring and ease of assistance
- Match offspring with their dam and link with electronic identification tags
- Identify ewes’ udder health and milking ability and remove lambs if required
- Identify wet-dry ewes and mother lambs on or remove them from the mob where they are consuming valuable feed
- Ability to sort mob into sets of 1, 2 or 3 lambs and allocate feeding through lactation appropriately
- Tailing at 24 hours of age
- Ensuring triplet lambs receive sufficient colostrum

Cons:

- Perceived significant capital investment required e.g. covered shed, Prattley panels, water systems
- Costly supplementary feeding
- Specialist labour and skills required
- Transition from grass to supplements late in pregnancy has a risk of triggering metabolic issues
- Hygiene and animal health issues
- Questionable economics
- Contrasts the free-range reputation of NZ farming

Multiple European studies are available detailing lamb wastage in indoor systems. Carson et al. (2004) compared indoor to outdoor survival across multiple farms in Northern Ireland. Survival was similar, with less labour and costs in the outdoor systems. Gascoigne et al. (2023) showed that current industry figures for total lamb losses range from 5 to 30% in the United Kingdom, with industry targets commonly being less than 15% per cent.

While interesting, these results should not be compared to NZ data due to the variables in farm conditions and systems between countries. However, several adaptations of indoor lambing are currently implemented on NZ farms. One system is detailed in Case Study A: ‘The Pyramid’. The Dawkins family have nearly halved

their triplet lamb death rates from 33% to 17- 20% and reduced triplet ewe deaths from a long-term average of 10% down to 2 - 5 %.

Further perspectives from industry professionals are included below, indicating there is a need to further explore indoor lambing in a NZ context.

*"Regarding indoor lambing, it is important to note this is not about whole systems transfer, but accessing what works in a NZ context" – Dr Scott Champion, Founding Partner, Primary Purpose*

*"In Scotland, the enlightened ones use a hybrid system. This means a very good use of pastures, and also have addressed welfare issues." – Trevor Cook, Vet and Farm Consultant*

*"For triplets, lambing indoors should be considered. I have not seen successful management outdoors. With large flocks, NZ farms have covered yards and there is an opportunity to utilise that asset. Existing gates or portable yards can be used to set up pens. It's a mindset issue, not infrastructure related. "I hate triplets" is the wrong mindset. Education is required to help people get their heads around the opportunity. What's my bank balance going to look like if I increase survival? Farmers are not fully aware of the cost of feeding an animal for two years, then the opportunity cost of losing all the future production. – Jeff Sewell, Sheep pregnancy tester.*

## 9.6 Driving Behaviour Change

*"Policy is generally only required when there is an issue to address. If we address potential issues internally, then legislation is not required" – Chris Dawkins, Case Study A, The Pyramid*

Despite the numerous benefits of reduced mortality, achieving consistent industry-wide improvement appears challenging. The barriers to improving survival in lambing systems identified by interviews and surveys were:

1. A lack of knowledge regarding accurate death rates and the opportunity costs
2. The perceived significant capital investment required for intensive systems
3. Lack of access to labour with specialist skills
4. A tendency to stick to traditional methods and acceptance of the status quo
5. Challenging terrain and climate
6. Lack of investment in seeking innovative solutions by the industry

Three methods of driving behaviour change to overcome these barriers, where possible, are explored below.

### 9.6.1 Legislation

While legislation can change behaviour, it can be met with significant resistance. 100% of experts interviewed explained that incentives and education are far more effective at driving behaviour change in farmers than policy. Additionally, legislation needs to be measurable and enforceable. With current sheep and beef codes of

welfare recommending the humane slaughter of lambs which the dam can't feed, it would be surprising if a policy was implemented to reduce paddock wastage.

*"There could be legislative pressure, but social pressure will be greater. Also, financial pressure from what you are missing out on. Farmers need to understand the opportunity. I would never rule out legislative changes, but no signals are in place. It would be very poorly received." – Toby Williams, Meat and Wool Chairman, Federated Farmers*

### 9.6.2 Incentives

Current premiums for NZ produce are driven through already robust animal welfare standards and measured through numerous auditing processes. Currently, there is little concern in the market regarding levels of wastage through the lambing season, thus specific market incentives are unavailable.

NZFAP and NZFAP Plus are New Zealand's National Farm Assurance Programmes. These are in place to provide confidence to consumers that the meat and wool produced from New Zealand's sheep, beef and deer farms are authentic, genuine, and safe. They provide assurances regarding integrity, traceability, animal health and welfare, people, farm and natural resources and biosecurity. The majority of red meat processors and wool exporters are participating members.

The NZFAP incorporates three fundamental components of origin and traceability, food safety and animal welfare. The animal health and welfare section states:

1. All livestock shall be cared for under the five freedoms.

- Freedom from thirst, hunger and malnutrition
- Freedom from discomfort
- Freedom from pain, injury or disease
- Freedom from distress
- Freedom to express normal behaviour

2. All animal handlers will have the knowledge, training or supervision to ensure the animal's health and welfare.

3. All farm infrastructures will be constructed, maintained and operated in a manner that minimises distress or injury to animals or humans.

4. A documented preventative animal health plan must be prepared and reviewed annually for all livestock on the farm.

5. All livestock shall have sufficient food, water, nutrients and shelter to maintain good health and welfare (Further information can be found on the NZFAP website: https://www.nzfap.com)

*"Currently market premiums are covered by the NZFAP accreditation programme and also on specific lines of grass-fed, antibiotic-free animals. There are also premiums for presentation such as being shorn or bellied. The NZFAP accreditation is*

*wide-ranging and looks at animal welfare broadly. It doesn't require specific information on wastage" – Sam Houston, Livestock Rep, Silver Fern Farms.*

Regarding market requirements and premiums on offer, *Greg McSkimming, National Agribusiness and Strategic Solutions Manager from Silver Fern Farms explained: "Processors don't want to tell our farmers what they need to do or micro-manage inside the farm gate. Farmers are continually reassessing their businesses and the best decisions to drive better financial and production improvements.*

*Our customers and consumers give us detailed insight into what red meat means to them, what they are prepared to pay more for and emerging trends in red meat consumption that we then reverse engineer, so we can align with current New Zealand farming practices and if any changes are required work with our farmers to unlock this value and new opportunities"*

### 9.6.3 Education and Extension

*"It's so important to educate farmers about how to think of the overall picture for their farm, not what others do or what previous generations have done. Today's genetics can make the previous generations thinking outdated." –Mark Zino, Canterbury Farmer*

Most experts interviewed indicated that farmers lack awareness and knowledge of wastage. This was confirmed in all of the farmer surveys when the cost of wastage was calculated inaccurately.

18/20 respondents agreed that farmers prefer learning from peers. The vast majority agreed that current industry extension work needs improvement and there were numerous suggestions that rural professionals could play an important role in driving discussions. 8/10 farmers said they often discussed lamb wastage. Furthermore, 7/10 said more discussion was required as an industry.

Significant material outlines the opportunities in improving lamb survival (Beef and Lamb New Zealand, Knowledge Hub). However, the number of farmers accessing and then implementing this information is questionable, with zero farmers indicating they use the Beef and Lamb NZ knowledge hub to seek new information. Although all farmers explained that they attend Beef and Lamb field days and workshops and read rural publications.

*"The biggest field days are always pre-lamb and getting basics right. People started scanning for triplets but didn't know what to do with them. Many people want an education. If everyone takes one step forward, we make big progress as an industry." – Lynley Wyeth, Case Study B, Spring Valley Enterprises*

Having access to data from comparable farming operations is important. Industry figures provide an overview, but farmers knowing the performance of others in their area or similar land use classes is more important (Gascoigne et al. 2022).

In NZ the most reliable source of benchmarking information is the Beef+ Lamb Economic Service. This has an interactive tool on their website to benchmark your lambing percentage (lambs weaned) against others in the same farm class.

Interestingly, there is no measure of death rates as scanning percentages are not measured in the economic service farm survey (https://beeflambnz.com/data-tools/benchmarking-tool).

Beef + Lamb NZ also publish a lamb crop report based on data collected from their farm surveys. These data provide commentary about lambing percentages but do not provide information about scanning to weaning death rates (Beef + Lamb NZ, 2022). Broad statements and assumptions are made, highlighting the need for a more robust analysis.

*"Good information leads to good decisions. Unless you have accurate and reliable data, you won't make good decisions". – Dr Ken Geenty, Research and Development Consultant*

## 9.7 Research and Development

*"More effort is required. More research and development and reduced wastage as an industry. It is unacceptable and needs to be looked at closely. Better we are doing it than the consumers who don't accept it." – Matt Wyeth, Case Study B, Spring Valley Enterprises*

*"With an increased environmental focus, production has become a dirty word. We need a productive industry to be sustainable and to thrive as a country" – Chris Dawkins, Case Study A, The Pyramid*

The sheep industry's primary levy body, Beef + Lamb NZ are funded directly by farmers through levies. Beef + Lamb NZ's scope is wide, with $30.9m of levy revenue in 2021 – 2022 being spread across communications, advocacy, R&D, extension services and marketing (Beef and Lamb Annual Report, 2022). $4.39m was spent on advocacy compared with $5.76m on 'Research and Development' and 'Beef & Lamb NZ Genetics' combined. Notably, 70% of farmers surveyed indicated they would favour increased investment in productive research at the expense of advocacy spending by Beef + Lamb NZ.

*"The issue is that the industry's investment is in Beef + Lamb NZ, our primary investor. This is a small pot of money compared to what is required for research, and they have many pressing issues that they are trying to cover. Research is reasonably expensive unless it is subsidised by someone else. This does make it challenging from a levy body's perspective and highlights the value of government support. Regarding sheep performance, we are at the pointy end of the investment curve now, so any answers are harder and cost more money to investigate." – Dr David Stevens, Senior Scientist, AgResearch*

An example of this expensive research required, which could lead to significant productivity gains on farms was explained by Dr Ken Geenty: *"The full extent of early embryonic loss is not known. It is more common in multiples and it occurs before scanning so it can only be measured from ovulation rates – a very expensive exercise!"*

In the 2022 budget, the NZ Government announced a significant investment in the primary sector of over $1b (Farmers Weekly, May 2022). However, $710m was to

tackle agricultural emissions, $118.4m was given for farm advisory services, $40m to help transformation in the forestry industry and $31.6m to help maintain and lift animal welfare practices. **"***This includes increasing compliance and enforcement, for example, through more on-farm inspectors and providing more help on the ground when responding to adverse events,"* Associate Agriculture Minister Meka Whaitiri said.

This outlines how investment in the primary sector fails to empower production research. This allocation of resources is described by industry experts below.

*"There has been limited funding for production-based research in recent years. The model changed with the formation of Crown Research Institutes in the 1980s. Two things happened at that point. Govt essentially said industries need to invest in themselves, and they stopped hiring production-based scientists. The emphasis has changed to align with political requirements, not industry requirements. Political issues are the impact of agriculture on the environment and climate change. Not only do we have the challenge of being unsubsidised, we need to fund our own performance research too" – Dr Derrick Moot, Professor of Plant Science, Lincoln University*

*"The quote above is largely correct and regrettable. Unfortunately, with the Commodity Levies Act, and the need to get a mandate every 5 years, industry organisations have looked more short-term at research priorities. In recent years, with the growth in policy and political pressure, the effort has moved more to advocacy, with a reduction in improved productivity research as a result." – Dr David Stevens, Senior Scientist, AgResearch*

One example of collaboration and investment leading to productive outcomes is the Sheep Coop Research Centre (CRC) in Australia. After ten years of employment in Australia, Dr Ken Geenty explained how the sheep CRC there is a *"shining example of research effectively delivering game-changing technologies for farmers."* And that three CRC terms have transformed the Australian sheep industry to greater productivity and profit under the mantra "concept to impact" (Country Wide, 2020).

The Sheep CRC is funded by cooperation between four state departments of primary industries, producer organisations, universities, commercial companies and farming groups. Over 25 partners worked together, with financial and in-kind contributions matched dollar for dollar by the Australian federal government's multi-million-dollar investment.

One clear example of this type of work that would have a direct benefit to NZ farmers was detailed by Kenyon (2022) *"Before clear guidelines can be developed for the management of triplets bearing/rearing ewes and their lambs additional research is required. Future studies need to examine the impacts on both the ewe and her lambs of varying feeding regimens in both pregnancy and lactation, across the body condition score range. In addition, knowledge of the impacts of shelter and other paddock factors, stocking rate, mob size, and human intervention is required. Future studies must be large enough in size to allow for the evaluation of lamb survival and should present the impacts of the various interventions on litter birth weight variation."*

Dr Geenty summarised his experience at the Sheep CRC:

*"It was a rewarding experience with co-operative research, which is generally more effective and beneficial to farming than the contestable model. Participating partners added strength by working together towards common outcomes without potential competitive barriers around contestable funding and exclusive intellectual property. It is suggested that applying some elements of the CRC model in our New Zealand research environment would pay dividends."*

## 9.8 Rogers Diffusion of Innovation Theory

Diffusion of Innovation Theory is one of the oldest social science theories (Boston University, 2022). The model explains how, over time, an idea or product gains momentum and diffuses through a specific population or social system, as shown below in *Figure 6.0*.

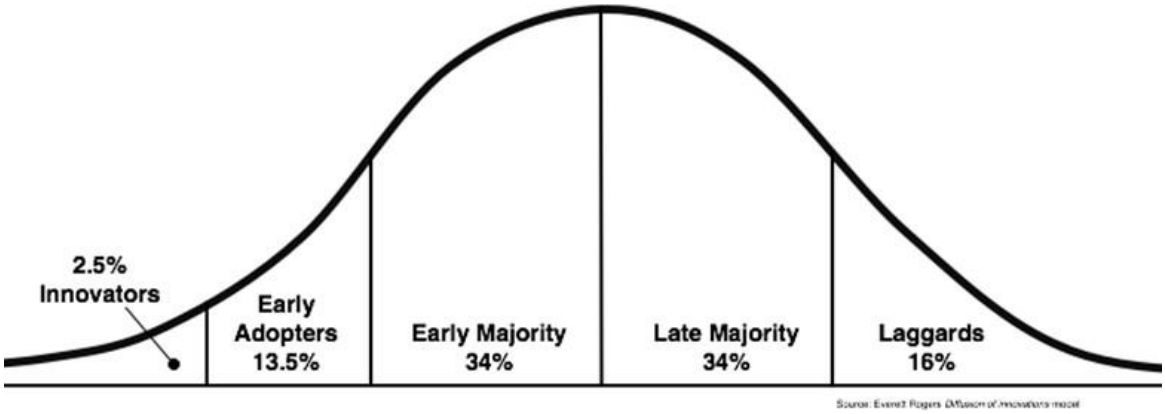


*Figure 6.0: Roger's Theory of Diffusion of Innovation Model (Source: http://blog.leanmonitor.com/early-adopters-allies-launching-product.)*

There are five established adopter categories and these can be applied to farmers when considering the adoption of new practices to improve survival in their lambing systems.

9.8.1 Innovators – want to be the first to try the innovation. They are venturesome and interested in new ideas. These people are very willing to take risks and are often the first to develop new ideas. Very little, if anything, needs to be done to appeal to this population.

Innovators in the sheep industry are those who have developed lambing systems where lower-than-average death rates are occurring. These innovations could be intensive lambing systems adapted to NZ conditions or more traditional methods executed well. Innovators could be further incentivised by funding through existing levies or from a new joint research venture between industry bodies and MPI. Courage is required from industry leaders to recognise the wastage issue and empower these innovators to appeal to early adopters.

9.8.2 Early Adopters – represent opinion leaders. They enjoy leadership roles and embrace change opportunities. They are already aware of the need to change

and so are very comfortable adopting new ideas. Strategies to appeal to this population include how-to manuals and information sheets on implementation. They do not need information to convince them to change.

Early adopters are farmers who understand why they must improve survival, have seen the success of the innovators and have attempted to implement these ideas on their farms. Given the variability and complexity of NZ farm systems, these early adopters may need to be innovative in modifying an existing practice into their own farm system. An example of this could be farmers lacking infrastructure, so they identify the highest-risk triplets and lamb them in existing infrastructure such as a hayshed. Other early adopters could see the benefits of pulling back their scanning percentages and intensively managing the smaller number of triplets remaining. Motivating early adopters could be achieved through extension work by Beef + Lamb NZ and this would be a key step in changing the culture surrounding poor performers.

9.8.3 Early Majority – These people are rarely leaders, but they do adopt new ideas before the average person. That said, they typically need to see evidence that the innovation works before they are willing to adopt it. Strategies to appeal to this population include success stories and evidence of the innovation's effectiveness.

Encouraging the early majority to take action would most likely be implemented through further education and extension work. The early majority would be motivated through in-person events such as field days, discussion groups or conversations with industry professionals.

9.8.4 Late Majority – These people are sceptical of change and will only adopt an innovation after it has been tried by the majority. Strategies to appeal to this population include information on how many other people have tried the innovation and have adopted it successfully.

Similar to the early majority, education will be a key driver, although there will be more adoption through peer-to-peer learning. The late majority risk having market forces or stricter welfare regulations coming into play before they have adopted an improved system. Peer pressure and a culture of high wastage rates being unacceptable could also motivate the late majority.

9.8.5 Laggards – These people are bound by tradition and very conservative. They are very sceptical of change and are the hardest group to bring on board. Strategies to appeal to this population include statistics, fear appeals, and pressure from people in the other adopter groups.

Laggards are unlikely to change existing practices, and often these farmers retire or market forces drive them out of the industry. Without the poor practices implemented by laggards, policy would often not be required. While existing animal welfare standards reduce instances of the poorest behaviour, existing standards do not address the significant levels of lamb mortality on some farms. Laggards' behaviour change will most likely be forced through regulation.

# 10.0 Findings and Discussion

Mortality rates in New Zealand lambing systems differ significantly and the highest-risk animals are triplet-bearing ewes, mated hoggets and their offspring. Systems are generally in place to reduce the number of high-risk animals through genetics and lower scanning percentages. However, the required management of the remaining high-risk animals isn't always implemented. Additionally, some flocks are very fecund, resulting in high proportions of triplets and subsequent wastage when not managed appropriately, even in favourable weather conditions.

Another major concern is the mass losses associated with harsh weather events, even in less fecund or easy-care flocks. The free range and pasture-based image of NZ farming comes with market benefits however these significant lamb losses are also an animal welfare and potential marketplace issue if customer sentiments change.

100% of contributors stated that lamb mortality could be a barrier to marketplace access in the future, yet focus on this issue from the industry is limited. There is an incredible wealth of knowledge of sheep science in the agricultural sector, which appears to be an untapped resource. It was disappointing to learn how this knowledge was being underutilised through a lack of funding which focuses on sheep performance.

While there are a range of management strategies through the lambing period which can improve survival, it is paramount to understand that pre-parturition management must be well executed. All information reviewed concludes that mortality on most New Zealand sheep farms can be reduced through improved management throughout the year prior to lambing. Beef + Lamb NZ's 'Making Every Mating Count', 2013 claims that 70% of lamb losses can potentially be prevented by improved nutrition and preventative measures. This information is widespread and is known as best practice, so attempting to get wider uptake of such practices is not a new strategy.

The key priorities, or 'lowest-hanging fruit' identified for setting up a successful lambing, were matching genetics and fecundity to farm type and management systems, and nutrition and body condition scoring. Intensive management through the lambing period for high-priority animals is then required. Of note was Spring Valley's use of drones for the monitoring of stock in remote locations. This reduced labour, improved health and safety and minimised stock disturbance. As displayed in *Table 2.0*, preventing the death of an in-lamb triplet two-tooth represents significant savings and the use of a drone allows for this in extensive situations. This demonstrates the innovations and new technology required to progress continually.

Interestingly, despite feeding and nutrition being unanimously accepted as the most important strategy to improve survival, only 1/10 farmers were using ram harnesses at mating, preferring foetal ageing at scanning instead. If harness raddles are changed often and reliable records are kept, ram harnesses provide a more accurate lambing date so that targeted feeding can be more efficiently allocated to high-demand animals prior to lambing, as explained in *Table 8.0*. With half of the farmers surveyed indicating they would like to see more extension work focusing on feeding

and body condition scoring, the cost-benefits of using ram harnesses could be further explored.

Worth considering is that even with intensive management plans in place, farmers and shepherds must have the knowledge, skills and motivation to manage the animals accordingly. Triplets and hoggets require significant inputs to achieve the desired survival outcomes. Interviews and surveys cast doubt on the level of knowledge and skills of farmers when conducting a lambing beat. Having a plan and having the ability to execute it are two different skill sets.

Market incentives do not currently exist for improved survival. Therefore, the most rewarding incentive to the farmer is the increased productivity and profitability of the farm business through the overall weight of lambs weaned. Additional benefits outlined were improved carbon efficiency, reduced environmental footprint, genetic gains and farmer morale.

While it is clear that most NZ farms are far too large to manage the whole flock intensively, there are many practices to enhance survival in extensive situations. At-risk animals generally comprise a small portion of the flock and can be managed intensively. This was demonstrated in each case study where hoggets were shepherded through lambing to combat issues related to bearings and dystocia.

For farmers with high scanning percentages, innovators and early adopters run successful intensive systems that require further investigation and possibly wider adoption. Case Study A, 'The Pyramid', identified the high-risk animals as singles and triplets and were lambing these indoors, with successful outcomes. Most contributors agreed that an indoor lambing system could be adapted to suit NZ conditions. However, the main perception was that the economics don't stack up, too much capital investment is required and NZ's sheer scale means it is impractical. These perceptions have been proved wrong at The Pyramid. However, a more robust and independent analysis is required.

Worth noting is that if targeting the high-risk animals only, and generally triplets make up around 5 – 10% of a flock, the scale is significantly reduced. Interestingly, a common drawback of indoor lambing was noted to be the capital outlay required. However, most farms have the available infrastructure with covered yards and various sheds which could be modified. With an increased understanding of indoor lambing in a NZ context, farmers may have little need to invest in new infrastructure.

While financial implications are important, greater priority should be given to potential market and welfare requirements. If a policy were enforced, economics would no longer be an argument at a farm level. This has been demonstrated by Fonterra and their requirement for bobby calves to enter the supply chain.

Using the Delphi Method, Recommendations for Industry were distributed to the experts interviewed. 100% of respondents agreed with the final recommendations, with one additional recommendation added as a 'call to action' to ensure the report is circulated appropriately. This unanimous agreement with the recommendations displays that they are achievable, realistic and credible.

*I think your report is very good and your conclusions and recommendations sound. I think your final report is going to be excellent and will have an industry impact. – Dr Ken Geenty, Research and Development Consultant*

*I think the report reads really well, and your conclusions are sound and robust. It would be disappointing if this was an 'interesting' document for the sector and then gets left on the shelf – Mike Petersen, Farmer and Company Director*

# 11.0 Conclusions

The New Zealand brand of pasture-based, natural and free-range farming currently trumps the welfare issues of lambing mortality. Lambing deaths from storms and subsequent hypothermia, mismothering and starvation appears to be acceptable to customers and consumers. However, this begs the question of how accurate their understanding of wastage is.

Through courageous leadership, a culture shift is required in the farming community, where animal welfare through lambing is considered paramount and extra care and attention for ewes and lambs is given priority. High levels of wastage and poor management should be frowned upon, and peer pressure used to improve animal welfare outcomes. Without this change in culture, it is likely that in time the unpopular motivator of legislation or market-driven changes will be enforced.

Given that most NZ farms are hill country and Romney-based genetics, most farmers prefer 'easy-care' management and their scanning percentages should be conservative to reflect that. Identifying and intensively managing the remaining small portion of the flock is more practical than targeting every single animal. However, in contrast, when instances of triplets are low it appears they are simply mixed in with twinning mobs and considered 'out of sight, out of mind'. Even more unacceptable is the practice of "short-scanning" where only dries, singles and twins are identified without marking ewes with three or more lambs. Not scanning for triplets and ignoring the issue does not absolve responsibility.

Farmers with minimal numbers of high-risk animals must still be aware of the mass death events associated with storms. Ensuring farm management throughout the year is well executed is paramount, and careful plans put in place for lambing, even in extensive situations.

In high-performing flocks, sheep are managed to allow their genetic merit to be expressed. Managing the fruits of this successfully requires an acceptance of the responsibility to operate at the highest level. If the required lambing management isn't implemented, farmers must consider when deaths transition from being 'natural and free-range' to unnatural, unacceptable and a practice customers and consumers will not support.

Additionally, an increased focus on monitoring and recording is required from farmers and from the industry at a broader scale. Documenting and quantifying the size of the problem will be the first step in solving it. Furthermore, analysis of this information must be used to support better management decisions.

The combination of high scanning percentages leading to a disproportionate number of triplets and an 'easy care' lambing system should not be considered acceptable. The same should apply to mated hoggets which require intensive management to improve welfare outcomes. If mating results in a high proportion of triplets, farmers should invest in the required farm systems and infrastructure to ensure that death rates are kept as low as possible. Genetic gains don't need to rely on high-maintenance animals dying, it can still be achieved by tagging animals into a 'B mob' if they require assistance or can be culled to be sold. If farmers are unwilling

to do that, genetics, feeding and the subsequent scanning percentages should be applied accordingly.

Farmers must be aware not to fall into the mindset that if they are addressing this issue or they have an easy-care flock then wastage is not their problem. Logic would say composite flocks with higher-risk animals would be the target of lobby groups or the general consumer; however, headlines highlighting thousands of lamb deaths after a storm pose a similar risk. It is important to note if one part of the sheep sector comes under fire, then it will most likely be every farmer's issue to address. As with any looming changes, it is best to get on the front foot and make improvements before being forced to comply with regulations or market requirements.

Guidelines exist in abundance for best practices on farms but widespread implementation or improvement of existing practices appears difficult to achieve. To improve welfare outcomes, the bigger picture must be considered. There is a lack of understanding of wastage among farmers and a lack of innovative solutions available for high-risk animals. This can be traced all the way back to underinvestment in production-related research and failures in our industry's education and extension systems.

The sheep industry must allocate extra funding to study and understand the actual wastage rates and the best systems to address it. Sheep farming has changed significantly since robust studies were undertaken, but the sector relies on old information. There is a distinct lack of reliable research into triplet and hogget management.

While conservative scanning percentages are an excellent method for reducing mortality in NZ lambing systems, the practice has a significant opportunity cost. Triplets are potentially the most productive, profitable and eco-efficient animals on the farm. Farmers intentionally avoiding them represents a missed opportunity and portrays a lagging industry in terms of understanding, management and transforming the challenge into an opportunity.

The sheep industry has a significant opportunity to address mortality in NZ lambing systems before changes are driven through policy or market requirements.

So "How can New Zealand farmers improve survival during the lambing season?"

1. Employ best practice management throughout the year to position themselves for a successful lambing
2. Identify the preferred management system through the lambing period and select genetics and breed fecundity accordingly
3. Follow best practice for set stocking in extensive situations and better understand their land resources such as slope, aspect, prevailing wind, natural hazards and shelter
4. Identify high-risk animals such as triplets and hoggets, separate and manage accordingly through lambing
5. Study different methods of intensive management and evaluate how they might fit into existing systems
6. Increase monitoring and recoding of KPIs, especially those relating to lamb survival and performance

7. Further develop knowledge and skills around animal husbandry and best practice
8. Develop a culture shift amongst farmers where animal welfare is considered paramount through the lambing season and high wastage rates are frowned upon and viewed as unacceptable by peers

Achieving the above strategies can't be done in isolation. Farmers require assistance through industry investment in:

1. Applied science and production research to discover new practices and innovations
2. Examining relevant and existing overseas research such as the Australian CRC
3. Education and extension services detailing existing and new best practices and innovations
4. Market research for risks and value-add opportunities

Levy bodies do not have the resources to fund this work alone, which can be time-consuming, complex and expensive. With mounting costs on producers, the industry must become increasingly productive to survive and continue being a significant contributor to the NZ economy. Collaboration is required to drive this research and to continue to progress as an industry.

The following recommendations will address the above issues and reduce mortality in NZ lambing systems.

# 12.0 Recommendations for Industry

1. Distribute this report to industry leaders such as the Federated Farmers Meat and Wool Council and the Beef + Lamb NZ Farmer Council. This will be viewed as a 'call to action' to highlight the project Conclusions and Recommendations for Industry and promote further discussion.

2. Conduct market research to thoroughly understand perceptions of wastage in New Zealand lambing systems and the risk this poses in accessing premium markets.

3. Monitor death rates by region and breed through the Beef + Lamb NZ Economic Service. Scanning and weaning data should be surveyed to calculate wastage and then used to create a benchmarking programme.

4. Collaborate across the industry and with MPI to fund new research and assist farmers with the adoption of key findings. The focus must be to ensure the prosperity of the sheep and beef sector through performance-based research. Areas of study must have a direct pathway to implementation leading to increased production and eco-efficiency. This could be implemented through existing entities or with the formation of a new, independent body. The Sheep CRC in Australia should be analysed and the appropriate framework be applied to a New Zealand model.

5. Invest in trials and research studies comparing ewe and lamb mortality rates across different farm systems. Trials must be across multiple farms focusing on lambing performance in extensive and intensive management systems. Independent analysis of 'The Pyramid' indoor lambing system should be undertaken to determine wastage rates, economics and the potential to be further adopted.

6. Study orphan lamb-rearing systems to determine the economics and best practice for widespread adoption. Research new markets or outlets for orphan lambs such as large-scale rearers or pet adoption.

7. Review Beef + Lamb NZ's spending priorities. Identify how resources can be reallocated toward increased research and development and extension services in the areas detailed below.

8. Development of new Beef + Lamb NZ extension modules. This could be achieved in multiple ways:

- Development of a specific programme with a structure similar to Wormwise. This must drive improved survival, with a particular focus on the importance of "the lowest hanging fruit" including matching genetics to farm management systems, the importance of feeding, forage management and body condition scoring
- Further programmes to inform farmers of the cost of livestock wastage, the importance of "long-scanning" and best practice livestock management to improve survival across different farm systems
- Improve knowledge transfer regarding lambing management through articles in rural publications and research new or alternate methods for farmers to access information

- Empower industry experts and incentivise further interaction with farmers to promote discussions around wastage
- Increase funding for in-person discussion groups and farmer field days which will assist with implementing existing and also new ideas

9. Educate future farmers with the stockmanship skills required to manage high-performing ewes effectively. Collaboration is required between industry leaders and polytechnics, cadet training farms and Primary ITO. Increased focus on lambing management could utilise several mediums such as instructional videos, visits to intensive farm systems, autopsy demonstrations, models to simulate assisted births and new unit standards focusing on lambing management with a practical component. Similar information can be provided through Beef + Lamb NZ and discussion group networks.

# 13.0 References


Beef + Lamb New Zealand. (2022). *Annual Report*

https://beeflambnz.com/sites/default/files/content-pages/BLNZ-AR-2022.pdf

Beef + Lamb New Zealand. (2023, April 10th) *Lambing percent benchmarking tool.*

https://beeflambnz.com/data-tools/benchmarking-tool

Beef + Lamb New Zealand. (2023, April 10th) *Knowledge Hub*.

https://beeflambnz.com/knowledge-hub

Beef + Lamb New Zealand. (2022). *Lamb Crop Report.*

https://beeflambnz.com/sites/ default/ files/data/files/Lamb-Crop-Report

Beef + Lamb New Zealand. (2010). *400 Plus: A Guide to improved lamb growth for Farmers and advisors.*

https://beeflambnz.com/knowledge-hub/PDF/400-plus- guide

Beef + Lamb New Zealand. (2020). *Rearing Orphan Lambs*

https://beeflambnz.com/news-views/rearing-orphan-lambs

Beef + Lamb New Zealand & Meat Industry Association. (2023). *New Zealand's red meat sector: our priorities for a prosperous New Zealand*

https://beeflambnz.com/sites/default/files/newsdocs/Summary%20manifesto%202023%20%28final%20master%29.pdf

Boston University (2022, Nov 3) Diffusion of Innovation Theory

https://sphweb.bumc.bu.edu/otlt/mphmodules/sb/behavioralchangetheories/behavioralchangetheories4.html

Braun, V. & Clarke, V. (2006). *Using thematic analysis in psychology, Qualitative Research in Psychology*, 3:2, 77-101, DOI: 10.1191/1478088706qp063oa

Carson, A. F., Dawson, L.E.R., Irwin D. & Kilpatrick D.J. (2004). *The effect of Management system at lambing and flock genetics on lamb output and la Labour requirements on lowland sheep farms.* Animal Science, Volume 78, Issue 3 439 - 450

https://doi.org/10.1017/S1357729800058847

Country Wide. (2020). *Co-operative research delivers for Aussie sheep farmers*

https://nzfarmlife.co.nz/co-operative-research-delivers-for-aussie sheep farmers

Dalton, D.C., Knight, T.W. & Johnson, D.L. (1980*). Lamb survival in sheep breeds on New Zealand hill country. New Zealand Journal of Agricultural Research*, 23(2), 167-173.

10.1080/00288233.1980.10430783

Dwyer, C.M., Conington, J., Corbiere, F., Holmøy, H., Muri., K, Nowak., R, Rooke., J, Vipond, J., Gautier & J.M. (2016*) Invited review: improving neonatal survival in small ruminants: science into practice.* Animal. 10:49–459.

Everett-Hincks, J.M., Dodds, K.G. (2008) *Management of maternal-offspring behaviour to improve lamb survival in easy care sheep systems.* Journal of Animal Science 86: E259-E270.

Farmers Weekly (May, 2022) *Adding up agriculture's budget haul*

https://www.farmersweekly.co.nz/news/adding-up-agricultures-budget-haul

Ferguson, D.M., Schreurs, N.M., Kenyon, P.R. & Jacob, R.H. (2014). Balancing consumer and societal requirements for sheep meat production: An Australasian perspective. *Meat Science. 98:477–483*

https://doi.org/10.1016/j.meatsci.2014.06.020

Fisher, M.W & Mellor, D.J. (2002) *The Welfare Implications of Shepherding During Lambing in Extensive New Zealand Farming Systems.* Animal Welfare 11 (2002), 157 – 170

10.1017/S0962728600028128

Fisher, M.W. (2003) *New Zealand Farmer Narratives of the Benefits of Reduced Human Intervention During Lambing in Extensive Farming Systems* Journal of Agricultural and Environmental Ethics Vol. 16, Iss. 1, (2003): 77

Flay, K.J., Ridler, A.L., Compton, C.W.R. & Kenyon, P.R. (2021) Ewe Wastage in New Zealand Commercial Flocks: Extent, Timing, Association with Hogget Reproductive Outcomes and BCS. *Animals 2021, 11, 779.* https://doi.org/10.3390/ani11030779

Gascoigne, E., Corbishley, A. & Davies P. (2023) *Targeting lamb survival in commercial flocks: inspiring and effecting change.* In Practice. https://doi.org.ezproxy.lincoln.ac.nz/10.1002/inpr.238

Geenty, K. G. (1998*). A guide to improved lambing percentage:* Wools of New Zealand and Meat New Zealand.

Hinch, G. N. & Brien, F. (2014) Lamb survival in Australian flocks: a review. *Animal Production Science* 54, 656-666

Hotton, M. (Oct 2010) *Storm cost months away,* Stuff https://www.stuff.co.nz/southland-times/news/4205400/Storm-cost-months-away

Kenyon, P.R., Roca Fraga F.J., Blumer, S & Thompson, A.N. (2019) Triplet lambs and their dams – a review of current knowledge and management systems, *New Zealand Journal of Agricultural Research*, 62:4, 399-437, DOI: 10.1080/00288233.2019.1616568

Knight T.W., McMillan W.H., Kilgour R. (1983). *Effects of slope on lamb survival. Agricultural Research Division Annual Report*, New Zealand Ministry of Agriculture and Fisheries 1982-83, pp. 143-144.

Langlands, J.P., Donald, G.E. & Paull, D.R. (1984). *Effects of different stocking intensities in early life on the productivity of Merino ewes grazed as adults at two stocking rates. Survival of ewes and their lambs, and the implications for flock productivity.* Australian Journal of Experimental Agriculture 24, 57-

65.https://doi.org/10.1071/EA9840057

McMillan W.H. & Knight, T.W (1985) *Effect of slope on lamb mortality*

Proceedings of the New Zealand Society of Animal Production 1985, Vol. 45:

163-165 163

Mead, T. (Jan 2023) Fonterra tells suppliers they can no longer kill bobby calves. One

News. https://www.1news.co.nz/2023/01/24/fonterra-tells-suppliers-they-can-no-longer-kill-

Meat Industry Association, 2020. Economic and social contribution of the New

Zealand red meat industry

https://www.mia.co.nz/assets/MIA-Publications/Economic-and-Social-Contribution-of-the-NZ-Red-Meat-Industry-Overview.pdf

Moot, D. J, Davison, R. (2021) *Changes in New Zealand red meat production over*

*the past 30 yr, Animal Frontiers*, Volume 11, Issue 4, July 2021, Pages 26–31

https://doi.org/10.1093/af/vfab027

Morris, S.T.,1, Kenyon, P.R., Burnham, D. L. & McCutcheon, S.N. (1999) *The influence of*

*pre- lamb shearing on lamb birthweight and survival* Proceedings of the New

Zealand Grassland Association 61:95–98.

National Animal Welfare Advisory Committee (2018) *Sheep and Beef Code of*

*Welfare 2018*

8.2 p23 https://www.mpi.govt.nz/dmsdocument/46051-Code-of-Welfare-Sheep-and-beef-cattle

National Animal Welfare Advisory Committee (2019) *Dairy Cattle Code of Welfare*

2019 6.9 p28 https://www.mpi.govt.nz/dmsdocument/46024-Code-of-Welfare-Dairy-cattle

New Zealand's National Farm Assurance Programmes

https://www.nzfap.com/NZFAP

Nicoll, G. B., Dodds, K. G. & Alderton, M. J. (1999). Field data analysis of lamb survival

and mortality rates occurring between pregnancy scanning and weaning.

*Proceedings of the New Zealand Society of Animal Production, 59, 98-100*

https://www.nzsap.org/proceedings/1999/field-data-analysis-lamb-survival-and-mortality-rates-occurring-between-pregnancy

Oldham, C.M., Thompson, A.N., Ferguson, M.B., Gordon, D.J., Kearney, G.A. & Paganoni, B.L*. The birthweight and survival of Merino lambs can be predicted from the profile of liveweight change of their mothers during pregnancy.* Animal Production Science. 2011;51(9):776-83

Pollard, J.C. (2006*) Shelter for lambing sheep in New Zealand: a review.* New Zealand Journal of Agricultural Research. 49:395–404. https://doi.org/10.1080/00288233.2006.9513730

Refshauge, G., Brien, F.D., Hinch, G.N. & Van de Ven, R. (2015) *Neonatal lamb mortality: factors associated with the death of Australian lambs.* Animal Production Science 56**,** 726-735. https://doi.org/10.1071/AN15121

Robertson S. M., King B. J., Broster J. C. &Friend M. A. (2012) *The survival of lambs in Shelter declines at high stocking intensities.* Animal Production Science 52, 497-501.https://doi.org/10.1071/AN11261

Thompson, B.R, Stevens, D.R., Bywater, A.C., Rendel. J.M., & Cox, N.R*. Impacts of Animal genetic gain on the profitability of three different grassland farming Systems producing red meat,* Agricultural Systems, Volume 141,2015 https://doi.org/10.1016/j.agsy.2015.09.006

Young, E.A., Yuan, J.V. & Everett-Hincks, J. (2010) *Yearling lambing performance and Primary cause of lamb death,* Proceedings of the New Zealand Society of Animal Production 2010.Vol 70: 96-100.

# 14.0 Appendix

## 14.1 Interview Template

Section One: Awareness of wastage

1. How seriously do lamb death rates rank in terms of industry challenges for the sheep and beef sector?

2. Are ewe and lamb wastage, particularly in triplets and quads, currently an issue or a potential issue for marketplace access for NZ meat companies?

3. What level and frequency of discussion have you had about the ethical issues of high wastage in multiple-bearing ewes and lambs with others in the agricultural community? (Farmers and professionals)

Section Two: Livestock management on farm

1. Which livestock management practices are currently implemented on NZ farms during
lambing to improve survival?

2. Why are these chosen practices implemented?

3. Which strategies are the most effective at reducing death rates?

4. What are the limitations for farmers to implement improved lambing systems to achieve higher survival?

5. How familiar are you with indoor lambing systems overseas? What do you see as the pros and cons of such systems?

6. Could these systems be modified into an NZ environment? Please explain why or why not?

7. What areas of livestock management throughout the year are generally lacking or undervalued and could be improved to improve survival during lambing? E.g., higher pasture covers, more body condition scoring, udder culling, etc.

Section 3: Methods for driving behaviour change

1. To improve survival, how would behaviour change or implementing new livestock management on farms be driven effectively?

    a) What do you think about processors offering a premium to farmers who could achieve below-industry-average death rates?

    b) Alternatively, would legislation be effective in improving survival? How

could this be worded in policy to drive improved livestock management?

2. With the direction of policy moving towards better outcomes for animal welfare across the primary industry, how do you picture legislation around ewe and lamb death rates changing in the coming years?

Section 4: Extension and record keeping

1. In your experience, how accurate do you think farmers are with their record-keeping and understanding of the causes of livestock deaths on farms?

2. Which KPIs relating to survival through lambing should farmers have accurate records and a thorough understanding of?

3. How could the current education and extension work about animal welfare and livestock performance by training providers and industry bodies be improved?

4. Which areas of the sheep industry would you like to see increased investment from levy bodies and the government?

Section 5: Summary

Do you have any additional comments, perspectives, or industry contacts that would add value to this report?

## 14.2 Farmer Survey

Farm overview:

1. Which region are you farming in?
2. B&L Class of farm ?
3. Number of S.U?
4. Maternal breed of sheep?
5. Farm effective area?

Farm record keeping

1. How do you record livestock performance on your farm? E.g., Farm IQ, diary, spreadsheets
2. Which sheep flock performance KPIs do you record and monitor throughout the year?
3. How important do you consider accurate record keeping and the subsequent monitoring of those results from season to season?

Livestock Wastage

1. What level of lamb death rate do you view as "acceptable" on your farm?
2. What is your annual ewe death rate?
3. Which ewes have the highest rate of mortality through lambing on your farm?
    - Dry ewes
    - Single bearing
    - Twin bearing
    - Triplet Bearing
    - Don't know
4. When do the most deaths occur?
    - After weaning and prior to mating
    - Through pregnancy
    - Through the lambing period
    - Through lactation
5. What is your average lambing percentage? (number of lambs weaned per ewe mated)
6. What is your annual lamb death rate? (Scanning to weaning)
7. Which lambs have the highest death rates?
    - Singles

- Twins
- Triplets

8. Are you concerned about your lamb death rates?

9. If you are concerned, what are the barriers to implementing a more effective system which results in higher survival?
10. What are some benefits of improving survival in triplets?

Farm management:

1. In the period leading up to lambing, which management practices do you think are the most important to ensure high ewe and lamb survival?

2. Which livestock practices do you implement through lambing season to improve survival?

3. Why are these chosen practices implemented?

4. Have you changed these management practices through the years? What has been the change which has provided the biggest improvement in survival?

5. What is your average scanning percentage?

6. Do you identify triplets and quads at scanning?

7. How do you think triplet and quadruplet ewes and their lambs should be managed through lambing compared to singles and twins?

8. Do you mate Hoggets? Why or why not?
9. If you do mate Hoggets, how do the death rates compare to MA ewes and their offspring through lambing?

10. How should hoggets be managed through lambing to enhance survival?

11. Do you use ram harnesses? What are the benefits of using harnesses?

12. Do you foetal age at scanning?

13. If the economics of a more intensive management system were demonstrated to you would you be willing to invest the required capital and/or labour into your farm?

Methods for change

1. In seeking improved animal welfare outcomes, how can implementing new livestock management on farms be driven effectively?

- Legislation
- Market incentives through meat processors

- Farm-level improvements through education and extension

Provide comment if you choose:

2. What level and frequency of discussion have you had about the ethical issues of high wastage in multiple-bearing ewes and lambs with others in the agricultural community? (Farmers and professionals)

3. Would you like to see more discussion around this issue by consultants and industry groups, even if it was at the expense of other topics?

4. Are you interested in learning about the practicalities and economics of incorporating indoor lambing into a NZ system?

5. Do you think high levels of wastage could impact our social licence and marketplace access in the future?

6. Would you support an increase in investment from Beef & Lamb NZ into extension work highlighting the importance of nutrition, body condition scoring, genetics and management strategies prior to lambing?

7. If Yes, would you support this work if it came at the expense of policy work?

8. Alternatively, would you be willing to increase your levy to see more investment into research and development or performance-based studies?

9. What is your most trusted source of agricultural information?

- Rural publications e.g. Farmers Weekly, RuralNews, Country Wide etc
- Radio shows e.g. The Country, REX etc
- Other farmers (neighbours, discussions groups, Beef and Lamb field days etc)
- Other?

<u>Animal Husbandry:</u>

1. Have you been taught how to conduct a lambing beat? If so, describe the process when entering a paddock for observation.

2. Have you ever seen a post-mortem decision diagram or been taught the post-mortem process?
3. Do you know how to properly assist a ewe who is having difficulty lambing? If so, describe the steps you would take to lamb the ewe effectively.

4. How much money does the death of a two-tooth in lamb with triplets cost you? Or what is the opportunity cost? Please explain your methodology.

<u>Final Comments:</u>

Do you have anything you would like to add which would be useful for my research project?

## 14.3 Case Study Template

Farm overview

1. Which region are you farming in?
2. B&L Class of farm?
3. Number of S.U?
4. Farm effective area?

Farm record keeping

1. How do you record livestock performance on your farm? E.g Farm IQ, diary, notebook.
2. Which KPI's in relation to your sheep flock and performance do you record and monitor throughout the year?
3. How important do you consider accurate record keeping and monitoring these results from season to season?

Livestock Wastage

1. Which animals are the highest risk for reproductive wastage on your farm?
2. What are the causes of death?
3. What is the death rate of each class of stock?
4. What is your average scanning percentage?
5. Do you identify triplets and quads at scanning?
6. What is your lambing percentage? (number of lambs weaned per ewe mated)
7. What is your annual lamb death rate? (Scanning to weaning)
8. What was your average ewe wastage per year? (Deaths only)
9. Which proportion of these occur through lambing?

Farm management

1. Through the year, which management practices do you think are the most important to ensure high ewe and lamb survival?
2. What has been your most effective management system during the lambing period for reducing death rates?
3. Do you still implement this? Why or why not?

4. What is limiting you from implementing improved lambing systems to achieve higher survival?

5. How do you think triplet and quadruplet ewes/lambs should be managed compared to singles and twins?

6. What percent of reproductive wastage can be attributed to embryonic losses (abortion) on your farm?

7. Do you mate Hoggets? Why or why not?

8. If you do mate Hgts, how do losses compare to MA ewes and their offspring?

9. How should hoggets be managed through lambing to enhance survival?

10. Do you see triplets as a liability or opportunity? Please explain

11. Do you see mated hoggets as a liability or opportunity? Please explain

12. How familiar are you with indoor lambing systems? What do you see as the pros and cons of such systems?

13. Could these systems be modified into an NZ environment? Please explain why or why not?

Education and Investment

1. How could the current education and extension work about animal welfare and livestock performance by training providers and industry bodies be improved?

2. Which areas of the sheep industry would you like to see increased investment from levy bodies and the government?

Final Comments

Do you have any final comments or insights about reproductive wastage in NZ farm systems?

## 14.4 The Pyramid Indoor Lambing Collage