# Can scalable dairy systems position non-replacement dairy calves as a viable 10-month alternative to traditional beef breeds?

Kellogg Rural Leadership Programme
Course 55 2026
Phil Lowe

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

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# Executive summary

The New Zealand dairy industry remains one of the country's most significant export sectors and continues to play a major role in supporting regional economies and rural communities. Alongside milk production, the dairy sector also contributes heavily to New Zealand's beef industry, with a large proportion of beef exports now originating from dairy animals or dairy-beef cross systems.

New Zealand's international reputation has largely been built around seasonal pasture-based farming systems capable of converting grass into high-value milk and beef products with relatively low levels of confinement feeding compared with many overseas production systems. However, the same seasonal system that underpins this competitive advantage also produces a large number of surplus calves each spring.

Historically, many of these calves have entered the Bobby calf system at approximately 4–5 days of age. For decades this was widely accepted as part of seasonal dairy farming. This traditional system prioritises labour efficiency and operational simplicity but captures limited economic value from surplus calves. Increasing societal expectations around sustainability, animal welfare, and resource-use efficiency, combined with potential opportunities for improved dairy-beef integration, have renewed interest in alternative calf management systems.

This study evaluated the feasibility of retaining non-replacement dairy calves to heavier liveweights within a commercial seasonal dairy system, without compromising cow numbers. A representative irrigated Mid Canterbury dairy farm (1,000 cows, 270 ha, 3.7 cows/ha) was modelled under three calf management scenarios:

- Model 1: Traditional Bobby calf system
- Model 2: Calves reared to 100 kg liveweight
- Model 3: Calves reared to 225 kg liveweight

Results demonstrated a clear trade-off between profitability and operational complexity. The Bobby calf system was the simplest and lowest-risk option but generated the lowest financial return. Retaining calves to 100 kg improved profitability while maintaining manageable system pressure. Retaining calves to 225 kg generated the highest financial return but created substantial increases in feed demand, labour requirements, and exposure to seasonal and market volatility.

The study highlights that while improved calf retention can significantly increase value capture, system viability is strongly constrained by feed availability, labour capacity, and whole-farm operational pressure. The most appropriate system is therefore likely to vary depending on farm resources, management capability, and climatic conditions.

Overall, results indicate genuine potential for improved dairy-beef integration in New Zealand, but only where systems remain operationally practical within seasonal pasture-based dairy farming

# Acknowledgements

I would like to sincerely thank the organisers of the Kellogg Rural Leadership Programme for providing me with the opportunity to be part of such a valuable and rewarding learning experience. The programme has challenged my thinking, broadened my perspective, and allowed me to connect with an outstanding group of people across the rural sector.

To my fellow members of the Kellogg 55 cohort, thank you for the support, encouragement, humour, and shared experiences throughout the journey. Being surrounded by such a passionate and capable group has been both motivating and inspiring.

A special thank you goes to my wife, Donna, for her unwavering support throughout this project and the wider Kellogg journey. To my children, Chloe and Josh, thank you for encouraging me to take on a new challenge and for all the IT support along the way. I would also like to acknowledge Keeva Hintz for her academic guidance and support throughout the development of this report.

Finally, I would like to thank the team at Spring River Farms for their encouragement, flexibility, and support, which allowed me the time and opportunity to undertake this programme.

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# 1.0 Introduction

The New Zealand dairy industry is one of the country's most important export sectors and plays a major role in supporting regional economies and rural communities. In addition to milk production, the sector is also a significant contributor to New Zealand's beef industry, with a large proportion of beef exports now originating from dairy animals or dairy-beef cross systems.

New Zealand's international reputation is strongly built around seasonal, pasture-based farming systems that efficiently convert grass into high value milk and beef products with relatively low levels of confinement feeding compared with many overseas production systems. However, the same seasonal structure that underpins this competitive advantage also results in a large number of surplus calves each spring.

Historically, many of these calves have entered the Bobby calf system at approximately 4–5 days of age. This approach has long been widely accepted within seasonal dairy farming systems, largely because farm systems have been designed around efficient milk production, tight calving patterns, labour efficiency, and pasture utilisation rather than retaining calves for beef production.

However, expectations around food production systems are changing. Internationally, there is increasing emphasis on sustainability, animal welfare, emissions, resource-use efficiency, and broader social licence considerations. As a result, surplus calf management is receiving increasing attention both within New Zealand and internationally.

At the same time, improved dairy-beef integration presents a potential opportunity for New Zealand agriculture. Retaining and rearing more non-replacement dairy calves may allow greater value capture from animals already being produced within the dairy system, while also supporting beef supply chains and improving utilisation of existing livestock resources.

This report evaluates whether non-replacement dairy calves can be retained and reared to heavier liveweights within systems that remain both commercially viable and practically achievable alongside a seasonal New Zealand dairy platform. The project does not focus solely on calf performance or financial return in isolation. Instead, it evaluates how retained calf systems interact with the wider dairy farm operation. It assessed the operational realities of commercial dairy farming, particularly around labour demand, feed supply, infrastructure pressure, and wider whole-farm performance.

Within seasonal pasture-based dairy systems, this is particularly important because labour demand, feed pressure, and management intensity are already heavily concentrated through spring and early summer. Calving, mating, irrigation management, pasture allocation, and milk production all compete for time and resources during relatively condensed periods of the season. As a result, retained calf systems must complement the wider dairy platform operationally rather than compete directly against it.

The report also considers the broader implications that improved dairy-beef integration may have for New Zealand agriculture in the longer term. This includes the potential to improve resource-use efficiency, capture greater value from calves already being produced within the dairy system, strengthen beef supply chains, improve utilisation of existing livestock resources, and support evolving expectations around sustainability and animal welfare.

Scalability is also a central consideration throughout the analysis. While smaller retained calf systems may function effectively within existing farm resources, their practicality under expanding calf numbers and increasing operational pressure across the wider dairy platform remains uncertain. This includes how systems cope as demands increase on labour availability, feed supply reliability, infrastructure capacity, management complexity, and seasonal farm system pressure.

# 2.0 Objectives

The primary objective of this study was to evaluate the feasibility of retaining and rearing non-replacement dairy calves to heavier liveweights within a seasonal New Zealand dairy system.

Specific objectives were to investigate how increasing calf retention influences:

- feed demand and supplementary feeding requirements
- labour input and management pressure
- grazing management and pasture allocation
- infrastructure demand and operational capability
- animal health performance
- working capital exposure
- and wider farm-system resilience.

The study adopts a whole-farm systems perspective, recognising that calf management decisions must align with wider dairy farm performance, including milk production, feed allocation, labour efficiency, and seasonal constraints.

# 3.0 Literature Review

## *3.1 Current Dairy Calf Outcomes in New Zealand (Problem and Opportunity)*

The New Zealand dairy industry continues to evolve toward greater efficiency and productivity, with farmers now producing increasing volumes of milk solids from fewer cows. During the 2024/25 season, national cow numbers declined slightly while total milk solids production increased to record levels (*2024-25NZ Dairy Herd Statistics*, 2025;  *LIC Dairy Statistics*, n.d.). This trend largely reflects ongoing improvements in genetics, reproductive performance, animal productivity, and wider farm-system efficiency across the dairy sector.

Alongside milk production, the dairy industry also plays a major role in supporting New Zealand's beef sector. A large proportion of beef animals processed within New Zealand originate from dairy systems, either through Friesian bull pathways, cull cows or increasingly through dairy-beef cross systems bred specifically for beef-finishing operations (*Rabobank, 2025*).

Research and industry reporting suggest approximately 70–75% of New Zealand beef exports now contain some degree of dairy origin, reinforcing the increasingly interconnected relationship between the dairy and beef industries (*Rabobank, 2025*). At the same time, New Zealand's highly seasonal pasture-based dairy model also creates a significant number of surplus calves each spring. Because calving is concentrated into relatively short seasonal windows, a large proportion of calves born annually remain surplus to replacement requirements (*Rabobank, 2025*).

Historically, many of these calves have either entered the Bobby calf system at approximately 4–5 days of age, flowed into lower-value beef pathways, or been managed through short-term calf-rearing systems before sale. Research indicates that only a relatively small proportion of surplus dairy calves are currently retained through integrated dairy-beef systems, despite growing industry discussion surrounding improved value capture and resource utilisation (*Rabobank, 2025*).

For many years this approach was widely accepted as part of the New Zealand dairy model. Seasonal dairy systems were designed primarily around efficient milk production, labour efficiency, tight calving periods, and pasture utilisation (*DairyNZ, n.d.-a*; *Rabobank, 2025*). Within that framework, surplus calves were often viewed more as a by-product of milk production than a major value stream in their own right. However, wider expectations around food production systems are changing rapidly.

Consumers, retailers, processors, and international food companies are increasingly placing pressure on agricultural systems to demonstrate stronger performance across sustainability, animal welfare, traceability, resource-use efficiency, emissions management and broader social licence outcomes (*Mars Incorporated. 2024*.

*Sustainable in a Generation Plan. Mars Inc.*, n.d.; *Rabobank, 2025*). As a result, surplus calf management is increasingly becoming part of a wider discussion around how efficiently food-production systems utilise existing biological resources.

At the same time, there appears to be growing recognition that non-replacement dairy calves may represent a significantly underutilised economic and biological resource within New Zealand agriculture. Improved dairy-beef integration has the potential to increase value capture from calves already being produced within the dairy system, improve utilisation of existing livestock resources, strengthen domestic beef supply chains and potentially improve wider public perception surrounding surplus calf management (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Rabobank, 2025*).

Rabobank identified dairy-beef integration as a significant long-term opportunity for New Zealand agriculture, with wider industry commentary describing the sector as a potential '$1.2 billion opportunity' for New Zealand agriculture (Rabobank New Zealand, 2025).

Advances in genetics are also changing the conversation surrounding surplus calves. The increasing use of sexed semen, beef genetics over dairy cows, and improved reproductive technologies is producing calves increasingly suited to modern beef-finishing systems. As a result, dairy-origin calves are likely to become an increasingly important component of future beef supply chains both within New Zealand and internationally (*2024-25NZ Dairy Herd Statistics*, 2025; *LIC Dairy Statistics*, n.d.).

The literature also suggests that the discussion around surplus calves is shifting beyond calf survival or short-term calf management alone, with increasing emphasis on broader questions of system efficiency, value capture, resource utilisation, long-term sustainability, and whole-farm performance (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Rabobank, 2025*). This shift appears particularly important within the New Zealand context, where the country's international reputation remains strongly linked to pasture-based food production systems.

While the Bobby calf system remains legal and heavily regulated within New Zealand, market expectations and public scrutiny surrounding livestock systems continue evolving (*MPI HAVING OUR CAKE AND EATING IT Unlocking the Potential of Dairy-Beef*, n.d.). As a result, there may be increasing pressure on the industry to demonstrate that surplus calves are being managed in ways that align with changing expectations around animal welfare, sustainability, and responsible resource use.

The literature consistently reinforces that improving calf retention is not automatically straightforward or economically risk free. Retaining calves for longer periods introduces substantially greater feed demand, labour requirements, infrastructure pressure, working capital exposure, and management complexity (*DairyNZ, n.d.-a*; *Rabobank, 2025*). As a result, the challenge is not simply whether calves can physically be reared successfully, but whether retained calf systems genuinely fit within the operational realities of seasonal pasture-based dairy farming systems. That tension sits at the centre of much of the current dairy-beef discussion within New Zealand agriculture.

## 3.2 Market Drivers and Sustainability Expectations

The New Zealand dairy industry is increasingly operating within a market environment where sustainability, environmental performance, animal welfare, and supply-chain transparency are becoming major commercial drivers.

International consumers and food companies are placing far greater emphasis on how food is produced, not simply the final product itself. Expectations surrounding emissions reduction, ethical food production, traceability, and environmental performance now influence procurement policies, investment decisions, and wider market positioning throughout global food supply chains (*Rabobank, 2025*).

Large multinational companies, who are some of New Zealand's largest dairy customers,  such as Nestlé and Mars Incorporated have publicly committed to improving sustainability outcomes throughout agricultural supply chains. Importantly, these expectations extend well beyond carbon reporting alone and increasingly encompass animal welfare, social licence, resource-use efficiency, and broader production-system transparency (*Mars Incorporated. 2024. Sustainable in a Generation Plan. Mars Inc.*, n.d.). This is particularly relevant within the New Zealand context, where agriculture remains heavily export focused.

New Zealand's international competitiveness increasingly depends not only on production efficiency and product quality, but also on wider perceptions surrounding environmental performance, sustainability, and ethical food production systems. At the same time, domestic pressure surrounding environmental performance also continues increasing. Water quality, greenhouse gas emissions, nutrient loss, biodiversity, and land-use intensity remain major issues across the wider agricultural sector (*Rabobank, 2025*). Within that environment, surplus calf management is increasingly becoming part of a broader conversation around how effectively livestock systems utilise existing biological resources. Historically, the bobby calf pathway was largely viewed as a normal component of seasonal dairy farming. However, changing consumer expectations and increasing scrutiny surrounding livestock systems appear to be shifting that discussion. The literature suggests there may also be genuine commercial opportunity emerging through stronger dairy-beef integration (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Rabobank, 2025*).

Global demand for high-quality beef protein remains strong, and dairy-origin beef systems have been identified as a potential mechanism for improving production efficiency through greater utilisation of feed resources, genetics, and livestock already generated within dairy systems. International research has highlighted the increasingly important role dairy-origin beef production is expected to play in future livestock industries worldwide. As reproductive efficiency within dairy herds continues to improve through technologies such as sexed semen, genomic selection, and the increased strategic use of beef sires over dairy cows, dairy-origin calves are becoming a progressively more important component of global beef supply chains (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Rabobank, 2025*).

The literature further suggests that pasture-based dairy-beef systems may provide an effective balance between profitability, sustainability, and resource-use efficiency compared with more intensive feedlot-style production systems (*Rabobank, 2025*). Research and industry reporting suggest approximately 70–75% of New Zealand beef exports now contain some degree of dairy origin, reinforcing the increasingly interconnected relationship between the dairy and beef industries (*Rabobank, 2025*). At the same time, New Zealand's highly seasonal pasture-based dairy model also creates a significant number of surplus calves each spring. Because calving is concentrated into relatively short seasonal windows, a large proportion of calves born annually remain surplus to replacement requirements (*Rabobank, 2025*).

Historically, many of these calves have either entered the bobby calf system at approximately 4–5 days of age, flowed into lower-value beef pathways, or been managed through short-term calf-rearing systems before sale (*Rabobank, 2025*). Research indicates that only a relatively small proportion of surplus dairy calves are currently retained through integrated dairy-beef systems, despite growing industry discussion surrounding improved value capture and resource utilisation (*Rabobank, 2025*).

However, the literature consistently demonstrates that no single dairy-beef production system optimises all outcomes simultaneously. Trade-offs commonly exist between profitability, labour demand, feed requirements, greenhouse gas emissions, infrastructure investment, operational simplicity, and management complexity. Systems capable of generating stronger financial returns often require higher levels of supplementary feeding, greater management capability, and increased operational input. Equally, lower-input systems may reduce labour, and feed demands but do not necessarily maximise financial performance (*Hemmert 2026*; *Rabobank, 2025*).

Overall, the literature indicates that successful dairy-beef integration is unlikely to be determined by biological performance alone. Rather, long-term adoption will likely depend on whether retained calf systems remain commercially practical and operationally achievable within seasonal pasture-based dairy farming environments (*Rabobank, 2025*).

## 3.3 Feed Demand and Pasture-Based System Constraints

Feed demand emerged as one of the most significant practical constraints associated with retained calf systems throughout the literature. New Zealand dairy farms are largely designed around seasonal pasture utilisation and efficient milk production. Feed demand across many systems is already tightly aligned with pasture growth patterns, irrigation management, supplementary feeding strategies, and seasonal milk production targets (*DairyNZ, n.d.-a*; *Rabobank, 2025*).

Retaining larger numbers of calves beyond the traditional bobby calf pathway introduces additional pressure on pasture allocation, supplementary feed demand, grazing management, labour resources, and wider whole-farm feed planning. This becomes particularly relevant during periods when pressure on the dairy platform is already elevated, including late winter, early spring, dry summer periods, and autumn feed budgeting (*DairyNZ, n.d.-a*; *Rabobank, 2025*).

The literature consistently highlighted the challenge of integrating retained calf systems into existing dairy operations without compromising overall farm performance. While calves may technically achieve target liveweight gains, the more difficult question is whether those gains can be achieved without creating excessive pressure on milk production, pasture cover, supplement demand, or wider feed availability (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *DairyNZ, n.d.-a*; *Rabobank, 2025*).

Research examining calf growth performance suggested that retained calf systems are heavily influenced by feed quality, nutritional consistency, supplement allocation, and overall management quality during the early stages of life. Systems targeting higher liveweight gains generally require substantially greater feed allocation and more consistent nutrition, particularly where calves are retained through summer and autumn periods (*Hemmert, 2026* ; *Soberon et al., 2012*).

This creates an important tension within seasonal pasture-based dairy systems. While retained calf systems may improve value capture from animals already being produced within the dairy platform, they may also compete directly with the primary objective of the dairy system, which remains efficient milk production. As calf numbers increase, systems often require additional silage reserves, greater supplement use, more feed storage infrastructure, tighter grazing management, and significantly greater feed planning. This appears particularly relevant within irrigated Canterbury dairy systems, where stocking rates are already relatively high and feed demand is tightly managed throughout the season (*Contract Grazing*, n.d.; *DairyNZ, n.d.-a*; *Rabobank, 2025*).

Scalability also emerged as a major issue throughout the literature. Smaller retained calf systems may operate successfully within existing farm resources; however, retaining larger numbers of calves at a commercial scale often requires materially different labour structures, feed systems, infrastructure capability, and management approaches (*Opportunities for Beef on Dairy in New Zealand By Nuffield Scholar*, 2024; *Rabobank, 2025*).

The seasonal nature of New Zealand pasture production creates additional complexity. Feed demand associated with retained calf systems does not always align with periods of peak pasture growth. As a result, many systems become increasingly reliant on supplementary feed during periods when pasture deficits may already exist across the wider dairy platform. This creates additional exposure to supplement price volatility, feed availability risk, climatic variability, and broader market fluctuations (*Rabobank, 2025*).

Dry seasons or periods of reduced pasture growth may significantly alter the economics of retained calf systems, particularly where animal target growth rates become increasingly dependent on purchased feed inputs. The literature ultimately reinforces that New Zealand's pasture-based systems remain both one of the country's greatest production strengths and one of the largest practical constraints when considering large-scale retained calf systems (*DairyNZ, n.d.-a*; *Rabobank, 2025*).

Successful systems are unlikely to be those that simply maximise liveweight gain. Instead, the literature suggests that the most commercially viable systems will be those capable of balancing profitability, feed demand, labour requirements, and operational practicality without materially compromising wider dairy platform performance (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *DairyNZ, n.d.-a*).

## *3.4 Labour, Infrastructure and Operational Complexity*

Labour availability and operational complexity also emerged as major constraints throughout the literature. Seasonal dairy farming already operates within highly concentrated workload periods, particularly during calving, mating, irrigation management, pasture allocation, and peak milk production. Introducing retained calf systems into these already demanding periods has the potential to significantly increase operational pressure across the wider farm system (*DairyNZ, n.d.-a*; *Opportunities for Beef on Dairy in New Zealand By Nuffield Scholar*, n.d.; *Rabobank, 2025*).

The literature consistently highlighted that successful calf-rearing systems rely heavily on management quality, labour consistency, feeding accuracy, hygiene standards, and effective animal health oversight. This becomes increasingly important as calf numbers increase. Retaining calves beyond the traditional bobby calf stage generally requires substantially greater labour input associated with milk feeding, meal feeding, health treatments, monitoring and weighing, cleaning and hygiene, grazing transitions, and ongoing animal observation (*Bell Booth Holger Studies*, n.d.; *Best Practices for Handling Newly Arrived Calves in Feedlots*, n.d.; *Calf Rearers Top Notch Calves*, n.d.).

Several studies identified labour efficiency as a critical factor as retained calf systems increase in scale. Smaller systems may remain manageable within existing farm teams; however, larger retained calf enterprises often require dedicated calf-rearing staff, additional management oversight, greater infrastructure investment, and more specialised operational systems. This creates additional pressure during periods when labour demand across the wider dairy platform is already high (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Rabobank, 2025*; *Viability of Dairy-Origin Calves for a New Beef Production Enterprise in New Zealand*, n.d.).

Infrastructure requirements also increase rapidly as systems intensify. Larger retained calf operations often require additional calf housing, improved drainage and effluent management systems, feed storage facilities, reliable water infrastructure, fencing and grazing infrastructure, and machinery suitable for feeding and animal handling. Importantly, many of these costs are not always fully accounted for when assessing the economic viability of retained calf systems (*Feedlot Housing Entegra*, n.d.; *Rabobank, 2025*).

The literature further reinforced that profitability alone does not determine whether a system is practically achievable at the farm level. Operational simplicity, labour availability, infrastructure quality, management capability, and compatibility with the wider farming system remain equally important considerations (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Rabobank, 2025*).

Research examining calf-rearing performance also highlighted the importance of management quality in determining animal outcomes. Poor early-life management can significantly reduce growth performance, feed efficiency, animal health, and ultimately overall financial returns(*Hemmert, 2026* ; *Preweaning Milk Replacer Intake and Effects on Long-Term Productivity of Dairy Calves*, n.d.; *Soberon et al., 2012*). Consequently, systems that appear financially attractive on paper may still prove difficult to implement successfully within commercial dairy environments if labour quality becomes inconsistent or operational demands become excessive (*DairyNZ, n.d.-a*; *Rabobank, 2025*).

This appears particularly relevant within larger seasonal dairy systems, where management attention is already heavily focused on maintaining milk production performance across the wider platform. A recurring theme throughout the literature was that operational simplicity continues to hold substantial value within commercial dairy farming systems. Although additional profitability may be financially attractive, systems that place excessive pressure on labour, management, infrastructure, and operational flexibility may ultimately prove difficult to sustain over the long term (*Contract Grazing*, n.d.; *Opportunities for Beef on Dairy in New Zealand By Nuffield Scholar*, n.d.; *Rabobank, 2025*).

Overall, the literature consistently indicates that successful retained calf systems must function not only biologically and economically, but also operationally within the practical realities and constraints of commercial seasonal dairy farming (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *DairyNZ, n.d.-a*; *Rabobank, 2025*).

## 3.5 Economic Trade-Offs and System Viability

Research indicated that improved calf retention has the potential to significantly increase value capture from calves already being produced within the dairy industry. Compared with the traditional bobby calf pathway, retained calf systems may create opportunities to increase revenue per calf, improve utilisation of existing biological resources, strengthen dairy-beef integration, improve beef production efficiency, and potentially enhance wider system sustainability (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Pamu Farms Non Dairy Beef*, n.d.; *Rabobank, 2025*).

However, the literature elucidated that increases in value capture rarely occur without corresponding increases in cost, risk, and operational pressure elsewhere within the farming system. As calves are retained for longer periods, systems generally experience increased feed demand, supplement use, labour requirements, animal health costs, infrastructure pressure, and working capital exposure. This creates important economic trade-offs within commercial dairy farming systems (*DairyNZ, n.d.-a*; *Rabobank, 2025*; *Viability of Dairy-Origin Calves for a New Beef Production Enterprise in New Zealand*, n.d.).

Systems capable of generating stronger gross financial returns often also carry materially greater exposure to feed price volatility, supplement cost increases, labour shortages, climatic variability, and changing beef market conditions. One of the most consistent findings throughout the literature was the sensitivity of retained calf systems to shifts in feed availability and market dynamics (*Meat Industry Association NZ*, n.d.; *Rabobank, 2025*).

Feed price volatility emerged as a particularly important consideration. More intensive retained calf systems often become increasingly reliant on milk powder, meal feeding, silage reserves, purchased supplements, and consistent feed supply throughout summer and autumn periods. Consequently, fluctuations in supplement pricing or periods of reduced pasture growth may significantly alter system profitability between seasons (*DairyNZ, n.d.-a*; *How to Improve Your Feed Conversion Ratio Through Feed Management Strategies*, n.d.; *Rabobank, 2025*).

Beef market volatility similarly has the potential to materially influence financial performance. Changes in calf sale prices, beef schedules, feed costs, and wider input prices may substantially affect final economic outcomes, particularly in higher-input retained calf systems where costs accumulate over extended periods.

The literature suggests that retained calf systems are most likely to perform well where feed resources are reliable, infrastructure is already established, labour systems are strong, management capability is high, and operational pressure across the wider dairy platform remains manageable. Conversely, systems may struggle where feed supply is inconsistent, labour availability is limited, infrastructure is insufficient, or wider farm system pressure becomes excessive (*Dairy Nz*, n.d.-a; *Opportunities for Beef on Dairy in New Zealand By Nuffield Scholar*, n.d.; *Rabobank, 2025*).

A recurring theme throughout the literature is that the "best" retained calf system is unlikely to be uniform across all dairy farms. System suitability appears strongly influenced by farm scale, climatic conditions, irrigation reliability, feed supply, labour availability, infrastructure capability, management quality, and broader business objectives. This is particularly relevant in the New Zealand context, where dairy systems vary substantially between regions in terms of climate, feed base, and operational scale (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *DairyNZ, n.d.-a* ; *Rabobank, 2025*).

The literature further reinforces that profitability alone is unlikely to determine widespread adoption of retained calf systems within the dairy industry. While wider industry commentary has described dairy-beef integration as a potential '$1.2 billion opportunity' for New Zealand agriculture (Rabobank New Zealand, 2025), long-term adoption will still depend heavily on operational practicality, labour efficiency, scalability, and resilience within commercial dairy systems. Financial attractiveness must be matched by operational feasibility, scalability within commercial farm systems, labour efficiency, and resilience during periods of seasonal pressure (*Rabobank, 2025*; *Viability of Dairy-Origin Calves for a New Beef Production Enterprise in New Zealand*, n.d.).

A consistent theme is that many successful retained calf systems are either relatively specialised, operated at smaller scale, or supported by highly experienced calf-rearing capability. As a result, systems that perform well under controlled or specialised conditions may not necessarily translate effectively into larger commercial dairy businesses already operating under significant labour and management constraints (*Calf Rearers Top Notch Calves*, n.d.; *Calf Ways Project Waste Not, Want Not: Value Chain Stakeholder Attitudes to Surplus Dairy Calf Management in Australia*, n.d.; *Rabobank, 2025*).

Overall, the literature reinforces that successful dairy-beef integration is unlikely to be determined by biology or profitability alone. Long-term adoption will depend on whether retained calf systems can remain commercially viable while also fitting practically within the operational realities of seasonal, pasture-based dairy farming systems (*Rabobank, 2025*).

## *3.6 Implications for Scalable Dairy-Beef Systems in New Zealand*

The international literature highlighted that both intensive housed systems and outdoor pasture-based systems present distinct advantages and limitations when considering scalable beef production systems. Intensive housed or feedlot systems may improve feeding consistency, growth performance, nutritional control, and animal monitoring capability. However, these systems also introduce additional challenges associated with infrastructure cost, effluent management, ventilation, respiratory disease, heat stress, bedding management, and wider public perceptions of intensive livestock production (*An On-Farm Feedlot Setup: The Basics*, n.d.; *Best Practices for Handling Newly Arrived Calves in Feedlots*, n.d.; *Feedlot Housing Entegra*, n.d.).

Conversely, outdoor pasture-based systems may offer advantages associated with lower levels of confinement, pasture utilisation, natural ventilation, and alignment with New Zealand's wider grass-fed market positioning. However, these systems remain heavily influenced by seasonal pasture supply, climatic variability, weather exposure, parasite pressure, grazing management, and pasture quality variation (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *Dairy Nz*, n.d.-a; *Rabobank, 2025*).

These findings are particularly relevant within the New Zealand context, where livestock production systems have historically been built around low-cost pasture utilisation and seasonal grazing systems. While this model provides several inherent production advantages, the same system characteristics may also constrain the rapid scaling of retained calf systems (*DairyNZ, n.d.-a*; *Rabobank, 2025*).

One of the major limitations associated with large-scale outdoor calf systems is the requirement for a consistent, high-quality feed supply capable of sustaining target liveweight gains over extended periods. Seasonal pasture deficits, irrigation constraints, climatic variability, and increasing competition for feed across the wider dairy platform may limit the ability to economically scale retained calf systems without greater reliance on supplementary feed inputs (*Contract Grazing*, n.d.; *DairyNZ, n.d.-a*; *Rabobank, 2025*).

As stocking pressure increases, systems may also experience increased parasite burden, animal health challenges, grazing management complexity, and environmental pressure. Labour availability and management capability also emerged throughout the literature as major constraints to scalability. Although pasture-based systems may avoid some of the capital intensity associated with feedlot systems, large-scale retained calf systems still require substantial labour input, management oversight, animal monitoring, infrastructure management, and operational coordination (*Calf and Replacement Heifer Mortality from Birth until Weaning in Pasture-Based Dairy Herds in New Zealand*, n.d.; *Calf Rearers Top Notch Calves*, n.d.; *Rabobank, 2025*).

As system scale increases, maintaining consistency in animal performance, feed allocation, welfare outcomes, and day-to-day management becomes increasingly difficult. The literature repeatedly reinforces that scalability may ultimately represent one of the most significant challenges for retained calf systems within New Zealand agriculture. While smaller systems may operate effectively within existing farm resources, larger systems may require materially different labour structures, feed systems, infrastructure capability, management systems, and overall operational design (*Opportunities for Beef on Dairy in New Zealand By Nuffield Scholar*, n.d.;

*Rabobank, 2025*; *Viability of Dairy-Origin Calves for a New Beef Production Enterprise in New Zealand*, n.d.).

This consideration becomes particularly important when assessing whether retained calf systems can be more widely adopted across the New Zealand dairy industry. Another consistent theme throughout the literature is the importance of maintaining New Zealand's wider pasture-based production advantage. Internationally, New Zealand agriculture continues to be recognised for producing milk and beef predominantly from pasture-based systems rather than highly intensive feedlot models. This positioning carries increasing value in international food markets where consumers are placing greater emphasis on sustainability, natural production systems, and reduced levels of confinement feeding (*DairyNZ*, n.d.-a; *Mars Incorporated. 2024. Sustainable in a Generation Plan. Mars Inc.*, n.d.; *Meat Industry Association NZ*, n.d.).

As a result, future expansion of retained calf systems will likely need to ensure that New Zealand's pasture-based reputation, environmental positioning, and international market differentiation are maintained and not undermined through excessive intensification. This consideration becomes increasingly important as dairy-beef integration is being discussed as a major strategic opportunity for New Zealand agriculture (Rabobank New Zealand, 2025).

The literature suggests that the future opportunity for New Zealand may not lie in replicating overseas feedlot systems, but in developing approaches that balance pasture utilisation, targeted supplementation, animal welfare, environmental sustainability, labour practicality, and commercial performance (Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016, n.d.; MPI HAVING OUR CAKE AND EATING IT Unlocking the Potential of Dairy-Beef, n.d.; Rabobank, 2025).

Rather than maximising production intensity alone, the more realistic long-term opportunity may involve systems that remain closely aligned with New Zealand farming conditions and market positioning while improving value capture from surplus calves. Ultimately, the literature reinforces that successful dairy-beef integration within New Zealand is likely to depend on developing systems that remain commercially practical, operationally achievable, scalable, resilient, and compatible with seasonal pasture-based farming structures (*Beef + Lamb New Zealand Dairy Beef Integration Project: Final Report Vicki Burggraaf September 2016*, n.d.; *DairyNZ, n.d.-a; Rabobank, 2025*).

The key challenge moving forward is therefore less about whether retained calf systems can be developed, and more about identifying which systems can function successfully within the operational, environmental, and economic realities of commercial New Zealand dairy farming.

# 4.0 Methodology

## *4.1 Farm System Overview*

A comparative modelling approach was used to evaluate the financial and operational implications of retaining non-replacement dairy calves beyond the traditional bobby calf system. The analysis was based on a representative irrigated Mid Canterbury dairy farm system and assessed the integration of retained calf systems within the wider dairy platform, rather than evaluating calf performance in isolation.

The primary objective was to determine how increasing levels of calf retention to higher weights whilst not compromising  whole-farm outcomes, including profitability, feed demand, labour requirements, and operational complexity. Particular emphasis was placed on system interactions, recognising that within seasonal pasture-based dairy systems, any additional enterprise must be compatible with existing farm constraints, particularly during peak spring workload periods.

The representative farm system comprised 270 ha effective area, milking 1,000 cows, at a stocking rate of 3.7 cows/ha. The system reflected a typical irrigated Canterbury dairy platform utilising a seasonal pasture-based system supplemented with conserved and purchased feed when required.

Approximately 1,000 calves were assumed to be born annually. A 5% mortality rate was applied, with 250 calves retained as replacement heifers and approximately 10% classified as short-gestation or lower-value calves entering conventional bobby calf pathways. This resulted in approximately 600 surplus calves available for inclusion in retained calf system scenarios.

The analysis focused on the impact of increasing calf retention on:

- whole-farm profitability
- labour demand and allocation
- feed supply and utilisation
- grazing and pasture management
- animal health management
- infrastructure pressure
- and overall system complexity

As retention intensity increased, greater pressure was expected across feed supply, labour availability, and infrastructure capacity, particularly during summer and autumn periods when pasture growth variability and supplementary feed demand typically increase in Canterbury systems.

## 4.2 Comparative Modelling Approach

Three calf management systems were developed and evaluated under a comparative framework. The systems were structured to represent progressively increasing levels of calf retention, feed demand, labour requirement, and operational complexity. The objective of this approach was to enable direct comparison of biological, financial, and operational trade-offs associated with alternative surplus calf management strategies.

## 4.3 Model Assumptions and Scenario Inputs

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Cows milked (head) | 1,000 | 1,000 | 1,000 |
| Effective farm area (ha) | 270 | 270 | 270 |
| Stocking rate (cows/ha) | 3.7 | 3.7 | 3.7 |
| Total calves born (head/year) | 1,000 | 1,000 | 1,000 |
| Neonatal mortality (%) | 5 | 5 | 5 |
| Replacement heifers retained (head) | 250 | 250 | 250 |

*Table 1: Farm system parameters*

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Surplus calves reared (head) | 0 | 600 | 600 |
| Mortality during rearing (%) | 0 | 5 | 5 |
| Calves sold after rearing (head) | 0 | 570 | 570 |
| Sale liveweight (kg LW) | 0 | 100 | 225 |
| Sale price ($/kg LW) | 0 | 6.75 | 6.20 |
| Bobby calf price ($/head) | 35 | 35 | 35 |
| Sale timing | Spring | Nov–Dec | Apr–May |

*Table 2: Calf flow and liveweight pathways*

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Milk powder (kg/calf) | 50 | 50 | 50 |
| Milk powder cost ($/kg) | 5.00 | 5.00 | 5.00 |
| Calf meal (kg/calf) | 15 | 15 | 15 |
| Meal cost ($/kg) | 1.05 | 1.05 | 1.05 |
| Supplement to 100 kg LW (kg DM/calf) | 162 | 162 | 162 |
| Supplement cost ($/kg DM) | 0.60 | 0.60 | 0.60 |

*Table 3: Feed inputs per calf*

| Parameter | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Labour to 100 kg (hrs/calf) | 6.0 | 6.0 | 6.0 |

| | | | |
|---|---|---|---|
| Labour beyond 100 kg (hrs/calf) | 0 | 0 | 3.4 |
| Labour cost ($/hr) | 30 | 30 | 30 |
| Animal health to 100 kg ($/calf) | 40 | 40 | 40 |
| Animal health beyond 100 kg ($/calf) | 0 | 0 | 40 |

*Table 4: Labour and animal health inputs*

A consistent set of biological, feed, labour, and financial assumptions was applied across all three calf management models to enable direct comparison of system performance under a standardised farm environment (Tables 1-4).

Calf allocation differed by system, with replacement heifers (250 head) retained consistently across all models. Surplus calf pathways varied between scenarios, with Model 1 representing a traditional bobby calf system and Models 2 and 3 incorporating increasing levels of calf retention with higher liveweight gains to meet sale expectations. (Table 2).

Feed inputs were standardised on a per-calf basis, incorporating milk powder, meal, and pasture/supplementary feed requirements, with the majority of feed been imported off farm ie. meal, powder and silage. Supplementary feed requirements beyond 100 kg liveweight were applied only in Model 3, reflecting extended retention through summer and autumn grazing periods (Table 3).

Labour and animal health costs were structured to reflect increasing management intensity with extended retention duration. Labour requirements increased substantially beyond 100 kg liveweight in Model 3 to account for extended grazing management, animal movement, and monitoring requirements (Table 4).

# 5.0 Results

Three calf management systems were evaluated to assess the financial and operational implications of increasing levels of surplus calf retention within a representative irrigated Mid Canterbury dairy farm system. The results demonstrated a clear trade-off between increasing value capture from surplus calves and escalating feed, labour, and management requirements as retention intensity increased.

## *5.1 Revenue Outcomes*

Total revenue increased substantially with increasing calf retention intensity (Table 5). Model 1 generated minimal income from surplus calves, reflecting early exit through the bobby calf pathway. In contrast, Models 2 and 3 generated significantly higher revenue due to the capture of additional liveweight gain prior to sale. Model 3 produced the highest total income, driven by both increased sale weight and higher per-calf value. These results demonstrate that retaining calves beyond the bobby stage materially increases gross revenue potential within the system (Table 5).

| Revenue component | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Bobby calf income ($) | 24,500 | 3,500 | 3,500 |
| Reared calf income ($) | 0 | 384,750 | 795,150 |
| Total income ($) | 24,500 | 388,250 | 798,650 |

*Table 5: Revenue comparison across models*

## 5.2 Direct operating costs

Direct operating costs increased progressively with calf retention intensity across all models (Table 6). Model 1 incurred the lowest costs due to minimal feed, labour, and animal health requirements beyond early calf removal. Model 2 showed a substantial increase in costs, primarily driven by milk feeding, labour input, and supplementary feed use. Model 3 incurred the highest total costs, with significant increases in supplement and labour expenditure reflecting extended retention through summer and autumn. Cost escalation closely followed increases in system intensity and feed demand (Table 6).

| Cost item ($) | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Milk powder | 62,500 | 205,000 | 205,000 |
| Meal | 3,938 | 12,915 | 12,915 |
| Supplement | 24,300 | 79,704 | 318,249 |
| Labour (increases over the models) | 45,000 | 147,600 | 205,740 |
| Animal health | 10,000 | 32,800 | 55,600 |
| Fixed / infrastructure | 0 | 0 | 0 |
| Total direct costs ($) | 145,738 | 478,019 | 797,504 |

*Table 6: Direct operating cost comparison across models*

## 5.3 Profitability and efficiency outcomes

Profitability outcomes showed a non-linear response to increasing calf retention. Model 1 generated a substantial negative return due to low revenue capture from surplus calves. Model 2 improved value capture substantially compared with the traditional bobby calf pathway, although profitability remained sensitive to feed, labour, and rearing cost assumptions (Table 7). Model 3 produced only marginal net returns despite high gross income, reflecting proportional increases in operating costs. Efficiency metrics per cow and per hectare followed a similar pattern, with Model 2 performing most favourably relative to resource use.

| Metric | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Return less direct costs ($) | -121,238 | -89769 | 1,146 |
| Return per cow ($/cow) | -121 | -90 | 1 |
| Return per ha ($/ha) | -449 | -332 | 4 |
| Return per costed calf ($/calf) | -485 | -109 | 1 |
| Costed calves (head) | 250 | 820 | 820 |

*Table 7: Profitability and efficiency comparison across models*

## 5.4 Feed and labour demand

Feed and labour requirements increased sharply with calf retention intensity (Table 8). Supplement demand rose from relatively low levels in Model 1 to more than half a million kilograms of dry matter in Model 3, highlighting the increasing integration of retained calves into whole-farm feed budgets. Labour input followed a similar trend, increasing more than four-fold between Model 1 and Model 3. These results indicate that system intensity is strongly associated with escalating resource demand, particularly under extended calf retention.

| Metric | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Total supplement demand (kg DM) | 40,500 | 132,840 | 530,415 |
| Supplement demand (kg DM/ha) | 150 | 492 | 1,964.5 |
| Labour input (hours) | 1,500 | 4,920 | 6,858 |
| Labour cost ($/hr) | 30 | 30 | 30 |

*Table 8: Feed and labour comparisons across models*

## 5.5 System risk and exposure indicators

Model 1 maintained low exposure across all risk categories, reflecting its simplicity and early calf exit strategy (Table 9). Model 2 introduced moderate levels of exposure and/or pressure. Model 3 exhibited moderate to high levels of pressure on parasite and grazing pressure; and seasonal pasture exposure, as well as high feed system pressures.

| Attribute | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Feed system pressure | Low | Moderate | High |
| Seasonal pasture exposure | Low | Moderate | Moderate–High |
| Parasite/grazing pressure | Low | Moderate | Moderate–High |

Table 9: System risk comparison across models

## *5.6 Sensitivity summary (break even thresholds)*

Sensitivity analysis indicated that both retained calf systems were highly responsive to changes in input costs and sale prices. Model 2 required a higher breakeven price than Model 3, reflecting its lower sale weight and margin structure. However, Model 3 exhibited greater absolute exposure to feed cost volatility due to its higher total supplement demand (Table 10). Overall, results demonstrate that profitability in retained calf systems is highly dependent on both feed cost efficiency and market price stability.

| Metric | Model 2 | Model 3 |
|---|---|---|
| Breakeven sale price ($/kg LW) | 8.32 | 6.19 |
| Key driver of sensitivity | Feed + labour cost | Feed cost + sale price |
| Profit stability | Moderate | Low–Moderate |

Table 10: Sensitivity comparison across model 2 and model 3

# 6.0 Discussion

The project highlighted how quickly the balance shifts between profitability, simplicity, labour demand, and feed requirement as calf retention increases across a seasonal dairy system. While all three models started from the same biological base, the impact on the wider farm business changed considerably once calves remained in the system for longer periods.

One of the clearest outcomes from the analysis was that stronger financial returns generally came alongside greater exposure to feed cost volatility, labour demand, supplement use, infrastructure requirement, and seasonal variability. This relationship became particularly evident once calves were retained through summer and autumn.

Model 1 remained the simplest system to manage. Surplus calves exited early, allowing labour, feed, and management attention to remain focused on milk production and the core dairy operation. At the opposite end of the scale, Model 3 generated the highest gross revenue and strongest value capture potential but also became the most demanding system to maintain consistently. Feed supply, staffing capability, supplement pricing, infrastructure capacity, and seasonal conditions all had much greater influence on final performance once calves were retained for longer periods.

Model 2 appeared to sit somewhere between the two. Compared with the bobby calf pathway, it improved value capture substantially. At the same time, calves still exited before the more difficult summer and autumn feed periods, reducing some of the pressure associated with heavier retained calf systems. From a commercial dairy perspective, this became one of the more important findings from the project.

The results suggested that the most profitable system on paper was not necessarily the easiest system to operate successfully at farm level. As calf retention increased, the discussion moved beyond calf performance alone and became increasingly tied to wider decisions around feed allocation, irrigation management, labour structures, grazing management, and farm-system timing.

Large dairy businesses are already operating under significant pressure through spring and early summer. Calving, mating preparation, irrigation management, pasture allocation, and maintaining milk production all compete for time and labour during relatively condensed periods of the season. As a result, systems that materially increase workload or reduce flexibility may become difficult to sustain long term, even where projected returns appear attractive financially.

At the same time, however, the analysis also highlighted the opportunity cost associated with traditional surplus calf pathways. Large numbers of calves are already being produced annually across New Zealand dairy systems. Retaining more of those animals has the potential to improve value capture while also strengthening dairy-beef integration and making greater use of existing livestock resources.

Importantly, the project suggested no single system optimised every outcome simultaneously. Model 1 prioritised simplicity and reduced pressure but generated relatively low financial return from surplus calves. Model 3 maximised value capture, but required substantially greater feed input, labour commitment, infrastructure capability, and management consistency. Model 2 appeared to provide a more balanced middle ground, improving profitability without introducing the same level of exposure seen in the heavier retained calf system.

Overall, the project suggested there is genuine opportunity to improve value capture from surplus calves within New Zealand dairy systems. However, long-term success will likely depend on developing systems that remain commercially manageable under real farming conditions rather than simply performing well within theoretical financial modelling.

## *6.1 Model 1 – Traditional Bobby Calf System*

Model 1 reflected the traditional New Zealand dairy approach, where the primary focus remains efficient milk production with minimal additional demand placed on the wider farm system. Operationally, this system was by far the simplest of the three models evaluated.

Because surplus calves exited the farm at approximately 4–5 days of age, feed demand remained relatively low, labour requirements were manageable, infrastructure pressure was limited, and working capital exposure remained comparatively small. This aligned closely with the realities of seasonal dairy farming, where labour and management demand are already heavily concentrated around calving, mating, irrigation management, and maintaining milk production.

From a whole-farm perspective, Model 1 created minimal disruption to core dairy operations. Compared with the retained calf systems, the bobby calf pathway largely avoided extended feeding requirements, grazing pressure, large-scale supplement demand, additional infrastructure needs, and ongoing management intensity. This remained one of the key strengths of the traditional system.

At the same time, the analysis highlighted that relatively little value is captured from surplus calves under this approach. Although large numbers of calves are produced annually across the dairy platform, direct income remains limited once animals exit the system at a very young age.

Historically, this trade-off has been accepted because the system aligns well with the priorities of seasonal dairy farming, particularly labour efficiency and operational simplicity. However, increasing emphasis on animal welfare, sustainability, resource-use efficiency, and social licence may continue to place pressure on systems reliant on early calf exit pathways.

Overall, Model 1 remained highly manageable and comparatively low risk, but generated substantially lower financial returns than the retained calf systems, prioritising simplicity and reduced exposure at the expense of value capture.

## *6.2 Model 2 – 100 kg Liveweight System*

Model 2 represented a more balanced intermediate system between improving value capture and maintaining operational practicality within a seasonal dairy environment. Compared with the bobby calf pathway, this system substantially improved value capture from surplus calves while remaining operationally more manageable than Model 3

A key advantage of Model 2 was that calves exited the farm before the more feed-constrained summer and autumn periods. This reduced pressure on pasture allocation, supplement demand, grazing management, and seasonal feed availability, and was a major factor supporting its practical feasibility at commercial scale.

Despite this, Model 2 still required a substantial increase in operational input compared with Model 1. Labour demand increased considerably due to milk feeding, meal feeding, calf monitoring, animal health management, weighing and drafting, and general stock handling requirements.

The analysis also demonstrated that once calves are retained beyond the bobby stage, system profitability becomes increasingly sensitive to management quality. Financial outcomes in Model 2 were strongly influenced by calf growth performance, feed quality, labour efficiency, animal health outcomes, and overall execution consistency.

As retention intensity increased, calf rearing shifted from a relatively contained livestock activity into a broader farm management function requiring closer integration with labour allocation, feed systems, and operational coordination across the dairy platform.

Even so, Model 2 remained materially more scalable than Model 3. Feed demand, supplement use, infrastructure requirements, and seasonal exposure remained more controlled, allowing the system to operate within more typical seasonal dairy constraints.

Overall, Model 2 appeared to provide a relatively balanced middle-ground system between operational simplicity and increased value capture. While profitability remained highly sensitive to feed, labour, and calf-rearing costs under the assumptions used within this modelling exercise, the system remained materially more manageable and scalable than the heavier retained calf system represented in Model 3.

## *6.3 Model 3 – 225 kg Liveweight System*

Model 3 generated the highest gross revenue and the strongest value capture potential of all systems. however also created the highest level of exposure across the wider farm business. Compared with the other models, retaining calves through to approximately 225 kg liveweight significantly increased feed demand, supplement use, labour requirements, infrastructure pressure, grazing intensity, and working capital exposure.

A key finding from the analysis was that retained calf systems begin to materially influence whole-farm management once calves are carried through summer and autumn. At this point, calf rearing is no longer a separate enterprise but becomes closely integrated with broader farm decisions, including feed allocation, irrigation management, staffing structures, pasture management, and operational timing.

Relative to Model 2, Model 3 was far more exposed to seasonal variability. Feed shortages, supplement price volatility, pasture growth fluctuations, labour availability, and climatic conditions all had a greater influence on final system performance.

The analysis also indicated that maintaining consistent performance became increasingly difficult as retention duration and system scale increased. Profitability under Model 3 depended heavily on achieving target growth rates, maintaining reliable feed supply, controlling supplement costs, and sustaining strong day-to-day management performance.

While the system generated substantially greater revenue potential, the margin for error was considerably smaller than in the earlier systems. Small deviations in performance or input costs had a disproportionate effect on overall profitability.

Importantly, the results also suggested that scaling this system beyond relatively modest levels would likely require significant additional investment in infrastructure, including calf housing, feed storage, machinery, water systems, fencing, grazing infrastructure, and labour capacity.

Overall, Model 3 demonstrated that higher gross revenue and value capture potential does not necessarily translate into a system that is straightforward to implement or manage at scale under commercial dairy conditions.

## 6.4 Overall Industry Implications

The findings of this project suggest there is genuine potential to improve value capture from surplus calves within New Zealand dairy systems. Historically, the bobby calf pathway has aligned closely with the objectives of seasonal dairy farming by prioritising labour efficiency, simplicity, and reduced operational pressure during spring. However, increasing focus on sustainability, animal welfare, resource-use efficiency, and social licence is likely to continue driving interest in alternative calf management pathways.

At the same time, dairy-origin animals are becoming increasingly important within both domestic and international beef supply chains. Advances in reproductive technologies, beef genetics, and dairy-beef integration are improving the suitability and value of calves entering beef finishing systems, increasing opportunities for value capture from existing livestock streams.

Even so, the analysis reinforced that successful retained calf systems must remain compatible with the realities of seasonal pasture-based dairy farming. New Zealand's international positioning remains strongly linked to pasture utilisation, relatively low levels of confinement feeding, and efficient grass-based production systems. Future development of retained calf systems will therefore need to enhance value capture without compromising this underlying production philosophy.

Scalability remains one of the most significant constraints identified. While smaller-scale systems may integrate successfully within existing farm resources, larger systems require substantially greater coordination of feed supply, labour, infrastructure, and management consistency. This challenge is particularly relevant during spring and early summer, when farm systems are already operating under high pressure.

Rather than replicating intensive feedlot-style systems, the results suggest the most viable pathway for New Zealand may lie in developing systems that balance pasture utilisation, targeted supplementation, profitability, labour practicality, environmental performance, and commercial resilience.

Overall, the project indicates that no single retained calf system is likely to be universally optimal. Instead, adoption will depend on how well systems align with individual farm characteristics, including scale, feed supply, labour availability, irrigation reliability, infrastructure capacity, and management capability. Ultimately, the long-term success of dairy-beef integration in New Zealand will depend on ensuring that retained calf systems remain not only profitable, but also practical, scalable, and resilient under real-world farming conditions.

# 7.0 Limitations of the Modelling

Several limitations should be considered when interpreting the results of this modelling analysis. The study was based on a representative irrigated Mid Canterbury dairy platform and therefore may not be fully generalisable to other New Zealand dairy farming systems with different climatic, infrastructural, or management conditions.

A key limitation relates to system specificity. Variability in climate, pasture growth patterns, irrigation reliability, feed pricing, labour availability, beef market conditions, and farm infrastructure capacity may all materially influence system performance. Consequently, results should be interpreted as representative of a Mid Canterbury irrigated context rather than universally applicable across all dairy regions.

The modelling also relied on a range of static input assumptions, particularly for commodity prices and farm inputs. These included milk powder, supplementary feed costs, beef schedules, labour rates, and general farm operating expenses. Given the inherent volatility of agricultural markets, actual profitability outcomes are likely to vary both temporally and spatially.

A further limitation is the partial representation of whole-farm biological interactions. While the modelling captured direct feed and labour requirements for each calf system, potential knock-on effects on broader farm performance were not fully quantified. These include possible impacts on milk production, pasture cover dynamics, supplementary feed demand elsewhere in the system, and whole-farm feed allocation efficiency.

In addition, the analysis did not incorporate a full assessment of environmental outcomes. Greenhouse gas emissions, nitrogen losses, long-term soil and environmental impacts, and infrastructure depreciation were not explicitly modelled. While these factors are increasingly relevant within New Zealand agricultural systems, they were outside the scope of the present analysis.

The study also highlights a broader methodological constraint in agricultural systems modelling: the difficulty of quantifying operational pressure. While financial variables such as revenue, feed costs, labour expenses, and gross margins can be modelled with reasonable precision, non-financial dimensions such as management complexity, labour fatigue, operational stress, and system resilience are more difficult to quantify. This limitation is particularly relevant in higher-intensity retained calf systems, where operational demands increase disproportionately with extended retention duration.

Another limitation relates to transferability of results. Many successful retained calf systems in New Zealand are operated as specialised enterprises with dedicated infrastructure, experienced staff, and established management systems. As a result, outcomes observed in such systems may not be directly transferable to larger-scale commercial dairy platforms operating under different labour structures and competing seasonal priorities.

Furthermore, this modelling exercise was designed as a comparative system analysis rather than an optimisation of a single “best” retained calf strategy. The results therefore reflect relative differences between systems under a consistent set of assumptions, rather than absolute predictions of optimal system design.

Overall, the modelling indicates that retained calf system performance is highly sensitive to a combination of biological, financial, and operational factors, including management capability, feed reliability, labour efficiency, infrastructure availability, and system integration within the wider dairy platform. Systems that appear financially favourable under static assumptions may become operationally constrained when implemented within real-world seasonal dairy environments.

These limitations do not reduce the value of the comparative analysis; rather, they highlight the importance of interpreting results within the practical constraints of commercial seasonal dairy farming systems in New Zealand, where profitability, labour, feed supply, and operational simplicity must be considered jointly.

# 8.0 Conclusion

This project set out to assess whether surplus non-replacement dairy calves could be retained and reared within systems that remain both commercially viable and practically achievable alongside a seasonal New Zealand dairy platform.

The modelling and wider literature review reinforced that there is genuine opportunity to improve value capture from calves already being produced within the dairy industry. Compared with the traditional bobby calf pathway, retained calf systems demonstrated the potential to significantly increase financial return while also improving utilisation of existing livestock resources and strengthening integration between the dairy and beef sectors.

At the same time, the analysis also reinforced that increasing calf retention introduces substantially greater pressure across the wider dairy platform. As calves were retained for longer periods, systems became increasingly exposed to feed demand, supplement use, labour requirement, infrastructure pressure, management complexity, and wider operational risk.

One of the clearest findings throughout the project was how quickly retained calf systems shift from being a relatively straightforward calf-rearing exercise into a much larger whole-farm systems issue. Once calves remained within the platform through summer and autumn, retained calf systems became heavily integrated into wider decisions surrounding pasture allocation, feed budgeting, irrigation management, labour coordination, and operational timing across the dairy business. This became particularly relevant within large seasonal dairy systems where labour pressure and feed demand are already heavily concentrated during key periods of the farming calendar.

The project reinforced that the long-term success of retained calf systems is unlikely to be determined by theoretical profitability alone. Instead, system outcomes will likely depend on whether they remain operationally manageable, labour efficient, scalable, resilient, and commercially practical within the wider realities of seasonal pasture-based dairy farming.

Model 1 remained the simplest and operationally lowest-risk system. The traditional bobby calf pathway continued to align closely with the structure of seasonal dairy farming, where operational simplicity and efficient milk production remain dominant priorities. Because surplus calves exited the system early, pressure on labour, feed allocation, infrastructure, and wider farm management remained comparatively low. However, the modelling also highlighted how little direct value is ultimately captured from surplus calves under this system.

Model 2 appeared to provide one of the stronger balances between improving value capture and maintaining operational practicality. Compared with heavier retained calf systems, calves exited the platform before entering the more feed-constrained summer and autumn periods. As a result, feed pressure, supplement demand, and wider operational complexity remained more manageable within the broader dairy system. The modelling suggested that moderate retained calf systems may represent one of the more commercially realistic pathways for wider dairy-beef integration within seasonal New Zealand dairy farming.

Model 3 generated the highest gross revenue and value capture potential under the assumptions used throughout the analysis. However, it also introduced the greatest level of operational exposure across the wider farm system. Feed demand, supplement dependence, labour requirement, management pressure, and overall operational complexity all increased rapidly as calves were retained through summer and autumn periods. The modelling reinforced that heavier retained calf systems become increasingly dependent on consistent feed supply, strong labour performance, reliable management capability, and stable operating conditions. As a result, stronger revenue generation did not necessarily translate into greater practical suitability at commercial scale.

Another major finding throughout the project was the importance of protecting New Zealand's wider pasture-based production advantage. Internationally, New Zealand agriculture continues to differentiate itself through seasonal pasture utilisation and lower levels of confinement feeding compared with many overseas livestock systems. This positioning carries increasing value within global food markets where consumers are placing greater emphasis on sustainability, natural production systems, and animal welfare outcomes. The analysis suggested that future retained calf systems will need to improve value capture without undermining the wider pasture-based positioning that supports New Zealand’s international agricultural reputation, therefore targeted feeding of supplement will need to be across all animals on the dairy farm.

The project also reinforced that there is unlikely to be a single retained calf system suitable for all dairy farms. System suitability will continue to depend heavily on farm scale, feed supply, irrigation reliability, labour availability, management capability, infrastructure, and wider business objectives.

Ultimately, the project highlighted that improving outcomes for surplus calves is not simply about retaining more calves for longer periods. The greater challenge lies in developing systems that can successfully balance profitability, operational practicality, feed demand, labour efficiency, system resilience, and wider whole-farm performance.

Overall, the findings suggest there is genuine opportunity for improved dairy-beef integration within New Zealand agriculture. However, long-term success will likely depend on developing systems that remain commercially practical and operationally achievable within the realities of seasonal pasture-based dairy farming systems, rather than simply maximising production intensity or theoretical profitability alone.

# 9.0 Recommendation

The New Zealand dairy industry needs to shift from viewing surplus non-replacement calves as a by-product of seasonal milk production to recognising them as a valuable livestock resource. Greater focus should be placed on developing commercially practical systems that enable more calves to be retained and sold at either approximately 100 kg or 225 kg liveweight, providing finishers with healthy, well-grown animals capable of entering profitable beef production systems. While the most suitable system will vary between farms, increasing the value captured from calves already being produced presents a significant opportunity to strengthen both the dairy and beef sectors.

Achieving this at scale will require a whole-of-industry approach. Dairy farmers, beef finishers, processors, industry organisations, researchers, the arable sector and feed suppliers all have a role to play in developing integrated supply chains that improve profitability while maintaining New Zealand's pasture-based farming advantage. There is a real opportunity for the arable sector to produce high-quality protein and energy feed sources that complement pasture production, helping support retained calf systems while ensuring sufficient feed remains available for the milking herd. Greater collaboration between the dairy and arable sectors has the potential to improve feed resilience, strengthen whole-farm profitability, create additional and more diverse income streams for arable farmers, and unlock greater value across New Zealand agriculture.

Future investment should focus not simply on retaining more calves, but on developing systems that are commercially viable, operationally practical and scalable across New Zealand's seasonal dairy industry. The long-term success of retained calf systems will depend on balancing profitability, feed demand, labour requirements and whole-farm performance, while protecting the pasture-based farming systems that continue to differentiate New Zealand agriculture on the world stage.

# 10.0 References


2024–25 NZ Dairy Herd Statistics. (2025). Livestock Improvement Corporation (LIC), New Zealand.

An On-Farm Feedlot Setup: The Basics. (n.d.).

Beef + Lamb New Zealand. (2016). Dairy Beef Integration Project: Final Report. V. Burggraaf.

Bell, A., Booth, R., & Holger, D. (n.d.). Studies on calf-rearing systems and management.

Best Practices for Handling Newly Arrived Calves in Feedlots. (n.d.).

Calf and Replacement Heifer Mortality from Birth until Weaning in Pasture-Based Dairy Herds in New Zealand. (n.d.).

Calf Rearers Top Notch Calves. (n.d.).

Calf Ways Project. (n.d.). Waste Not, Want Not: Value Chain Stakeholder Attitudes to Surplus Dairy Calf Management in Australia.

Contract Grazing. (n.d.).

DairyNZ. (n.d.-a). Pasture-based dairy systems and calf-rearing resources.

DairyNZ. (n.d.-b). Feed management and supplementary feeding resources.

Feedlot Housing Entegra. (n.d.).

Hemmert, KJ. (2026). Research on dairy-beef production systems and retained calf performance, Science Direct

How to Improve Your Feed Conversion Ratio Through Feed Management Strategies. (n.d.).

LIC Dairy Statistics. (2025). Livestock Improvement Corporation, New Zealand.

Mars Incorporated. (2024). Sustainable in a Generation Plan. Mars Inc.

Meat Industry Association New Zealand. (n.d.).

Ministry for Primary Industries (MPI). (n.d.). Having Our Cake and Eating It: Unlocking the Potential of Dairy-Beef.

Iremonger, M. (2024). Opportunities for Beef on Dairy in New Zealand.. Nuffield New Zealand Scholar Report.

Pāmu Farms. (n.d.). Non-Dairy Beef Systems.

Rabobank. (2025). The Strategic Moment for Dairy-Beef in New Zealand.

Rabobank New Zealand. (2025). Strategic moment for ‘dairy’ beef – New Zealand agriculture’s $1.2 billion opportunity [Media release].

Soberon, F., Raffrenato, E., Everett, R. W., & Van Amburgh, M. E. (2012). Preweaning milk replacer intake and effects on long-term productivity of dairy calves.

Viability of Dairy-Origin Calves for a New Beef Production Enterprise in New Zealand. (n.d.).

# 11.0 Appendices

## *Appendix 1 – Detailed Modelling Assumptions*

The following assumptions were used in the dairy calf rearing model. The model was based on a representative irrigated Mid Canterbury dairy platform milking 1,000 cows across 270 effective hectares.

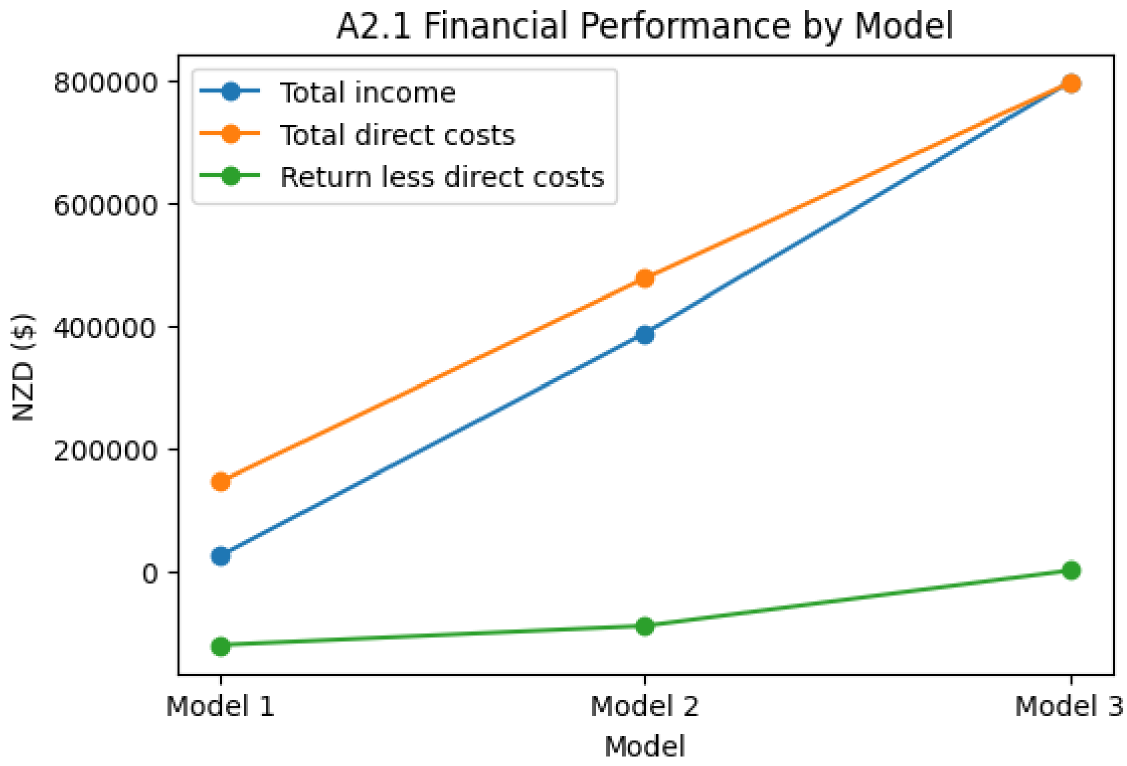
| Assumption | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Cows milked annually | 1,000 | 1,000 | 1,000 |
| Effective farm area | 270 ha | 270 ha | 270 ha |
| Stocking rate | 3.7 cows/ha | 3.7 cows/ha | 3.7 cows/ha |
| Total calves born | 1,000 | 1,000 | 1,000 |
| Replacement heifers retained | 250 | 250 | 250 |
| Surplus calves reared | 0 | 600 | 600 |
| Surplus calves sold after mortality | 0 | 570 | 570 |
| Sale liveweight | 0 kg | 100 kg | 225 kg |
| Sale price | $0/kg | $6.75/kg | $6.20/kg |
| Sale timing | Spring | Nov/Dec | Apr/May |

### Feed, Labour and Animal Health Inputs

| Input | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Milk powder per costed calf | 50 kg | 50 kg | 50 kg |
| Milk powder cost | $5.00/kg | $5.00/kg | $5.00/kg |
| Meal per calf to 100 kg | 15 kg | 15 kg | 15 kg |
| Meal cost | $1.05/kg | $1.05/kg | $1.05/kg |
| Supplement to 100 kg | 162 kg DM/calf | 162 kg DM/calf | 162 kg DM/calf |
| Supplement from 100 kg to sale | 0 | 0 | 697.5 kg DM/calf |
| Labour to 100 kg | 6 hrs/calf | 6 hrs/calf | 6 hrs/calf |
| Labour beyond 100 kg | 0 | 0 | 3.4 hrs/calf |
| Labour cost | $30/hr | $30/hr | $30/hr |
| Animal health to 100 kg | $40/calf | $40/calf | $40/calf |
| Animal health beyond 100 kg | $0 | $0 | $40/calf |

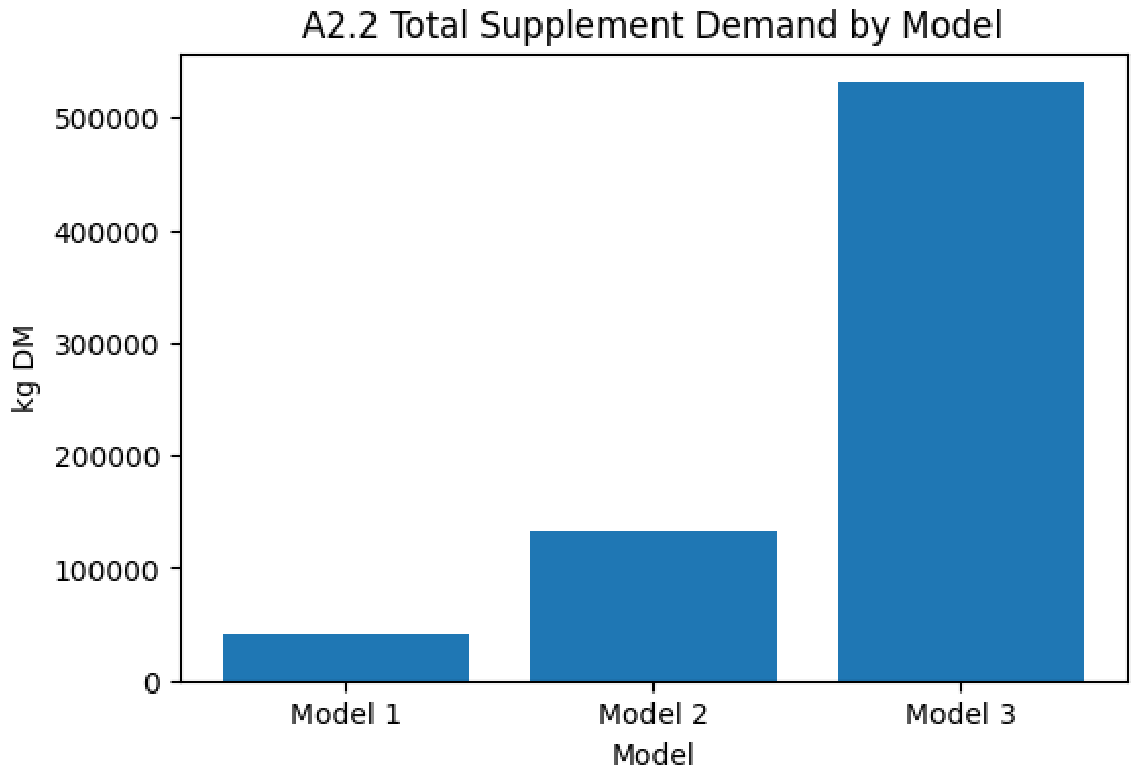
# *Appendix 2 – Sensitivity Graphs and Visual Outputs*

## A2.1 Financial Performance by Model



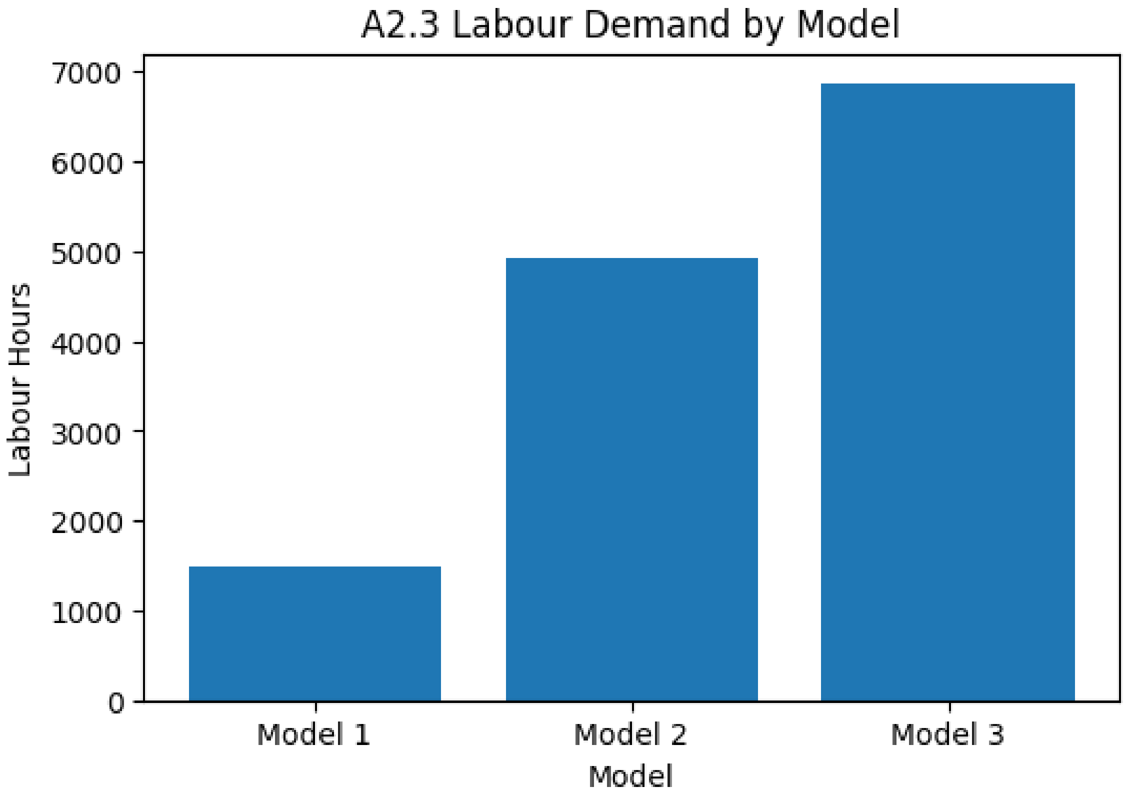

This graph shows that total income increases substantially as calves are retained longer. However, direct costs also rise sharply, particularly in Model 3. The modelling demonstrates that higher value capture is accompanied by greater cost exposure.

## A2.2 Feed Demand by Model




shows the increase in total supplement demand across the three models. Model 3 creates the greatest feed demand, requiring 530,415 kg DM compared with 132,840 kg DM in Model 2 and 40,500 kg DM in Model 1

### A2.3 Labour Demand by Model




el

This graph shows that labour demand increases as calf retention intensity increases. Model 1 requires 1,500 hours, Model 2 requires 4,920 hours, and Model 3 requires 6,858 hours.

### A2.4 Breakeven Sale Price

| Metric | Model 2 | Model 3 |
|---|---|---|
| Breakeven sale price | $8.32/kg LW | $6.19/kg LW |

The breakeven analysis shows that retained calf systems are sensitive to sale price, feed cost, and labour cost assumptions.

# Appendix 3 – Detailed Model Output Page

| Metric | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Bobby calf income | $24,500 | $3,500 | $3,500 |
| Reared surplus calf income | $0 | $384,750 | $795,150 |
| Total income | $24,500 | $388,250 | $798,650 |
| Milk powder cost | $62,500 | $205,000 | $205,000 |
| Meal cost | $3,938 | $12,915 | $12,915 |
| Supplement cost | $24,300 | $79,704 | $318,249 |
| Labour cost | $45,000 | $147,600 | $205,740 |
| Animal health cost | $10,000 | $32,800 | $55,600 |
| Total direct operating costs | $145,738 | $478,019 | $797,504 |
| Return less direct costs | -$121,238 | -$89,769 | $1,146 |
| Return per cow milked | -$121 | -$90 | $1 |
| Return per effective ha | -$449 | -$332 | $4 |
| Total supplement required | 40,500 kg DM | 132,840 kg DM | 530,415 kg DM |
| Labour hours required | 1,500 | 4,920 | 6,858 |
| Management complexity | Low | Moderate | High |

The detailed modelling reinforces that increasing calf retention improves gross income but also increases cost exposure, feed demand, labour requirement, and management complexity.