



Maternal Efficiency: The Key to Profitable Ruminant Animal Production

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New South Wales

December 2025
Nuffield Australia project number 2407

Supported by



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Executive Summary

This report explores the critical role maternal efficiency plays in driving profitability across beef and lamb production systems. Central to this are maternal traits such as fertility, conception rates, early puberty, and longevity. These biological benchmarks, when combined with optimal body condition scores (BCS), mature maternal size, and feed efficiency, form the backbone of a productive and economically viable business. Genetic selection tools and maternal indexes, including Estimated Breeding Values (EBVs), provide producers with precise tools to accelerate genetic gain and improve maternal performance across generations.

Maternal efficiency, measured as kilograms of offspring weaned per kilogram of maternal body weight, is identified as a key profit driver. Dams that wean more weight relative to their own size offer a superior return on feed inputs. Early weaning strategies also play a significant role in influencing lifetime performance, reproductive cycling, and post-weaning growth, thus laying the foundation for long-term productivity.

The report further outlines the alignment between maternal efficiency and carcass quality under the Meat Standards Australia (MSA) grading system. Understanding MSA's key price drivers, including intramuscular fat (IMF), eye muscle area (EMA), carcass weight, and rib/rump fat is essential for selecting and managing cows that not only breed well but also produce premium-quality carcasses. Nutritional programming during gestation and reproductive efficiency strategies amplify these outcomes, ensuring cows reach conception targets while maintaining body condition and producing market-ready progeny.

The MSA Index serves as a vital tool in benchmarking carcass performance, allowing producers to make informed breeding and management decisions that link maternal performance to market premiums. Insights into IMF and carcass quality from lamb production also reinforce the economic value of intramuscular fat as a consumer-driven trait that commands higher prices.

The Global Focus Program highlighted innovative systems that boost maternal efficiency. Regenerative grazing in Texas, precision grazing and TechnoGrazing in Wales, and rotational systems in Scotland all show how tailored pasture management and grazing design lead to improved condition, fertility, and productivity. Stocking rate optimisation, pasture diversity, and targeted supplementary feeding are also shown to improve maternal outcomes.

Environmental management, such as providing shelter and ensuring water access, further supports reproductive health and offspring viability. The integration of precision technologies like walk-over weighing systems, remote monitoring tools, and activity sensors is transforming herd management by delivering real-time insights, enabling earlier interventions, and reducing labour costs.

Keywords: beef, cattle, Australian Agriculture, ruminant, sheep, business,

Table of Contents

Maternal Efficiency: The Key to Profitable Ruminant Animal Production

.....	1
List of Tables	5
List of graphs	5
Foreword	6
Acknowledgments	8
Abbreviations	9
Objectives	10
Introduction	11
Maternal traits as profit drivers	13
Fertility and conception rate	13
Early puberty and longevity.....	13
Body condition score (BCS).....	14
Mature adult size and feed efficiency.....	15
Genetic tools and maternal indexes.....	15
Maternal traits summary.....	15
Weaning efficiency and early growth	16
Weaning Efficiency and Early Growth Summary	17
Linking maternal efficiency to carcass quality and MSA understanding MSA	17
Key price drivers in the MSA grading system	17
The relationship between maternal efficiency and MSA.....	18
Nutritional programming in gestation	20
Reproductive efficiency.....	20
Leveraging the MSA index for premium returns	20
Carcass quality and IMF in lamb production.....	21
Maternal efficiency and MSA grading summary	21
Global insights into maternal efficiency	22
GFP highlights.....	22
Scottish highlights	23
Wales highlights.....	24
TechnoGrazing.....	24
Global insights into maternal efficiency summary.....	25
Management practices and environmental strategies	26
Pasture composition and grazing systems	26
Optimising stocking rates to match feed availability	27
Supplementary feeding and targeted nutrition	27
Environmental shelter and water access	28
Use of precision technologies	29
Conclusions	30
Recommendations	31
References	32

Maternal Efficiency: The Key to Profitable Ruminant Animal Production

List of Tables

Table 1: Travel itinerary.....	7
Table 2: Effect of conception rate on weaning outcomes for sheep (Source: MLA, 2022a)	13
Table 3: Joining BCS and Marking Rates (Source: MLA, 2021).....	14
Table 4: Cow Weight vs. Feed Demand and Net Return (Source: Pitchford, 2020).....	15
Table 5: Economic impact of kg weaned/kg ewe (Source: Adapted from Pitchford, 2020, MLA 2022a).....	16
Table 6: Long-term return: early growth to lifetime output (Source: Thompson, 2021) ...	16
Table 7: Major Influencers of the MSA Index (Source: Packer – Understanding the MSA Index).....	17
Table 8: Relevant EBVs Linking Maternal Traits to MSA Outcomes (Source: MLA, 2018)	19
Table 9: Economic Impact of nutritional programming in gestation (Source: MLA, 2018)	20
Table 10: Leveraging the MSA Index (Source: MLA,2018)	20

List of graphs

Graph 1: Reproductive Longevity vs Age at First Conception of Cattle (Pitchford 2020)	14
Graph 2: Genetic Merit and Production Output	15
Graph 3: Effect of strategic supplementation on reproductive and maternal performance	28

Foreword

I grew up on a sheep, cattle, and goat station in far north-west New South Wales, where the resilience of both land and livestock shaped my early understanding of agriculture. That upbringing instilled in me a deep respect for the animals we raise and the systems that support them. From a young age, I observed firsthand the importance of functional, fertile females in keeping a grazing business not only productive but profitable under challenging and variable conditions.



Figure 1: Jack Courts, Author (Source: Author)

My professional journey has included two years working on a cattle station in the Northern Territory, where I was exposed to the demands of large-scale operations and the unique requirements of the live export market. This experience broadened my perspective on what profitability means in different production systems, and further reinforced the importance of fertility, growth, and adaptability in extensive ruminant enterprises.

From there, after completing a tertiary education at Marcus Oldham College, I transitioned into working with high-performance sheep genetics at Mumblebone Merino Stud. When the opportunity came up to carry forward my family's legacy, I stepped into the role. I now own and operate Glenalbyn Santa Gertrudis, with fertility, growth, carcass quality, and balanced profitability at the core of our breeding program.

The importance of maternal traits: fertility, moderate size, early puberty, condition score, and growth have been underscored repeatedly throughout my life and career. The maternal traits underpin the long-term productivity and efficiency of any grazing system. In an era where volatility in climate and global markets continues to increase, they offer a rare opportunity: a lever we can pull as producers to influence our bottom line.

We can't control rainfall or international commodity prices. But we can control the genetics and management of our breeding females. This report is the culmination of my exploration into how improving maternal efficiency can unlock significant economic gains, not just in theory, but in practice, in any operation, regardless of breed or grazing system.

My Nuffield journey took me across ten countries and exposed me to a wide variety of production systems, climates, and philosophies. I am incredibly grateful to the Nuffield Australia network and my many hosts for their generosity, insights, and openness.

Maternal Efficiency: The Key to Profitable Ruminant Animal Production

Table 1: Travel itinerary

Travel date	Location	Visits/contacts
4-7 March, 2024	Canberra, AUS (Pre CSC)	Various meeting
9-16 March, 2024	Brazil - Campo Grande, Bonito	Contemporary Scholars Conference
17-21 March, 2024	Brazil – Passo Fundo, Porto Alegre, Vacaria	Post-CSC tour (Southern Brazil)
22-29 March, 2024	Texas (GFP)	Various meeting and farm visits
1-6 April, 2024	Germany (GFP)	Various meeting and farm visits
7-9 April, 2024	Northern Ireland (GFP)	Various meeting and farm visits
9-14 April, 2024	Ireland (GFP)	Various meeting and farm visits
6-10 May, 2024	Rockhampton, AUS	Beef week 2024, various meeting, conferences and seminars
13-19 July, 2024	Western QLD – Blackall, Adavale, Qulipe, Eromanga, Thargominda, Hungerford, AUS	Farm visits Lexy Russel – Swann Hill Matt Sargood – Drensmaine Andrew Peterson – Alice Downs Ian Walker – Ravensbourne John Mooring – Nickavilla Scott Peggler – Mount Margaret David Keane – Waverly Downs Stuart Keane – Willara
7-27 October, 2024	Europe trip	Farm visits and conferences Sophie Geogry Nsch 2024 – UK Neil McGown Nsch 2015– UK Hugh Chamberlain - Scotland Vic Ballantyne Nsch 2022 – UK Amy Stoner Nsch 2024 – UK FAO – World food forum Rome GDP – Nourish conference Paris Gwion Perry Nsch 2024 – UK Harri Parri – Stabiliser breeder William Seth – cattle finisher Ianto Carrag – Techno Grazing Rhys Williams – Nsch 2010 UK

Acknowledgments

I would like to thank Nuffield Australia for the opportunity to undertake this scholarship, and all those who hosted, guided, and shared their knowledge during my travels. A particular thank you to my family, mentors, and colleagues who supported me through the process.

I would like to extend my deepest gratitude to Nuffield Australia for their invaluable support and guidance throughout this project. Special thanks to Jodie Redcliffe, CEO, for her leadership and vision, which have been instrumental in shaping my experience. I also appreciate the contributions of Jane Bennett, Chairperson, whose dedication has been pivotal in fostering a collaborative environment. To the Nuffield team, your dedication behind the scenes hasn't gone unnoticed.

I am particularly grateful to Meat & Livestock Australia (MLA) for their generous support and contribution. Their support has been crucial in making this scholarship possible, and I appreciate their commitment to advancing agricultural knowledge and practices.

To the 2024 cohort, I thank you for the camaraderie and shared experiences that enriched this journey. To those who travelled with me, hosted me, and to the scholars who stayed with me, your hospitality and insights have been invaluable. Your contributions have not only enhanced my understanding but have also created lasting memories.

This scholarship would not have been successful without the collective efforts of everyone involved, and I am honoured to have had the opportunity to work alongside such a dedicated and passionate group of individuals. Thank you again for your support.

Abbreviations

ASBV	Australian Sheep Breeding Value
BCS	Body Condition Score
CWT	Carcase Weight
DTC	Days to Calving
EBV	Estimated Breeding Value
EID	Electronic Identification
EMA	Eye Muscle Area
GFP	Global Focus Program
IMF	Intramuscular Fat
MLA	Meat and Livestock Australia
MSA	Meat Standards Australia
NFI	Net Feed Intake
NLW	Number of Lambs Weaned
NRC	National Research Council

Objectives

This report aims to:

- 1- Identify key maternal traits in ruminant livestock such as fertility, early puberty, body condition score, and moderate mature size that drive profitability in low-input systems.
- 2- Investigate how early growth and weaning efficiency (calf/lamb weight per kilogram of cow/ewe weight) influence economic outcomes in both sheep and cattle enterprises.
- 3- Explore the relationship between maternal efficiency and carcass quality, particularly within the context of Australia's MSA grading system and diverse market requirements.
- 4- Assess international breeding and management strategies for improving maternal efficiency and their relevance to Australian grazing systems.
- 5- Examine the role of management and environmental practices, such as pasture selection, early weaning, and mob management for twin-bearing ewes, in enhancing maternal performance and system efficiency.

Introduction

Maternal efficiency refers to the amount of kilograms of offspring weaned relative to the kilograms of the adult female producing them. It is a measure of how effectively a ewe or cow converts resources into a saleable product. In practical terms, a more efficient mother weans a greater proportion of her own body weight in calves or lambs, with fewer inputs such as feed, labour, and time. This efficiency is foundational to both productivity and profitability in livestock enterprises.

The Australian livestock industry is diverse and dynamic, shaped by fluctuating global markets, increasing climate pressures, and evolving consumer expectations. In this environment, both sheep and cattle producers face the dual challenge of lifting productivity while maintaining or improving profitability. Central to addressing this challenge is maternal efficiency, a concept that cuts across species and production systems. Whether managing a Merino ewe or a Santa Gertrudis cow, the ability of a female to conceive, rear, and wean offspring efficiently has a direct and compounding impact on overall enterprise success. Across Australia, ruminant livestock systems operate in a wide range of environments, from arid pastoral zones to high-rainfall grazing regions. Despite this diversity, the need to produce more from less remains a unifying goal. A focus on maternal efficiency, encompassing traits such as fertility, early puberty, body condition and moderate mature size, enables producers to optimise returns on feed, labour, and genetic investment. It also supports more predictable and resilient production outcomes in the face of increasing variability.

Australia's world-class Meat Standards Australia (MSA) grading system highlights the importance of aligning production practices with market expectations, especially regarding carcass quality and eating experience. While much of the attention in value chains centres on the end product, this report argues that profitability begins with the dam. The capacity of a ewe or cow to produce and raise healthy, fast-growing offspring sets the trajectory for efficiency across the entire production system, from kilograms weaned to carcass value.

This report explores maternal efficiency through five interrelated lenses. First, it investigates the key maternal traits, including fertility, early puberty, body condition score, and moderate mature size. These traits underpin both productivity and profitability in extensive and intensive systems alike. These traits are foundational to long-term genetic and financial gains.

Secondly, it examines how early growth and weaning efficiency contribute to overall system performance. This lens emphasises the importance of breeding females that convert feed into a saleable product more efficiently, helping producers get more output from the same land base.

Thirdly, this report looks at how maternal efficiency connects to carcass outcomes. Through the lens of MSA and other quality assurance systems, it explores how traits like muscling, fat cover, and frame size, influenced by dam genetics, can shape the profitability of offspring.

Fourthly, it draws on my global insights, examining international approaches to breeding and managing for maternal efficiency. Lessons from countries such as

Maternal Efficiency: The Key to Profitable Ruminant Animal Production

Germany, Ireland, Wales, Brazil, and the United States offer valuable perspectives on genetics, system design, and resource use.

Finally, the report highlights the importance of on-farm management and environmental strategies. From selecting appropriate pasture species to early weaning, and from splitting mobs at lambing to improve twin survival to optimising stocking rates, practical decisions play a crucial role in realising the genetic potential of breeding females.

This report is built on the belief that maternal efficiency is not just a biological concept but a strategic tool, one that can help producers navigate volatility, improve margins, and strengthen the sustainability of their operations across both sheep and cattle systems.

Maternal traits as profit drivers

Maternal traits including fertility, early puberty, body condition score (BCS), and moderate mature size are key levers in the economic performance of ruminant production systems. Their influence extends from conception through to kilograms weaned to kilogram of dam, making them essential targets in both sheep and cattle breeding programs.

Fertility and conception rate

Fertility and conception rate are the cornerstone to influencing the number of offspring produced and raised to weaning. Fertility is moderately heritable (0.10-0.25, MLA 2022). There are many tools that can be implemented to influence the improvement of fertility. Sheep genetics and breedplan offer genetics tools through the use of Estimated Breeding Values (EBVs) such as Number of Lambs Weaned (NLW) for sheep and Days to Calving (DTC), Scrotal Circumference, and gestation length for cattle. There are also maternal indexes that have been created to quantify the investment of sire selection. According to MLA (2022) maternal indexed sires in the top 20% of the industry can produce 15-20% more weaned weight per hectare. Nutritional management tools, reproductive technologies, environmental, and management interventions can also influence the outcome of conception rates. This includes practical decisions such as meeting the different nutritional requirements of single and twin-bearing ewes, using artificial insemination to fast-track genetic gain, and implementing shorter joining periods to minimise late conceptions and improve the consistency of weaning groups.

Table 2: Effect of conception rate on weaning outcomes for sheep (Source: MLA, 2022a)

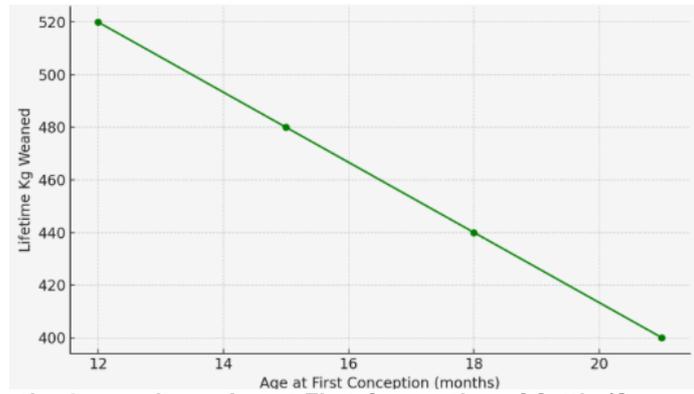
Conception Rate (%)	Lambs Weaned (%)	Kg Weaned/Dam	Net Return (\$/HD)
80%	70%	50 kg	\$150
90%	82%	58 kg	\$195
95%	87%	62 kg	\$215

In the above table it can be seen how improvements in conception rates directly lead to more lambs weaned and an increase in kilograms weaned per ewe. The economic outcome of this is substantial. An increase from 80% to 95% improves the maternal efficiency ratio by 24%, which realises a 43% increase in net return or \$65 per breeding ewe.

Early puberty and longevity

Early puberty refers to the ability of young females to begin cycling and conceive at a younger age. Typically, this occurs at 6-9 months in ewe lambs and 12-15 months in heifers. This not only reduces the generational interval but accelerated genetic gain. According to Pitchford (2020), early calving heifers produce up to 10% more kilograms of calf over their life.

Maternal Efficiency: The Key to Profitable Ruminant Animal Production



Graph 1: Reproductive Longevity vs Age at First Conception of Cattle (Source: Pitchford 2020)

This graph shows that animals conceiving at 12–15 months consistently wean over 500 kg more liveweight during their productive life compared to animals conceiving at 21 months or later. The difference is driven by an additional one to two lactations over the lifetime.

Producers can select for early puberty using EBVs and Australian Sheep Breeding Values (ASBVs). ASBVs that can be selected are Yearling Weight, Post Weaning Weight and Number of Lambs Weaned. Higher values in these ASBVs indicate lambs that mature faster through high growth rates and reproductive success. EBVs that can be selected are Days to Calving, Age at First Calving and gestation length. Selection of these EBVs improve reproductive efficiency and readiness, or the ability to conceive earlier.

There is a strong relationship between early puberty and longevity. Early breeders have higher lifetime conception rates because they are empty for fewer years, which increases the maternal efficiency ratio.

Body condition score (BCS)

BCS is a reliable indicator of maternal energy reserves and reproductive performance. Thompson et al. (2021) and Ferguson (2023) note that females with BCS 3 at joining and lambing have higher conception, lamb survival, and weaning weights.

Table 3: Joining BCS and Marking Rates (Source: MLA, 2021)

BCS at Joining	Conception Rate (%)	Lamb Survival (%)	Marking Rate (%)
2.5	85	70	110
3.0	93	85	135
3.5	90	78	125

The table above outlines BCS at joining. It highlights that 3.0 is optimal for ewe condition. This is shown in the conception rate, lamb survival and marking rate. It highlights that a ewe in 3.0 BCS is the most efficient, productive and will be the most profitable. Animals below or above this threshold experience lower lamb survival or reduced conception rates due to either undernourishment or metabolic stress.

Mature adult size and feed efficiency

Moderate mature size is increasingly recognised as a key driver of feed efficiency and profitability. Larger cows have higher maintenance requirements, reducing their net feed efficiency (Pitchford, 2020).

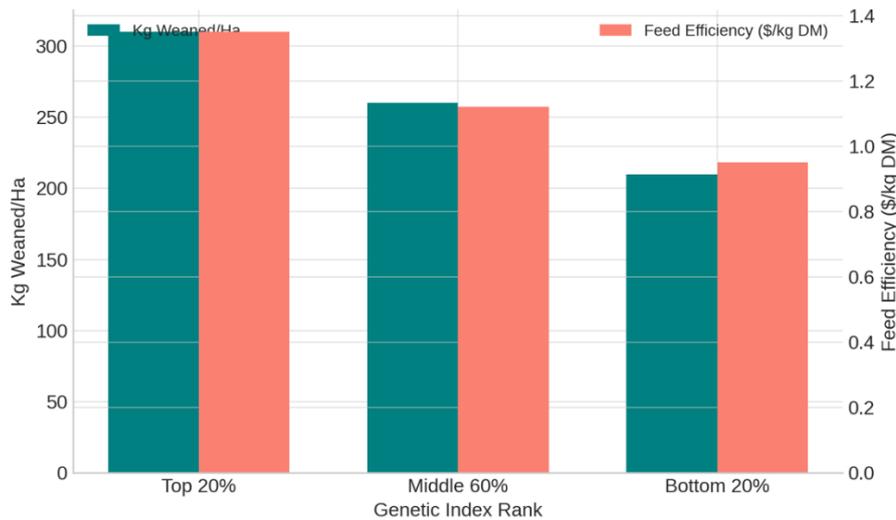
Table 4: Cow Weight vs. Feed Demand and Net Return (Source: Pitchford, 2020)

Cow Weight (kg)	Feed Demand (kg DM/yr)	Calf Weight (% of Cow)	Net Return (\$/ha)
450	5,500	47	270
550	6,800	45	260
650	8,100	40	220

Cows in the 450–550 kg range achieve the best economic balance, with the highest return per hectare due to better feed efficiency.

Genetic tools and maternal indexes

MLA and Sheep Genetics (MLA n.d.) have developed maternal indexes incorporating traits like Number of Lambs Weaned (NLW), gestation length, and weaning weight. According to Mark Ferguson (neXtgen Agri 2023), top-tier flocks using these indexes demonstrate improved productivity and profitability.



Graph 2: Genetic Merit and Production Output (Source: Ferguson, 2023)

This bar graph illustrates that improving maternal genetic merit translates directly into increased system output and profitability, even with constant feed resources.

Maternal traits summary

By quantifying and selecting for key maternal traits, producers can drive profitability through higher weaning rates, better feed efficiency, and improved genetic progress. These traits are interdependent; BCS supports fertility, moderate size enhances efficiency, and early puberty accelerates genetic gain. Genetic and on-farm management strategies that prioritise these traits are fundamental to maternal efficiency in ruminant livestock.

Weaning efficiency and early growth

Weaning efficiency is defined as the kilograms of offspring weaned per kilogram of maternal body weight. This reflects how efficiently a breeding female turns inputs like feed into a weaned saleable product. Either as a future breeder or for a range of markets.

High weaning efficiency means lower maintenance cost per kilogram of output. Smaller breeding females with higher output relative to body weight are more cost-efficient. According to MLA, research shows that increasing kilograms weaned per kilogram of female by 0.1 kg can boost gross margins per hectare by \$50-\$90 (MLA, 2022a).

Table 5: Economic impact of kg weaned/kg ewe (Source: Adapted from Pitchford, 2020, MLA 2022a)

Maternal Weight (kg)	Weaning Weight per Offspring (kg)	Offspring Weaned	Kg Weaned/Dam	Net Return (\$/HD)
50	40	1.1	44	\$180
60	42	1.05	44.1	\$160
70	43	0.95	40.9	\$135

The table above highlights the economic impact of smaller, more fertile females weaning heavier offspring relative to their size. The more weight weaned and more offspring weaned give a better return per hectare.

There are numerous management systems to improve weaning efficiency. This includes: early weaning, splitting mobs by litter size or weight, nutritional management around weaning, and selection of moderate mature size females.

Early weaning consists of weaning calves at 10-14 weeks and lambs at 10-12 weeks. The benefit of this is reducing maternal stress and energy drain. This also allows females to recover condition for the next joining. Early weaned dams return to cycling 2-3 weeks earlier, thus improving conception (Thompson, 2021). Splitting mobs by litter size allows us to draft twin-bearing ewes and cows into separate mobs to meet their extra nutritional requirements. It also promotes survival and growth rates, and in turn allows better condition management of dams. Nutritional management around weaning is key to maintaining optimal dam BCS. Post-weaning it is important to provide high-protein pasture or supplements to ensure young breeding stock can reach a target of 60-65% of mature reference weight at the desired joining date. It is also important to select moderate mature size females through purchasing or replacement selection.

Weaning and early growth impacts future joining. This matters because a well grown future breeder has a higher chance of conceiving early, this is contributing to early puberty, longer reproductive life, and higher lifetime kilograms weaned.

Table 6: Long-term return: early growth to lifetime output (Source: Thompson, 2021)

First Joining Age	Kg Weaned Lifetime	Lifetime Calves/Lambs	Gross Return (\$)
12–15 months	950	6.5	\$2,600
16–18 months	820	5.8	\$2,100
19–21 months	760	5.5	\$1,900

Weaning Efficiency and Early Growth summary

Weaning efficiency is a fundamental lever for profitability in livestock production, with the most direct measure being kilograms weaned per kilogram of dam body weight. This ratio reflects the maternal unit's productive output and is crucial for evaluating herd performance. Management practices significantly influence this outcome. Strategies such as early weaning, effective mob management, regular condition scoring, and targeted nutrition all contribute to improving weaning efficiency. Additionally, the growth trajectory of young animals after weaning plays a critical role in determining their age at puberty, lifetime productivity, and overall economic return. Incorporating genetic selection tools and data-driven management further enhances maternal efficiency, enabling producers to achieve compounding benefits across multiple generations.

Linking maternal efficiency to carcass quality and understanding MSA

Australia's competitive edge in global beef markets is underpinned by the Meat Standards Australia (MSA) grading system, a science-backed framework developed by Meat & Livestock Australia (MLA) to ensure consistent, high-quality eating experiences for consumers. With over 11 million cattle MSA-graded annually, the MSA Index serves not just as a quality gauge, but as a blueprint for profitability, guiding producers toward market-aligned specifications.

Yet, producing premium beef begins long before the processing floor. Maternal efficiency, through reproductive success, nutritional programming, and genetic alignment, plays a critical role in the eventual carcass quality and financial returns. This section of the report explores the interconnected pathways through which key MSA drivers, ideal carcass traits, hump height, and maternal performance influence bottom-line profitability in beef production.

Key price drivers in the MSA grading system

The MSA Index is a numerical representation (30 to 80 points) of predicted eating quality, aggregating measurements from various cuts and cooking methods. Grid payments are strongly tied to Index performance, and eligibility for branded programs like JBS Great Southern and Teys Grasslands depends on reaching minimum MSA thresholds.

Table 7: Major Influencers of the MSA Index (Source: Packer – Understanding the MSA Index)

Driver	Impact on MSA Index	Economic Relevance
Marbling	+2–6 points (300–500)	Improved flavour, tenderness; +\$0.30–\$1.00/kg
Ossification Score	+1–3 points (<150)	Reflects youth, better texture
HGP Status	–2 to –4 points	Premium markets require HGP-free cattle
Rib Fat	Mandatory ≥ 3 mm	Prevents cold shortening
pH @ 18–35°C	< 5.7	Critical for tenderness and shelf life
Hump Height	–2 to –8 points (>70 mm)	Correlates with tenderness (Bos indicus effect)

Sex of Animal	Bulls penalised	Steers/heifers grade higher
Dentition	0–2 teeth preferred	Indicates physiological youth
Carcase Weight (HSCW)	280–340 kg optimal	Matches premium specs

Grid prices can differ by over \$2/kg based on these variables, translating into hundreds of dollars per head. A clear understanding of these drivers enables producers to fine-tune genetic selection, nutrition, and handling practices to maximise returns.

The relationship between maternal efficiency and MSA

To align maternal efficiency with MSA grading, producers should consider selecting cows and heifers based on EBVs that are known to influence the key price drivers under the MSA system. These traits include Intramuscular Fat (IMF), rib fat, P8 rump fat, Eye Muscle Area (EMA), Carcass Weight (CWT), Net Feed Intake (NFI), and Shear Force. Each of these traits affects the eating quality, saleable yield, and compliance with MSA specifications, and they are all heritable to varying degrees. Selecting maternal animals with balanced profiles in these EBVs ensures that their calves inherit the genetic potential to meet premium grading targets. Furthermore, the application of BreedObject selection indexes, which incorporate these EBVs into profit-focused indexes like the Angus MSA Index, Santa Gertrudis Domestic Index, or Tropical Maternal Index. This allows producers to simplify multi-trait selection without compromising profitability or herd function.

A central challenge in selecting for both maternal efficiency and carcass quality is managing antagonistic traits that are negatively correlated and cannot be improved simultaneously without compromise. A well-known example in MSA-focused breeding is the inverse correlation between EMA and IMF. EMA, which reflects muscle yield, and IMF, which reflects marbling and is a major determinant of MSA eating quality, often compete genetically. High selection pressure on EMA can increase muscle deposition and shorten the time to slaughter weight, but this can be at the expense of adequate marbling, particularly in early-maturing animals. This creates a physiological conflict: a fast-finishing, muscular carcass may not have had sufficient time to deposit marbling, leading to a lower MSA Index despite good weight and yield. Therefore, a strategic balance must be struck, particularly in maternal animals whose genetics influence multiple progeny. Selecting females with moderate EMA and strong IMF EBVs allows producers to produce progeny that still meet carcass weight and yield targets while also ensuring sufficient marbling for higher MSA grading and brand program eligibility.

Fat EBVs, particularly rib fat and P8 rump fat, also play a dual role in maternal and carcass performance. Cows that deposit and maintain subcutaneous fat more readily are more likely to maintain condition through weaning and rebreed promptly, thus improving maternal efficiency. These fat traits also directly influence MSA compliance by helping reduce the risk of cold shortening in carcasses and by meeting minimum fat depth specifications at slaughter. Importantly, fat deposition can also enhance eating quality by providing insulation during chilling and supporting better marbling distribution. Selecting cows with balanced fat EBVs contributes not only to reproduction and BCS stability but also to progeny that finish consistently and score higher within the MSA system.

NFI is another valuable EBV to consider when aligning maternal efficiency with MSA performance. Cows with low NFI require less feed to maintain their weight and produce milk, which reduces overheads in breeding systems. Their calves are also more likely

Maternal Efficiency: The Key to Profitable Ruminant Animal Production

to be efficient converters of feed to growth, enabling them to reach target weights without excessive input costs. From an MSA perspective, this is important because faster finishing cattle tend to have lower ossification scores. A key trait in the MSA model that reflects physiological maturity and is inversely related to eating quality. By lowering days on feed while achieving carcass compliance, these animals contribute to better MSA grading and improved profitability per kilogram of carcass.

CWT and Shear Force also deserve specific attention. While heavier carcasses often return more revenue, there is a threshold beyond which additional weight does not result in better value if it compromises meat quality. Selecting maternal animals that produce progeny with moderate to high carcass weights and acceptable shear force (for example lower values, indicating more tender meat) ensures that output remains high without undermining tenderness. This is one of the top three MSA drivers. Notably, shear force is not widely available as a standard EBV across all breeds, but where it is reported, particularly in research herds, it is a valuable tool for identifying bloodlines that produce consistently tender beef.

A critical takeaway is that maternal animals are not just bred for reproduction. Their genetic profile influences every stage of the beef supply chain, from conception to carcass. By selecting cows and replacement heifers that express balanced EBVs across fertility, growth, feed efficiency, and carcass quality, producers can create cow herds that raise profitable calves and reduce variability in MSA performance. This genetic consistency is increasingly important for processors and brand programs, who require uniform, high-quality carcasses to meet domestic and international customer expectations. Furthermore, maternal lines that enhance progeny MSA Index scores not only contribute to premium grid payments but also position the herd for long-term genetic advancement through retained daughters.

Table 7: Relevant EBVs Linking Maternal Traits to MSA Outcomes (Source: MLA, 2018)

EBV Name	Trait Measured	Relevance to MSA Score
Intramuscular Fat (IMF%)	% of fat within the loin muscle	Strongest genetic indicator for marbling, a major positive driver of MSA eating quality
Ossification (experimental)	Maturity of skeletal system	Lower ossification = better tenderness and higher MSA Index
Eye Muscle Area (EMA)	Size of the loin muscle	Influences yield and lean meat content without negatively affecting marbling
Rib Fat (RibF)	Fat depth at the 12/13 rib site	Prevents cold shortening; ensures minimum fat thresholds for MSA compliance
P8 Fat (Rump Fat)	Fat depth over the rump	Additional indicator of finish and ability to meet MSA fat spec
Shear Force (experimental)	Objective measure of tenderness	Direct proxy for eating quality and tenderness
Carcass Weight (CWT)	Predicted hot standard carcass weight	Needed for market compliance; heavier carcasses attract premiums if still physiologically young
Net Feed Intake (NFI-F)	Efficiency of feed conversion	Indirect impact, more efficient animals can reach optimal specs faster (less ossification)

This table outlines how key EBVs influence both maternal efficiency and MSA grading outcomes. Traits such as intramuscular fat (IMF%), rib and P8 fat, and milk contribute

Maternal Efficiency: The Key to Profitable Ruminant Animal Production

to calf growth, marbling, and cow condition, directly enhancing eating quality and carcass compliance. Net feed intake (NFI-F) and mature cow weight (MCW) affect feed efficiency and maternal productivity, with moderate cow weights preferred for cost-effective weaning. Fertility traits like days to calving (DC) support tighter calving intervals and consistent turn-off timing. Selecting maternal animals with balanced profiles across these EBVs improves both herd reproductive efficiency and progeny carcass value under the MSA system.

Nutritional programming in gestation

MLA-funded research (B.NBP.0790) revealed that protein supplementation between 23–98 days of gestation boosts calf muscle development:

- **+7 cm²** in eye muscle area
- **+1.5%** dressing percentage
- **+10%** weaning weight

Table 8: Economic Impact of nutritional programming in gestation (Source: MLA, 2018)

Liveweight	Improvement	Value Added
600 kg	+9 kg HSCW	\$54 (@ \$6/kg)
Supplement Cost	\$10–\$20/head	ROI: 3–5x
Herd of 100	+1000 kg weaning weight	\$6,000 revenue gain

Reproductive efficiency

Heifers with >5 mm rib fat showed pregnancy rates of 91.5% versus 83% in leaner cohorts (MLA SBP.0050). For every 100-head herd, this results in 8.5 more calves/year.

At \$600/calf:

- Additional Revenue = **\$5,100/year**
- Combined with improved carcass traits, total impact > **\$11,000/year**

Leveraging the MSA index for premium returns

Each additional 4–5 points on the MSA Index can deliver \$120–150 more per carcass. A 10-point increase represents:

- **\$500/carcass** improvement
- **\$25,000/year** for 50-head draft

Table 9: Leveraging the MSA Index (Source: MLA, 2018)

MSA Index	Grid Price (\$/kg)	Carcass Value (300 kg)
72	\$8.20	\$2,460
68	\$7.80	\$2,340
64	\$7.40	\$2,220
60	\$7.00	\$2,100
55	\$6.50	\$1,950

Carcase quality and IMF in lamb production

While MSA focuses on beef, the principles of maternal impact on meat quality extend to lamb. Tom Bull (Bull, n.d.) reports that increasing IMF by just 2% in lamb loins can:

- Increase retail value by \$70/kg
- Make a 3 kg loin worth over **\$210**—triple its base value

MLA Project L.LSM.0008 also found:

- Ewes in BCS 2.7–3.3 yield the best lamb survival and weaning weights
- Every 10 kg ewe weight gain → 1.5 kg heavier lamb

At \$10/kg:

→ +\$15/lamb = \$15,000/year across a 1,000-head flock

Maternal efficiency and MSA grading summary

Maternal efficiency plays a crucial role in achieving premium MSA grading outcomes by influencing key traits such as EMA, intramuscular fat, fat depth, carcass weight, feed efficiency, and tenderness. Selecting cows with balanced EBVs ensures their progeny meet eating quality and yield targets without sacrificing fertility or rebreeding performance. Managing trade-offs, like marbling versus muscle yield, is essential to maintain both profitability and compliance with MSA specs. Nutritional strategies during gestation and fertility traits like rib fat further enhance carcass quality and herd productivity. These same principles apply in lamb production, where increased IMF and ewe condition drive higher value cuts and better lamb growth, as seen in systems like LambPro and Gundagai Meat Processors.

Global insights into maternal efficiency

GFP highlights

During a Global Focus Program (GFP) visit to Texas, valuable insights were gained into how leading producers are using regenerative grazing systems to enhance maternal efficiency in ruminant production. Across commercial production systems, regenerative grazing strategies were observed as a cornerstone of herd management. These systems, based on high-intensity, short-duration grazing followed by extended pasture rest periods, were shown to significantly improve forage quality and consistency. This, in turn, enabled breeding females to maintain optimal body condition throughout the year, supporting better fertility, more consistent lactation, and increased survival rates of offspring.

These Texas operations also demonstrated how regenerative grazing plays a critical role in reducing parasite loads and disease pressure, lowering the need for chemical inputs and interventions. By placing breeding animals under realistic, pasture-based conditions, producers were effectively selecting for low-input, high-performing females with strong maternal instincts and resilience. Additionally, many producers incorporated short joining periods and defined calving or lambing seasons, which streamlined labour demands and improved the uniformity of weaned cohorts.



Figure 2: Mixed Spices Pasture – Texas , Author (Source: Author)

A key observation from the program was how regenerative grazing functions not only as a sustainable land use strategy but also as a natural filter for maternal genetics. The system inherently favours fertile, functional animals capable of thriving with minimal assistance, thereby driving long-term gains in maternal longevity and efficiency. Ultimately, the integration of grazing management with genetic selection in Texas provided a compelling example of how environmental stewardship and maternal performance can be successfully aligned to deliver productivity gains per hectare and enhance the overall profitability of ruminant systems.

Scottish highlights

Travelling through Scotland provided a rich perspective on how maternal efficiency is being achieved in some of the country's most challenging grazing environments. In the Highlands, where winters are long and forage quality can be inconsistent, producers have adapted by breeding and managing animals that require minimal intervention while maintaining strong body condition and reproductive performance. These systems are not built around high inputs, but rather on selecting for functional, efficient livestock that can thrive with what the environment naturally provides. Survival, fertility, and the ability to rear offspring without assistance are top priorities.

At Neil McGowan's operation, Luing cattle have been developed with these principles at the core. This breed has been refined over time using performance-recorded maternal indexes, which allow for targeted selection of females that are fertile, structurally sound, and productive in marginal conditions. These cows are expected to rear a calf every year, on pasture, without excessive feeding or handling, a reflection of how maternal genetics and system design are working in sync. Meanwhile, Vic Ballantyne's sheep operation highlights the viability of low-input, outdoor lambing in North-East Scotland. Her breeding objective is clear: resilient ewes that lamb unassisted, raise vigorous lambs, and maintain condition on grass alone. This reduces costs and labour while improving the consistency of flock performance year after year.

Both operations implement simple but highly strategic management systems. Short joining periods, often just 4 to 6 weeks, help concentrate calving and lambing into tight, manageable windows. This streamlines labour, aligns peak nutritional demand with pasture growth, and produces a more even draft of animals for weaning, sale, or further breeding. The uniformity this brings is particularly valuable when targeting specific market specifications or planning breeding replacements.

Another key feature across these leading Scottish operations is the widespread use of electronic identification (EID). This technology enables producers to track the performance of individual dams across multiple seasons, recording data such as weaning weights, lambing intervals, number of offspring raised, and condition scores. This level of performance monitoring allows for more accurate selection and culling decisions, ensuring that only the most efficient, fertile, and reliable females are retained. The result is a more productive and resilient maternal herd or flock over time.

A visit to Hugh Chamberlain in the remote Scottish Highlands further reinforced the importance of adaptability. In these isolated and rugged landscapes, producers must be flexible. Not just in how they manage their stock or what breeds they run, but also in how they engage with markets. Matching the product to the right market outlet, whether that be store lambs, finished cattle, or breeding replacements, is critical to long-term profitability. Breed choice, production system, and marketing strategy are all interdependent, and the most successful operations are those that can pivot in response to seasonal variation, input prices, or shifting market demands.

Ultimately, the lessons from Scotland highlight that achieving maternal efficiency is not just about genetics or feeding, but about building systems that reward longevity, hybrid vigour, fertility, and functional traits. Real-world performance data, not just pedigree, drives decision-making. Systems must be designed to maximise kilograms of calf or lamb weaned per hectare or per breeding female, whether the animals are indoors, wintering on the hills, or grazing improved lowland pastures. The animals must be able to perform in tough climates, with fluctuating pasture availability, and without constant intervention. It is this combination of resilience, simplicity, and data-driven refinement

that is setting Scotland's leading producers apart, and offering valuable takeaways for ruminant systems around the world.



Figure 3: Feed Intake – Scotland, Author (Source: Author)

Wales highlights

TechnoGrazing

TechnoGrazing, as observed in Wales, is an advanced rotational grazing system designed to optimise both animal performance and pasture efficiency. At its core, the system relies on the principle of high-frequency rotation, where mobs of livestock are moved at least once per day and sometimes up to three times daily, depending on feed availability and growth rates. This frequent movement is facilitated by temporary electric fencing, which not only allows for flexible and adaptive paddock configurations but also keeps infrastructure costs relatively low compared to permanent fencing systems.

The key advantage of TechnoGrazing lies in its ability to significantly improve pasture utilisation. By ensuring animals graze each cell for a very short duration, plants are not overgrazed, allowing them adequate recovery time and promoting more robust regrowth. This results in a more productive and resilient pasture system. Additionally, consistent access to high-quality forage, combined with reduced parasite exposure due to shorter periods on any single area of ground, leads to improved animal health and increased weight gain. These gains in growth efficiency translate directly to enhanced maternal efficiency, as healthier dams with better nutrition are more likely to rear stronger, heavier progeny and return to oestrus more reliably.

Beyond the productive benefits, TechnoGrazing also offers substantial environmental advantages. The system supports improved ground cover and pasture diversity, which helps to protect soil from erosion and reduce surface water runoff. Moreover, longer rest periods between grazing periods promote deeper root systems, increased organic matter in the soil, and better nutrient cycling. Collectively, these outcomes contribute to a more sustainable and resilient grazing system, making TechnoGrazing a compelling option for both progressive livestock producers and environmentally conscious operations.



Figure 4: Techno Grazing - Wales, Author (Source: Author)

Global insights into maternal efficiency summary

Global insights from Texas, Scotland, and Wales highlight practical systems improving maternal efficiency in ruminant production. In Texas, regenerative grazing, short-duration, high-intensity grazing with long rest periods, has enhanced forage quality, reduced chemical inputs, and naturally selected for low-input, fertile females. Short joining periods and defined calving windows improved uniformity and labour efficiency.

In Scotland's harsh Highland environments, producers like Neil McGowan and Vic Ballantyne focus on breeding resilient cattle and sheep that thrive with minimal intervention. Selection based on real performance data, supported by electronic ID systems, ensures longevity, fertility, and consistent offspring production. Management strategies like tight joining periods and pasture-aligned nutrition boost productivity.

Wales showcases TechnoGrazing, an intensive, high-frequency rotational grazing using temporary fencing. Derived from New Zealand, this system improves pasture use, animal nutrition, and health while supporting sustainability. Across all regions, success comes from integrating grazing management, performance recording, and genetics to build efficient, resilient maternal systems.



Figure 5: Lambing Down – Ireland, Author (Source: Author)

Management practices and environmental strategies

On-farm management and environmental strategies play a critical role in optimising the productivity and reproductive performance of breeding females. Selecting high-quality pasture species such as lucerne, chicory, and phalaris boosts protein and energy intake during late gestation and lactation. Rotational and regenerative grazing systems enhance forage availability and consistency through improved pasture recovery. These approaches support body condition score (BCS), shorten calving intervals, and increase calf weaning weights. Early weaning reduces the nutritional burden on the dam, aiding faster condition recovery and improving conception timing, while also enhancing calf survival and post-weaning growth. Mob management strategies, particularly separating single and multiple-bearing females, allow for tailored nutrition and reduce mismothering, with proven improvements in survival rates. Maintaining optimal stocking rates is essential to avoid overgrazing, preserve pasture health, and sustain cow fertility; tools such as feed budgeting and satellite monitoring assist in making dynamic stocking decisions. Targeted supplementation of energy, protein, and essential trace minerals like selenium and copper strengthens immune function, supports calving ease, and improves reproductive outcomes. Environmental strategies including shade, wind protection, and reliable water access, reduce stress and promote feed intake. Finally, adopting precision livestock tools enables early detection of health or reproductive issues, ensuring timely interventions and more efficient management across the herd or flock.

Pasture composition and grazing systems

Pasture composition and grazing management are critical drivers of maternal efficiency, as they directly influence a dam's ability to maintain body condition through pregnancy and lactation. High-quality pastures, particularly those incorporating perennial legumes such as lucerne, clover, and chicory, offer significantly higher crude protein and metabolisable energy levels than native grasses, supporting fetal development, milk production, and maternal recovery. For example, lucerne-based systems have been shown to increase calf weaning weights by 30–50 kg due to enhanced lactation performance (Bell et al., 2013; MLA, 2020). Integrating these species into a well-planned rotational or regenerative grazing system further amplifies benefits. Regenerative practices, such as high-intensity, short-duration grazing followed by rest, enhance pasture quality, plant diversity, and soil health while enabling more consistent nutrient intake throughout the reproductive cycle (Ferguson, 2023). These systems reduce feed gaps and allow strategic pasture allocation based on class of stock, which is vital during energy-demanding periods like joining or lactation. Studies by Pitchford (2020) and Ferguson (2023) found that cows managed under regenerative systems had improved conception rates, shorter inter-calving intervals, and higher weaning efficiency. Practical tools such as pasture testing, feed budgeting, and rotational paddock planning help align forage supply with cow requirements, reducing overgrazing and improving fertility outcomes. Ultimately, managing pasture composition and grazing intensity enables producers to realise the genetic potential of breeding females while lowering input costs and improving calf or lamb survival.

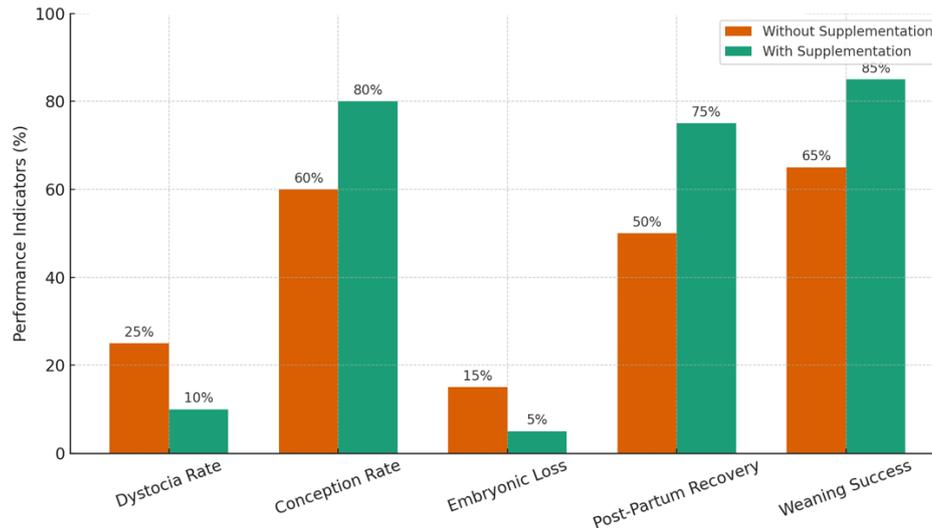
Optimising stocking rates to match feed availability

Optimising stocking rates to align with feed availability is a cornerstone of efficient herd and pasture management. Overstocking places excessive pressure on forage resources, resulting in overgrazing, slower pasture regrowth, and a decline in pasture quality over time. This directly impacts cow body condition, as lower forage availability reduces nutrient intake, leading to poorer fertility outcomes, delayed conception, and reduced milk production. Conversely, understocking can result in underutilised pasture, lowering overall production efficiency. Maintaining an optimal balance ensures cows receive adequate nutrition throughout critical reproductive stages, particularly during joining, gestation, and lactation. Tools such as feed budgeting models and satellite-based pasture monitoring technologies (MLA, 2022b) provide producers with accurate, real-time data to make informed decisions on adjusting stocking densities. These tools help match herd demand with forage supply, preventing degradation and avoiding unnecessary reliance on expensive supplements. Pitchford (2020) identifies stocking rate as a “first principle lever” because it influences not only pasture productivity but also reproductive efficiency at the herd level. By carefully managing stocking rates, producers can promote sustainable pasture use, maintain consistent cow condition, lower input costs, and improve weaning outcomes, ultimately enhancing the overall profitability and resilience of the production system.

Supplementary feeding and targeted nutrition

Strategic supplementation plays a crucial role in supporting the reproductive performance and maternal efficiency of breeding females, particularly during nutritionally demanding periods. Providing additional energy and protein in the weeks leading up to calving or lambing is essential for meeting the elevated metabolic demands of late gestation and preparing the cow for lactation. According to the NRC (2016), appropriate supplementation during this stage can reduce the incidence of calving difficulty (dystocia) by improving maternal strength and condition, while also promoting higher-quality colostrum and more vigorous calf behaviour at birth. Beyond macronutrients, trace elements such as selenium, copper, and cobalt are vital for reproductive and immune function. As outlined by McDowell (2003), deficiencies in these micronutrients are linked to increased rates of early embryonic loss, lower conception rates, and compromised uterine health, all of which negatively impact fertility. Importantly, nutritional support should not end at calving. Ferguson (2023) emphasises the value of post-weaning supplementation to help cows regain or maintain optimal BCS in preparation for the next joining. By addressing both short-term energy needs and long-term mineral balance, targeted supplementation supports improved conception rates, reduces post-partum complications, and enhances maternal behaviour, ultimately contributing to greater weaning success and herd productivity.

Maternal Efficiency: The Key to Profitable Ruminant Animal Production



Graph 3: Effect of strategic supplementation on reproductive and maternal performance
(Source: NRC. (2016). McDowell, L. R. (2003) Ferguson, M. (2023))

This graph illustrates the impact of strategic supplementation on key reproductive and maternal efficiency indicators. The data, based on published research, shows that supplementation significantly improves conception rates, reduces dystocia and embryonic loss, and enhances post-partum recovery and weaning success (adapted □ NRC. (2016). McDowell, L. R. (2003) Ferguson, M. (2023))

Environmental shelter and water access

Environmental shelter and water access are fundamental components of maternal efficiency, and several practical on-farm management tools can be implemented to optimise these elements with measurable reproductive and welfare benefits. Providing shade through natural vegetation, purpose-built shelters, or shade cloths helps to reduce heat stress. This is particularly important during summer calving or lactation. According to Rhoads (2009), heat-stressed cows show a marked reduction in dry matter intake and reproductive performance, with extended time to conception and lower embryo viability. Windbreaks, such as tree lines or artificial barriers, are equally important during colder months or in open, exposed environments, as wind chill can suppress appetite, increase energy requirements, and reduce calf vigour at birth.

Reliable access to clean water is another non-negotiable aspect of maternal management. Cows can reduce feed intake by up to 15% when water is restricted, leading to poor milk production and delayed post-partum recovery. Management tools such as solar-powered water pumps, gravity-fed trough systems, and remote tank level sensors help ensure consistent water availability even in remote or rotationally grazed paddocks.

Landscape-level planning also supports maternal efficiency. Designing paddock layouts with central laneways, rotational access to water points, and protection of erosion-prone or nutrient-sensitive areas can improve pasture utilisation and animal movement. Fencing off degraded or sensitive areas reduces pasture loss and allows focused rest and regrowth, while rotational grazing aligned with shelter and water access increases energy intake and supports better cow condition. These environmental strategies, when managed intentionally, contribute to reduced calf

mortality, improved lactation performance, and faster maternal recovery. These are key contributors to maternal efficiency in both intensive and extensive production systems.

Use of precision technologies

Precision technologies significantly improve maternal efficiency by enabling real-time monitoring of reproductive and nutritional performance in the paddock. Walk-over-weighing systems, such as Optiweigh and Gallagher's Mobile Weigh Platform, automatically record liveweight data without handling, allowing early detection of weight loss or suboptimal growth. This is critical for ensuring cows reach target body condition scores before joining or calving.

Optiweigh is solar-powered, records weight estimates in-field, and transmits data remotely. This is ideal for extensive systems. Gallagher's Mobile Weigh Platform offers mobility and integrates with EID for mob-specific management, supporting decisions around weaning, joining, or drafting underperforming animals.

Other tools include activity monitors and GPS collars, which detect oestrus, illness, or calving behaviours. Remote condition monitoring and pasture and animal tracking apps like Cibo Labs or AgriWebb help match feed supply to demand and plan mob movements based on nutritional needs.

Together, these technologies enable earlier interventions, better mating preparation, and improved recovery post-calving, resulting in higher conception rates, lower calf loss, and more kilograms weaned per hectare. They also streamline labour and improve record-keeping for genetic and performance selection.

Conclusions

Maternal traits play a pivotal role as profit drivers in beef and lamb production systems, with fertility, conception rates, early puberty, and longevity forming the foundation of productive and profitable operations. These biological attributes, coupled with consistent BCS and optimal mature adult size, directly influence feed efficiency and overall reproductive success. The integration of advanced genetic tools and maternal indexes now empowers producers to make data-driven selection decisions that enhance these traits across generations, ultimately improving herd productivity and profitability.

Weaning efficiency and early growth represent crucial economic levers, directly linking the productivity of the dam to the weight and health of the offspring. Efficient conversion of feed into calf or lamb growth reduces input costs and shortens time to market, supporting better lifetime performance and higher returns. When aligned with carcass quality traits and the Meat Standards Australia (MSA) grading system, maternal efficiency gains can be further leveraged to optimise product value. Understanding the key price drivers within MSA, such as IMF, rib and rump fat, EMA, and carcass weight, enables producers to select animals that not only reproduce efficiently but also produce premium-quality meat that commands higher market prices.

Nutritional programming during gestation and reproductive efficiency further complement genetic potential by ensuring dams maintain optimal condition for breeding, gestation, and lactation. This holistic approach strengthens the linkage between maternal performance and carcass outcomes, reinforcing the economic benefits of an integrated production strategy. Moreover, the use of the MSA Index provides a practical framework for breeders to target animals that maximize both reproductive efficiency and carcass quality, leading to a price premium.

Global perspectives highlight that regenerative grazing systems, pasture management, and stocking rate optimisation are critical environmental strategies that enhance maternal efficiency. Insights from regions such as Texas, Scotland, and Wales demonstrate how tailored grazing practices, supplemented feeding, and environmental management, including shelter and water access, boost animal health and productivity. Precision technologies such as walk-over weighing platforms (Optiweigh and Gallagher's mobile systems), activity sensors, and remote condition monitoring are revolutionising on-farm management by enabling timely interventions and improved data collection in real-time, which further enhances maternal efficiency and profitability.

In summary, the interaction between genetics, nutrition, management practices, and environmental stewardship forms the cornerstone of maternal efficiency in modern ruminant production. By leveraging these interconnected factors, producers can drive superior reproductive performance, optimise early growth, and consistently produce high-quality carcasses aligned with MSA standards. This integrated approach not only enhances animal welfare and sustainability but also delivers tangible economic gains, ensuring long-term profitability and resilience in the increasingly competitive global meat industry.

Recommendations

Improving maternal efficiency in beef and sheep systems requires a structured approach that begins with genetics and flows through management, nutrition, technology, and market alignment. Genetic selection is the foundation. Producers should prioritise maternal indexes that include traits such as Net Feed Intake (NFI), Days to Calving (DTC), Eye Muscle Area (EMA), and Intramuscular Fat (IMF). Selecting for early puberty and longevity delivers significant lifetime gains, heifers that calve at 12–15 months can produce up to 500 kg more weaned weight over their lifespan. Moderate mature cow size (450–550 kg) improves feed efficiency and enhances weaning efficiency, expressed as kilograms of offspring weaned per kilogram of dam weight. A key driver of profitability.

Reproductive performance must then be optimised. Achieving conception rates above 90% is critical, as each 5% improvement can add \$65 per head. Implementing shorter joining periods of 4–6 weeks tightens calving or lambing windows, increases labour efficiency, and boosts weaning uniformity. Body Condition Score should be monitored closely, with a target of BCS 3.0 at joining and calving for optimal fertility, milk production, and calf survival. Early weaning strategies (10–14 weeks) allow dams to regain condition sooner, improving reproductive success and reducing nutritional stress. Separating single and twin-bearing breeders enables better nutritional targeting and reduces mismothering losses.

Nutrition management underpins maternal efficiency. High-protein, high-digestibility pastures like lucerne, chicory, and phalaris, combined with rotational or regenerative grazing systems, help maintain condition and improve forage utilisation. Supplementation during key phases, i.e. late pregnancy and post-weaning can yield significant returns, with \$10–\$20 per head in cost often returning \$54–\$60 per head in added calf weight. Feed budgeting, condition scoring, and mob-based management ensure targeted, cost-effective use of inputs. Stocking rates should be aligned with seasonal carrying capacity to avoid overgrazing and loss of condition.

Integrating maternal efficiency goals with Meat Standards Australia (MSA) requirements further boosts profitability. Cows should carry EBVs that favour EMA, marbling (IMF), fat depth (rib, P8), carcass weight, and shear force—traits directly influencing MSA grading and price. Selecting for low NFI improves feedlot efficiency and reduces ossification scores, aiding tenderness and grading outcomes. Balancing antagonistic traits (EMA versus IMF) is essential to meet both yield and eating quality targets.

Finally, precision livestock technologies are vital tools. Walk-over-weighing systems like Optiweigh allow for remote, real-time tracking of weight gain and condition. These tools, combined with EID-based apps, activity monitors, and platforms like AgriWebb, enable proactive reproduction, health, and nutrition decisions. Environmental enhancements, shade, clean water access and low-stress paddock infrastructure; round out a system that supports profitable ruminant animal production.

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