



# Economics of Total Mixed Ration dairy feeding systems – where are the risks?

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## Further information is available from

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Thank you to the farmer participants who supplied their data for this project.

Project participants should not be viewed to represent the entire dairy farm population.

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## Accessibility

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# Summary

This study found that feeding system intensification required larger capital investment and management of different risks compared to pasture-grazing. An economic analysis of 15 Total Mixed Ration (TMR) farms across a 7-year period (8 farms in northern Victoria (Nth Vic) and 7 farms in inland NSW) revealed that the significant investment and transition to intensify the production system increased the total costs, cost of production and risk profile of these businesses. However, the extra efficiencies the TMR farms gained in milk production and water use efficiency helped partially offset the extra costs. The TMR farms tended to actively manage these price risks through multiple year milk price contracts and/or by increasing on-farm fodder inventory.

The TMR farms performance varied widely between the 15 farms suggesting that the choice of production system alone did not determine the profitability and resilience of an individual farm. A whole range of factors such as resources available, seasonal conditions and management influenced performance.

Average return on total assets for the TMR farms ranged between 2% and 9% across the 7 years. This was comparable with average returns for the Dairy Farm Monitor Project (DFMP) farms, in similar locations, with a range of -2% and 9% across the 7 years. In Nth Vic, the average Nth Vic TMR farms had higher returns than the Nth Vic DFMP farms in the first 5 years, until the returns declined relative to the Nth Vic DFMP farms in most recent years (2021/22 and 2022/23). The higher costs in those two years and the wet spring in 2022 (which resulted in significant flooding on a significant number of the TMR farms) influenced the returns on the Nth Vic TMR farms.

In NSW, the average returns for the NSW TMR farms were higher than the inland NSW DFMP farms in 2018/19 and 2019/20 – years of dry conditions, drought and high feed costs. In the following 3 years (2020/21 to 2022/23) the inland NSW DFMP farms recorded higher returns than the NSW TMR farms. While farms within both groups changed between years, the change in farms within the NSW TMR group had differing asset values relative to production, and the gap in average returns remained unchanged in the most recent years.

The transition to a TMR production system changed the risk profile in important areas. The TMR farms became more exposed to purchased feed markets. An increase in the total amount of feed required was partially met through higher homegrown feed production but the purchased feed requirements also increased. Further, the cost of production increased in a way that will likely be hard to reduce costs if milk price declines. The TMR farms were found to be actively managing these risks. Many were on multiple year milk price contracts and carried significantly larger volumes of feed and water inventories compared to the DFMP farms. Higher labour efficiency (kg MS/full time equivalent) on the TMR farms than the DFMP farms was another area where the TMR farms managed higher total labour costs.

As most of the TMR farms only recently finished their transition, it is likely to take a couple more years to learn how to manage and optimise the TMR production system. Continuing to find efficiencies and manage the risk will enable these systems to navigate changes in their operating environment. While a preliminary estimate of greenhouse gas emissions was conducted to reflect the average TMR emissions profile, further investigation is required. Further monitoring is required to gain a comprehensive understanding of the profitability, sustainability, and risk management of these production systems over time. This will help ensure the future resilience of the Australian dairy industry.

The project was made possible through funding and support from Agriculture Victoria, Dairy Australia, NSW Department of Primary Industries (NSW DPI) and Dairy UP.





# Introduction

The Australian dairy industry continues to evolve, and the range of production systems being used on-farm has diversified. Along with the traditional grazing based dairy system, the level of interest in, and adoption of more intensive production systems has increased. Some farms have adopted Total Mixed Ration (TMR) production systems with zero or very limited grazing by the milking herd.

Qualitative research commissioned by Agriculture Victoria found that feeding system intensification, including adoption of permanent cow housing, was one of the ways that dairy farmers in northern Victoria (Nth Vic) were adapting to long-term trends and drivers including climate change, decreasing irrigation water availability (and increasing cost of water resources) and the desire for ongoing farm and business growth (Nettle *et al.* 2021). These drivers will continue and there will be more dairy farmers progressing along the pathway of intensification.

A foundational study of 7 TMR farms in Nth Vic and 7 TMR farms in NSW (Dairy UP, P3 Economics of Intensification) analysed across 5 years (2016/17 to 2020/21) provided useful information to inform farmers transitioning to or operating a zero-grazing system. This work identified the need for continued monitoring and tracking to address gaps in the foundational research, and to further examine the practices that make the systems efficient and identify strategies for managing risk.

This project aimed to provide credible information for farmers considering a change to their system and for the dairy industry to have an improved understanding of the profitability and risk management of TMR systems. The report does not intend to recommend a type of production system but rather to help provide economic information on how intensive dairy production systems have been performing in Australia.

The participating TMR farms in this study were all zero (or very limited) grazing of the milking herd by 2022/23. Some farms operated as TMR for the whole period of analysis while others made the transition during the period. The contained housing facilities included dairy dry lot, loose housing and freestall. Limited access to the small number (8 Victorian TMR farms and 7 NSW TMR farms) meant a single farm skewed the averages, such as lower performance on those farms affected by flooding. Therefore, a range in the statistics is provided where possible.

The 2022/23 year was a unique year with record high milk price combined with a very wet and challenging spring, including significant flooding, that resulted in widespread poor-quality fodder being made and fed (reducing milk production). The wet conditions presented challenges to all dairy farms in Nth Vic and NSW, including the participating farms in the TMR and DFMP groups. A significant number of the TMR farms experienced flooding and storm impacts to their business. These events would have had a major negative effect on these businesses regardless of the production system type. These farms were included in the 2022/23 dataset and consideration is required when interpreting the results.

# Method

This study focused on dairy farmers transition towards intensive, zero-grazing dairy systems. Intensive animal production was assumed to be when land was used for animal production and the animal's food was imported from outside the immediate building, enclosure, paddock or pen. This definition of intensive system does not include grazing animal production. The diet of the milking herd was formulated from a mix of specific nutrients and fed as a total mixed ration (TMR). These farms are termed TMR farms for the purposes of this project.

Farm data was collected using the Dairy Farm Monitor Project (DFMP) input spreadsheets. The DFMP is a standardised method for farm performance analysis in Australia. It involves the comprehensive collection of financial and physical information using an accrual method (matching income and costs in the same year it was incurred). All farm data was stored in the national dairy database, DairyBase. A total of 8 farms in Nth Vic and 7 farms in inland NSW had their data collected, validated and analysed between 2016/17 and 2022/23 (7 years). Some farms were zero-grazing prior to 2016/17, while others finished transitioning during the period and all were operating a TMR system by 2022/23.

Not all 7 NSW TMR farms participated each year resulting in the movement of farms in and out of the sample. Some NSW TMR farms had challenges collecting information relating to feed production and therefore feed related physical metrics are not presented.

The TMR farm results were compared against their DFMP counterparts for the relevant years and region. Any DFMP farms transitioning or transitioned to TMR were excluded from the DFMP group to ensure the TMR farms were only compared against grazing and Partial Mixed Ration (PMR) farms. The DFMP group in Nth Vic only includes farms from the Goulburn-Murray irrigation regions (i.e., north-east Victorian farms were excluded). As all the NSW TMR farms were located in inland NSW, which has a very different climate, asset values and on occasions milk price to the coastal regions in NSW, this report only included NSW DFMP farms that were also located in inland NSW. Table 1 summarises the different groups referred to in this project.

In some instances, Nth Vic TMR performance was also compared to the Top 25% of Nth Vic DFMP farms, based on return on total assets. This provides a benchmark for comparison not only against the Nth Vic DFMP average but also against the best performing Nth Vic DFMP farms. The smaller sample size for the inland NSW DFMP dataset did not allow for a comparison against the Top 25%.

The report includes a comparative analysis of the profitability and milk prices both before and after the transition. An assessment of the physical performance, income, costs, profit, returns, and risk aspects is presented. Risk-related information is contained in each section, reflecting the inherent interconnectedness with various facets of a farm business.

All dollar values have been converted to 2022/23 dollars to account for the effects of inflation using the Consumer Price Index (Reserve Bank of Australia).

**Table 1.** Descriptions for the different farm groups

Group name	Number of farms in 2022/23	Description
TMR farms	14	Combined TMR farms; 8 Nth Vic TMR plus 6 NSW TMR farms. Note that a total of 7 NSW TMR participated in the study but not every farm participated each year.
Nth Vic TMR farms	8	Dairy farms in Nth Vic feeding a TMR, located in the northern irrigation district.
NSW TMR farms	7	Dairy farms in inland NSW feeding a TMR.
Nth Vic DFMP farms	24	Participants of the Victorian DFMP project who were in Nth Vic (northern irrigation district), excluding TMR farms. The DFMP farms located in north-east Victoria were also excluded.
Nth Vic DFMP Top 25% farms	6	Farms in the Nth Vic DFMP group which ranked in the top 25% according to return on total assets. This group excluded the TMR farms and the DFMP farms located in north-east Victoria.
Inland NSW DFMP farms	6	Participants of the NSW DFMP project who were in inland NSW, excluding TMR farms.
DFMP farms	30	Combined DFMP participants from Nth Vic DFMP and inland NSW DFMP groups.



# Analysis of production systems

Most TMR farms transitioned to a TMR production system during the 7-year analysis period. Figure 1 shows the average returns for the farms prior to converting their production system to a TMR (in transition), relative to the DFMP farms, and those converted to a TMR system. The figure shows that TMR farms had higher returns in later years (2019/20 to 2022/23) than in the earlier years (2016/17 to 2018/19). This was also the case for the DFMP farms. Across the 7-years, the DFMP average return on total assets ranged between -2.4% and 8.7%.

**Figure 1.** Return on total assets for the different production systems between 2016/17 and 2022/23



Table 2 shows the number of farms within each group presented in Figure 1. There were 2 farms operating as TMR during the entire 7-year period, with 8 in transition from the beginning of the analysis period. From 2018/19 onwards, 4 farms joined the project, and all of these farms were operating a TMR system by 2020/21.

**Table 2.** The number of farms representing each group for the 7 years of the project

Number of farms	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
In transition	8	8	7	8	3	1	0
TMR	2	2	4	6	11	13	14
DFMP	27	26	25	29	30	30	30



# Income

## Key points

Average milk price trended higher during the 7 years with a strong and stable price a characteristic of the TMR and DFMP groups for the last 5 years.

Most of the TMR farms were on multiple year milk supply contracts. In a rising milk price market, multiple year milk price contracts can result in a lower milk price than a single year contract but can also reduce the risk of milk price declines for a given year.

Diluting some of the higher costs with higher total milk production was one of the ways some TMR farms found efficiencies based on \$/kg MS.

## Milk income and production

Dairy cows fed in contained areas, such as PMR and TMR, have been shown to respond with an increase in milk production compared with cows offered supplements in the dairy and paddock. A previous study examined if the amount of extra milk and extra milk income would be enough to cover the extra costs associated with the investment in cattle feeding infrastructure (Agriculture Victoria, 2017). Milk income – being a factor of the milk price and the amount of milk sold, was also of interest for this study given the significant capital investment on the TMR farms.

Figure 2 and Figure 3 show that the milk price trended higher during the analysis period (2016/17 to 2022/23). In the last 5 years, a strong and stable milk price was a characteristic of the TMR and DFMP groups.

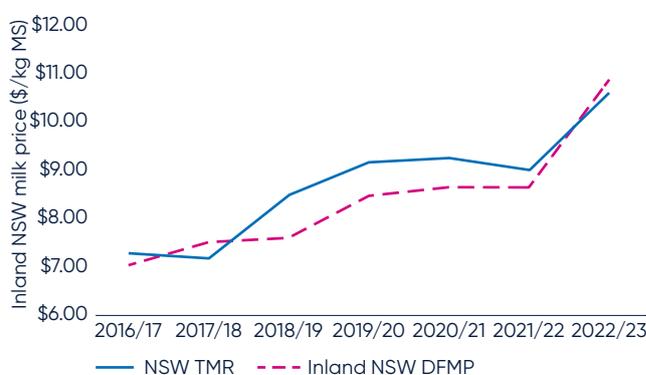
Most milk processors have offered payment systems that incentivise flat milk supply throughout the year. The TMR farms achieved consistent year-round milk supply by taking away the variables associated with grazing, minimising climate effects and moving to multiple or year-round calving.

Multiple year milk supply contracts have become more common as processors aim to secure their forward milk supply in a declining Australian milk pool. Most of the TMR farms entered multiple year milk contracts to manage milk price risk (mitigate against price declines). In a rising milk price market, multiple year milk contracts appeared to have resulted in a lower milk price than a single year contract. With a rising milk price since 2016/17, there were no observed average milk price premium for the TMR farms in Nth Vic (Figure 2) and the premium reduced in inland NSW (Figure 3).

**Figure 2.** Average milk price (\$/kg MS) for the Nth Vic TMR and Nth Vic DFMP farms between 2016/17 and 2022/23



**Figure 3.** Average milk price (\$/kg MS) for NSW TMR and inland NSW DFMP farms between 2016/17 and 2022/23

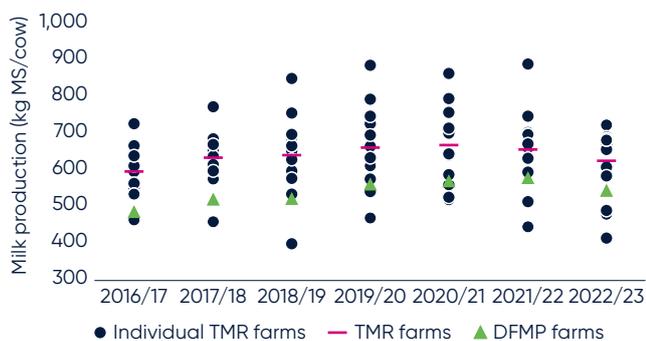


High milk production was important for the TMR farms. As demonstrated in this report, the higher total costs on TMR farms coincided with the transition to a TMR production system. Diluting some of the higher costs with higher total milk production was found to be one of the ways individual TMR farms found efficiencies. More profitable farms weigh up decisions to increase total milk production and income against incurring the extra costs.

Milk production per cow stayed reasonably consistent for the TMR farm at around 640 kg MS/cow on average (Figure 4). The biggest driver for the variation in milk production across the individual TMR farms was due to some of the TMR farms not included in every year. The years of lower average milk production per cow (2016/17 and 2022/23) coincided with unusually wet years, which was likely due to the lower quality fodder being made (or purchased) in those years.

In the last 2 years, the TMR average milk production declined from 657 kg MS/cow in 2021/22 to 626 kg MS/cow in 2022/23 (Figure 4). One TMR farm in 2022/23 did not complete a full lactation because of flooding and storm impacts. The cows that only completed a partial lactation (but over 3 months) were included in the average number of cows milked for the year thereby reducing their average milk production per cow in 2022/23. This farm was included in 2022/23 and contributed to the lower TMR farm average.

**Figure 4.** Milk production (kg MS/cow) for each of the TMR and average TMR and DFMP farms between 2016/17 and 2022/23



The average total milk production consistently increased for the Nth Vic TMR farms for the first 5 years of the analysis period (Figure 5). It appeared that in 2021/22, after most of the farms finished transitioning, the increase in milk production slowed as they reached cow number capacity (Figure 5). The decline in total milk production in 2022/23 was due to the wet spring of 2022 and the lower feed quality.

The average number of cows milked for the Nth Vic TMR group increased by 47% across the 7-year analysis period and steadied at around 900 cows, with a range across farms of 450 to over 2,000, in 2022/23. Whereas the average number of cows milked for the Nth Vic DFMP farms were lower and had modest growth, increasing 6% across the 7 years with an average of 341 cows in 2022/23.

**Figure 5.** Average total milk solids, and number of cows milked for the Nth Vic TMR farms between 2016/17 and 2022/23



## Gross farm income

Gross farm income trended upwards across the 7 years (Appendix Tables 1 and Table 4), largely reflecting the upward trend in milk price. The TMR and the DFMP farms had comparable gross farm income. However, the TMR farms had slightly more diverse income sources compared with the DFMP group. Income from milk (on average) comprised 90% of gross farm income for DFMP farms, compared to 87% for TMR farms in 2022/23. This was a deliberate strategy for individual farms to manage downside milk price risk and diversify income sources such as livestock and feed sales.

# Costs

## Key points

The significant investment and transition to intensify the production system was found to increase the total costs, cost of production and risk profile of the TMR farms.

However, the extra efficiencies the TMR farms gained in the areas of their business such as total milk production, water use efficiency and labour helped to partially offset the extra costs.

## Homegrown feed

The trend for intensification in Australian dairy has predominately occurred in lower rainfall areas with access to irrigation. The dramatic change in the water markets in the last 20 years, as well as a hotter and drier environment was one of the motivations for farmers to intensify (Nettle *et al.* 2021). The TMR participants used their production system with the aim of improving efficiencies in areas such water use and farm feed conversion. The TMR farms often carried-over larger feed reserves to reduce their exposure to the feed markets when prices were elevated. Storing feeds for one or multiple years and feeding cows efficiently (low wastage and balanced diet) were strategies some TMR farms employed to actively manage purchased feed price risks.

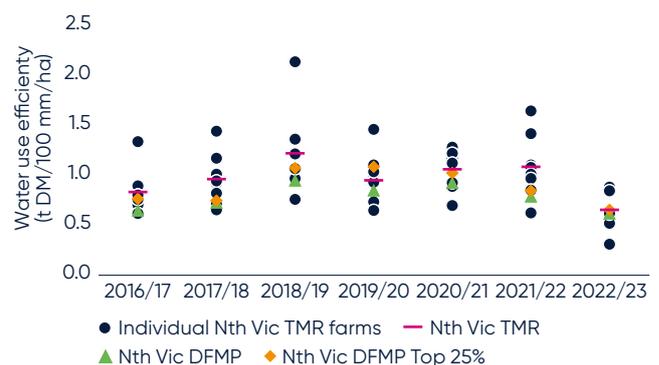
## Water use efficiency

The Nth Vic TMR farms achieved higher efficiencies than the Nth Vic DFMP group in converting every millimetre of rainfall and irrigation water applied to homegrown feed. Figure 6 shows that the Nth Vic TMR group averaged around 0.18 t DM/100mm/ha more than Nth Vic DFMP farms over the last 7 years. The Nth Vic TMR farms were also more efficient than the Nth Vic DFMP Top 25%, emphasising this was an area where the Nth Vic TMR farms were managing homegrown feed production risk better than their contemporaries.

Despite the higher average water use efficiency (WUE) (rainfall plus irrigation) for the Nth Vic TMR farms, the results varied widely across farms within this group (Figure 6). In 2021/22, there was a range of 1.0 t DM/100mm/ha between the highest and lowest TMR farms for WUE. The lower WUE in 2022/23 for all groups reflects the impact

of the wet spring and flooding in 2022 which caused waterlogging, water run-off and sub-optimal grazing and conservation of crops and pastures. In any year, WUE was sensitive to high volumes of rainfall that was not used effectively for increased feed production, and/or the timeliness of the rainfall events.

**Figure 6.** Water use efficiency on each of the Nth Vic TMR, and average Nth Vic TMR, Nth Vic DFMP and Nth Vic DFMP Top 25% farms between 2016/17 and 2022/23



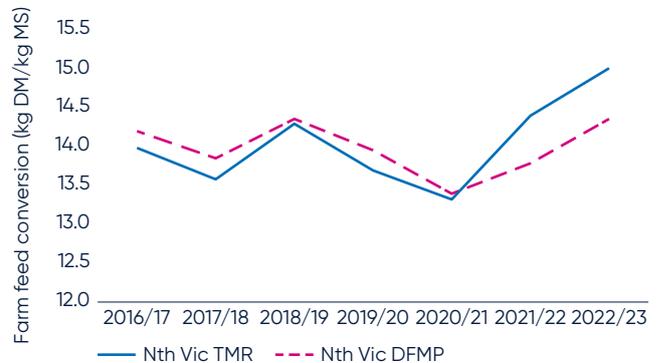
## Feed costs

Data collection on the TMR farms did not allow for the calculation of feed conversion efficiency for individual farms. Instead, a proxy was calculated for the Nth Vic TMR farms based on the assumption of a uniform feed conversion response for the entire herd, including replacements, young stock and other livestock on-farm, such as dairy-beef crosses. Figure 7 estimates farm feed conversion (kg DM/kg MS) using the total tonnes of feed fed (homegrown and purchased) and dividing by the milk solids produced, not accounting that some feed will have been allocated to other classes of stock. Feed wastage during the feed-out of the diet was estimated for each feed type on the TMR and DFMP farms. There may be other feed losses associated with delivery, storage and mixing which were not estimated in this project. Despite its limitations, this measure contributes to understanding variations in feed costs when measured based on per kg MS.

A discernible divergence in the average feed conversion efficiency for the Nth Vic TMR and Nth Vic DFMP groups occurred in the last two years. The greater feed required on the Nth Vic TMR farms did not translate into higher milk production, relative to the Nth Vic DFMP average. The lower farm feed conversion on the Nth Vic TMR farms meant more feed (kg DM) was required relative to the milk output (kg MS) than the Nth Vic DFMP farms. For example, in 2022/23 the TMR farms fed an extra 0.7 kg DM/kg MS which contributed to their higher feed cost by around \$0.27/kg MS.

The greater amount of feed fed on Nth Vic DFMP farms – to all livestock classes – relative to the amount of milk produced, resulted in higher costs when measured based on \$/kg MS. The divergence could be explained by the higher number of non-milking stock relative to milking cows. This also coincided with all Nth Vic TMR completing their farm transitions and will likely take more years for farmers to learn how to manage and optimise the TMR production system.

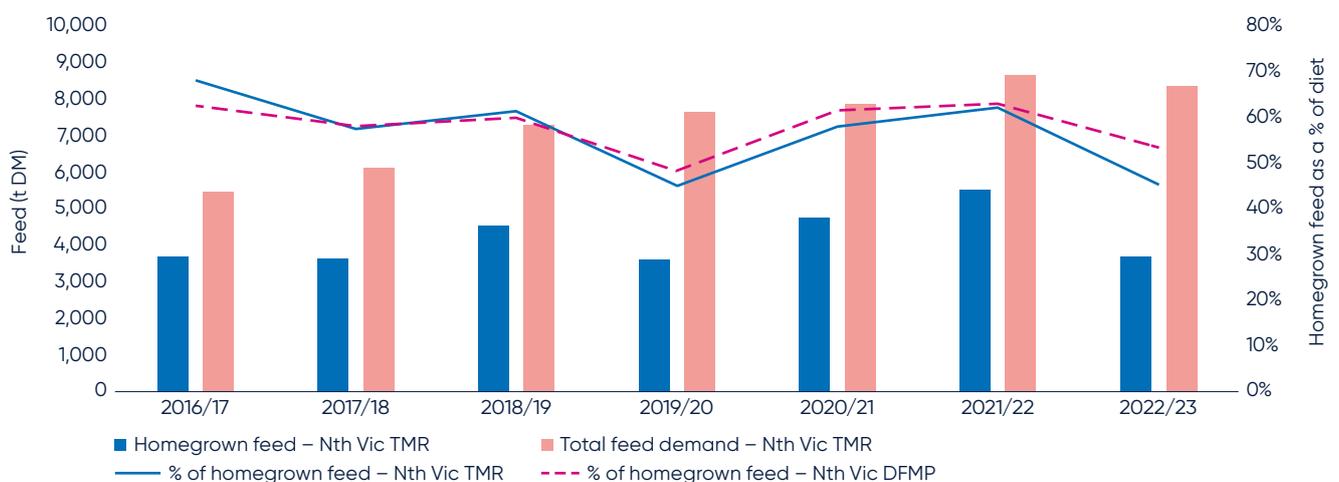
**Figure 7.** Average farm feed conversion (kg DM/kg MS) for the Nth Vic TMR and Nth Vic DFMP farms between 2016/17 and 2022/23



## Homegrown feed requirements

Across the 7 years, higher feed demand on Nth Vic TMR farms corresponded with increasing total milk production and all TMR farms completing their transition. The amount of feed required increased by 2,800 t DM (53% increase) between 2016/17 to 2022/23 (Figure 8). Homegrown feed production mostly kept pace with the higher demand, increasing by 1,800 t DM (49% increase) across the period, excluding the wet year in 2022/23. The proportion of homegrown feed fluctuated between 45% and 68% across the period (solid line in Figure 8). The variation in the amount of homegrown feed harvested year to year was due to seasonal conditions and input prices. The balance of feed demand was met through purchased feed. The increased purchased feed fed (t DM) have meant the TMR farms became more exposed to purchased feed markets.

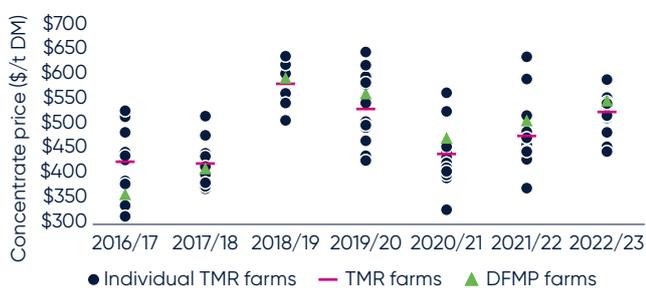
**Figure 8.** The total feed demand, the amount of homegrown feed harvested and the proportion of homegrown feed in the diet for the Nth Vic TMR farms between 2016/17 and 2022/23. The proportion of homegrown feed in the diet is also shown for the Nth Vic DFMP farms.



## Homegrown and purchased feed costs

The price paid for purchased feeds influenced the total feed costs. On average, TMR farms secured cheaper concentrates than DFMP farms (Figure 9). Some TMR farms grew part of their wheat and barley requirements. The average concentrate price per tonne was generally higher for those TMR farms as the higher priced protein and additives contributed a larger proportion of the concentrate price, relative to the lower grain purchased.

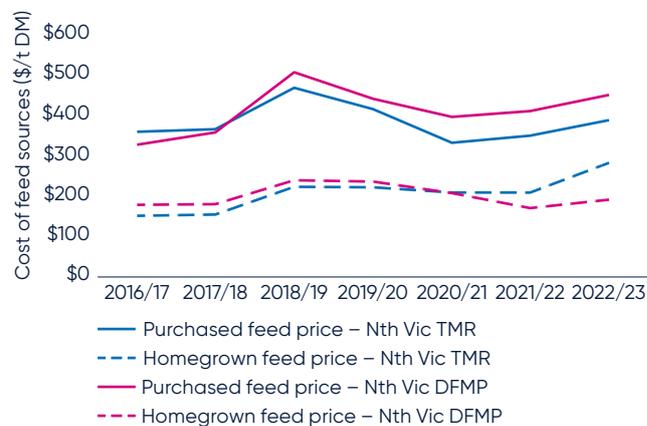
**Figure 9.** Cost of purchased concentrates (\$/t DM) for each of the TMR farms, and average TMR and DFMP farms between 2016/17 and 2022/23



The cheaper concentrate price contributed to the lower purchased feed costs for the TMR farms (Figure 10). Concentrate costs were the biggest influence on purchased feed costs for the TMR farms. Therefore, the lower concentrate prices lowered the total purchased feed costs (\$/t DM) for the TMR farms compared to the DFMP farms.

Homegrown feed was cheaper than purchased feed (\$/t DM) for both the TMR and DFMP group average – for the Nth Vic farms. For the first 5 years, the average cost to grow and harvest homegrown feed was similar between the Nth Vic TMR and Nth Vic DFMP groups. In the last two years, most of the Nth Vic TMR farms had finished their conversion to TMR. While this coincided with lower irrigation water price, the average cost to produce homegrown feed for the Nth Vic TMR group increased, relative to the Nth Vic DFMP group. On average, it cost the Nth Vic TMR farms an additional \$39/t DM in 2021/22 and \$91/t DM in 2022/23 to grow homegrown feed, compared to the Nth Vic DFMP farms. With the data provided, it was not possible to quantify the influence of growing grain crops on the homegrown feed costs for TMR farms and this may be another influencing factor on the cost of homegrown feed.

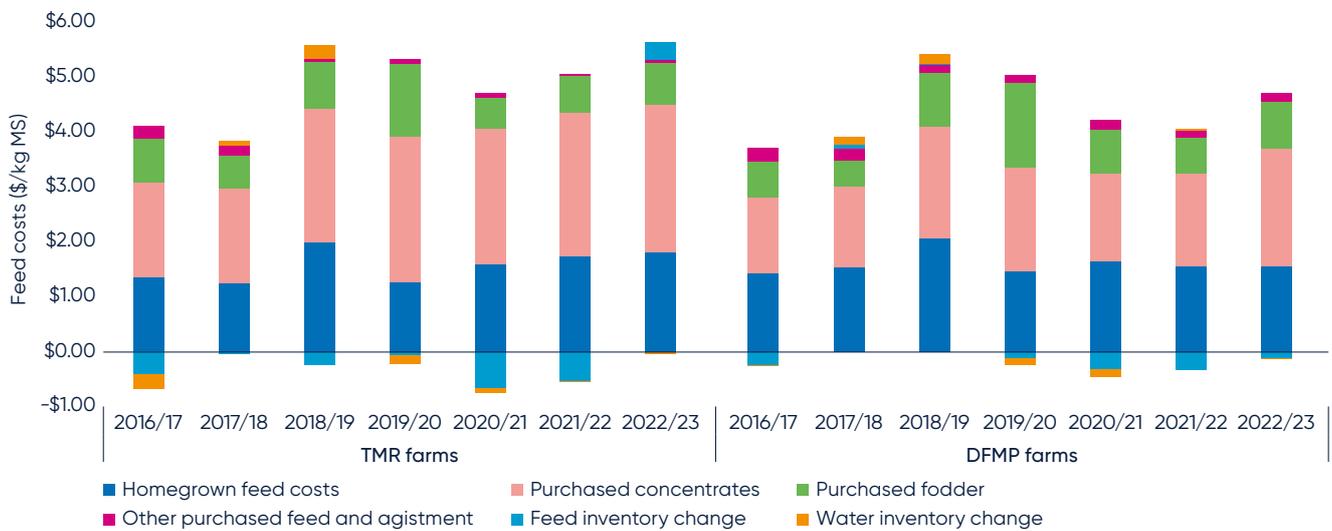
**Figure 10.** Average cost of purchased and homegrown feed for the Nth Vic TMR and Nth Vic DFMP farms between 2016/17 and 2022/23



The breakdown of the feed cost categories (\$/kg MS) is shown in Figure 11. Although variations in various feed cost categories emerged between TMR and DFMP farms, the cash costs associated with homegrown and purchased feed had the most significant impact on total feed costs, relative to feed and water inventory changes. The higher feed costs for TMR farms, compared to DFMP farms in the last two years (2021/22 and 2022/23), primarily stemmed from higher expenses on both homegrown and purchased feed, coupled with a greater overall feed requirement. The Nth Vic TMR farms demonstrated a greater requirement for purchased feed across the analysis period (Figure 8) and that the price paid for purchased feed was lower than their contemporaries (Figure 9). Although, the ability to purchase feed (including concentrates, fodder) at lower prices (Figure 10) did not fully offset the elevated costs of homegrown feed and additional purchased feed on TMR farms. Table 3 shows the extra costs on TMR farms, compared to DFMP for each feed cost category.

Note that a negative change in feed and water inventory lowered the feed cost. In a profit analysis, the costs associated with milk production are attributed in the same year they were incurred (matching principle). If the cost of producing the feed was not used for milk production in the year and remained as a carryover inventory for future use, then it lowered the feed cost. However, if the feed reserves were utilised during the year and there was less feed on-hand at the end of the year compared to the start, then it added to the feed costs, such as in 2022/23 (Figure 11).

**Figure 11.** The breakdown of the average feed costs for the TMR and DFMP farms between 2016/17 and 2022/23



**Table 3.** Additional costs for selected feed cost categories on the TMR farms compared to the DFMP farms (\$/kg MS)

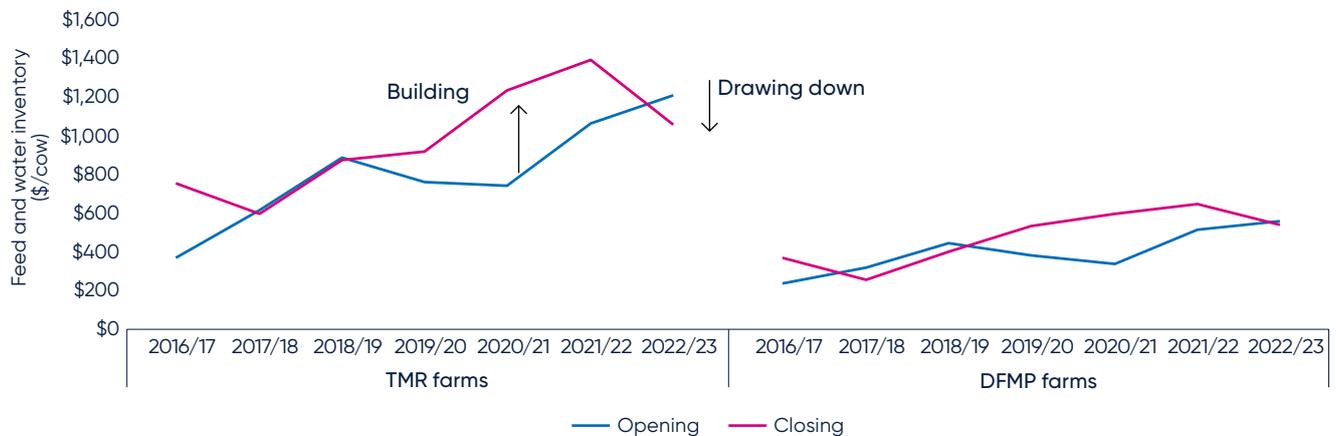
Feed cost category (\$/kg MS)	2021/22	2022/23
Homegrown feed costs	\$0.17	\$0.26
Purchased feed costs	\$0.96	\$0.44
Feed inventory change	-\$0.21	\$0.41
Water inventory change	-\$0.05	-\$0.01
Total feed costs	\$0.76	\$1.04

### Feed and water inventory changes

The amount of feed and water inventory an individual farm carried, along with the percentage of homegrown feed they grew each year, determined the risk exposure to seasons where feed and water prices were high, relative to the milk price. Most TMR farms were unable to harvest all their fodder crops in spring 2022. Transitioning to a production system where the whole crop is harvested annually (as opposed to grazing crops/pastures and lucerne that have multiple grazings/cuts each year) increased the exposure that TMR farms had to adverse weather conditions at critical times of the year. Increasing the amount of fodder inventory on-hand was a strategy the TMR farms employed to actively manage this risk.

On average, TMR farms increased their annual feed and water inventory across the 7-year analysis period. The TMR farms carried larger amounts compared to the DFMP farms (Figure 12) – based on \$/cow for ease of reference, highlighting they secured a larger proportion of the annual cows’ diet from feed inventories (carryover feed and water) as a risk management strategy. The value of the water and feed inventory changed each year, along with varied climatic and trading conditions. For this reason, it is expected that the value of feed and water inventory is unlikely to increase in a linear fashion. However, both the TMR and DFMP farms were found to use the more favourable conditions (2020/21 and 2021/22) to build up feed and water inventory which buffered against a future tough year (2022/23).

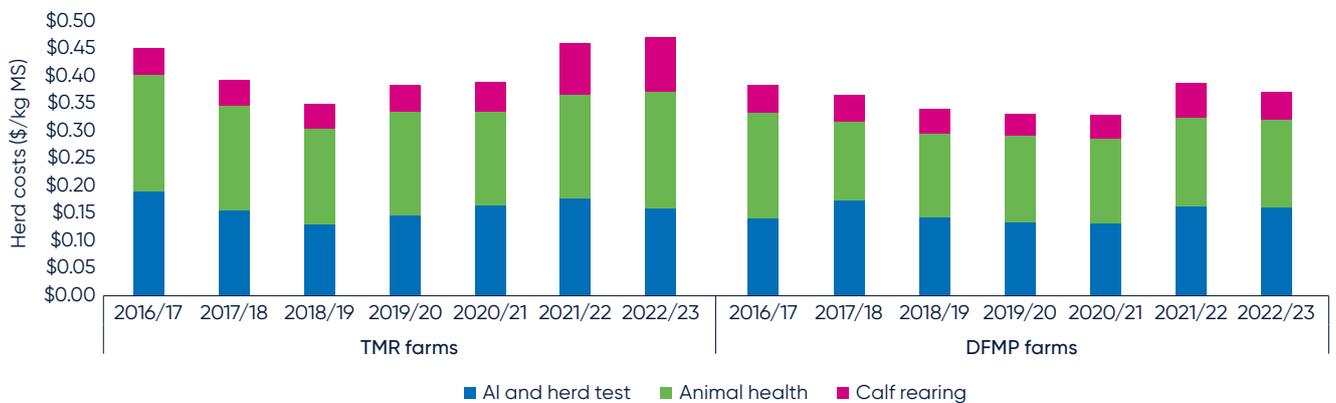
**Figure 12.** Average feed and water inventory for the TMR and DFMP farms between 2016/17 and 2022/23



### Herd costs

Herd costs for TMR farms became more expensive relative to the DFMP farms, corresponding with all TMR farms finishing their transition (Figure 13). The animal health and calf rearing costs noticeably increased. One TMR farm skewed the results with a large increase in their calf rearing costs in the last two years. They reared more calves and fed purchased milk powder to some calves.

**Figure 13.** Average herd costs categories (\$/kg MS) for the TMR and DFMP farms between 2016/17 and 2022/23

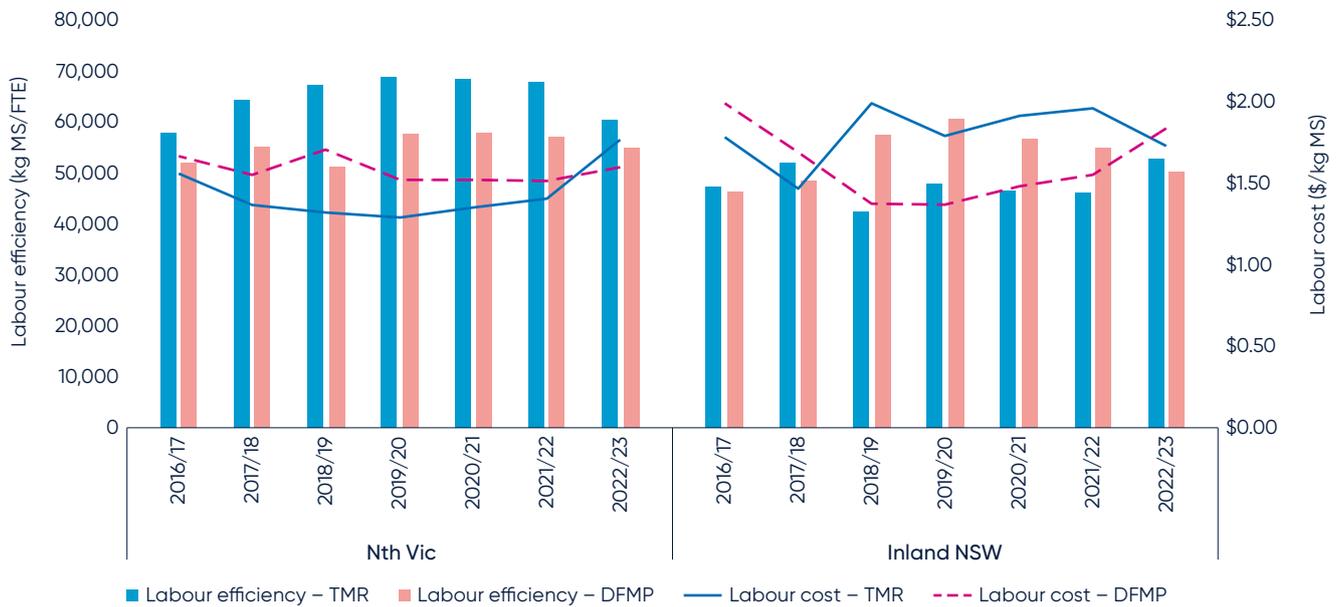


### Labour efficiency and costs

In general, TMR production systems required more labour (paid and unpaid) than DFMP farms. This was due to their larger herds, higher total milk production and additional operations associated with housing cows. While this increased the average total cost of labour, the TMR farms were more labour efficient (measured as kg MS per full time equivalent or standardised for working 2,400 hours per year) than the DFMP average. The Nth Vic TMR farms also had lower labour costs (\$/kg MS) than the Nth Vic DFMP group, except in 2022/23 (Figure 14). The lower milk production and higher total labour costs for the TMR farms in 2022/23 resulted in the sharp increase in labour cost (\$/kg MS).

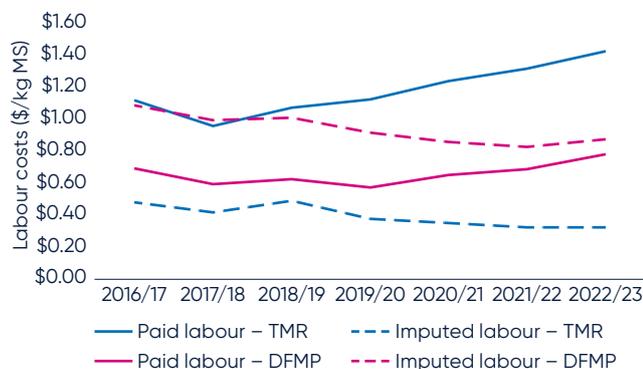
Average NSW TMR farm labour efficiency tended to be lower, and the total labour costs higher, than inland NSW DFMP farms (Figure 14). This was influenced by factors such as lower milk production efficiency for some NSW TMR farms due to seasonal conditions and stage of transition, decisions to pay higher wages and having surplus staff for lifestyle balance and staff retention purposes. However, the trend reversed in 2022/23 where the NSW TMR farms had higher average labour efficiency and lower costs compared to inland NSW DFMP farms.

**Figure 14.** Average labour costs (\$/kg MS) and labour efficiency (kg MS/FTE) for the TMR and DFMP farms separated into Nth Vic and inland NSW between 2016/17 and 2022/23



In 2022/23, paid labour on TMR farms nearly doubled the DFMP average (\$1.43/kg MS compared to the DFMP average of \$0.79/kg MS). However, imputed labour was lower for the TMR farms, averaging \$0.40/kg MS compared to DFMP average of \$0.94/kg MS across the 7 years (Figure 15). The biggest influence on this outcome was likely to be scale. As farms get larger, the hours worked by the owner operators contributed less to the overall hours worked on-farm. Imputed labour was estimated as the number of hours worked by unpaid labour (owner operators and family) multiplied by \$36/hour (in 2022/23).

**Figure 15.** Average paid and imputed labour costs (\$/kg MS) for DFMP and TMR farms between 2016/17 and 2022/23



## Overhead costs

Total overhead costs were noticeably higher for the TMR farms in the last two years compared to the DFMP average, when measured against milk solids (Figure 16). This coincided with all TMR farms completing their transition and the wet 2022/23 year. While labour costs comprised about 55% of total overhead costs, higher expenditure for both repairs and maintenance and depreciation contributed to the higher overhead costs on TMR farms compared to DFMP farms. Repairs and maintenance costs contributed 18% to total overheads, depreciation contributed 16% and all other overheads contributed the balance (11%).

**Figure 16.** Average total overhead costs (\$/kg MS) for the TMR and DFMP farms between 2016/17 and 2022/23

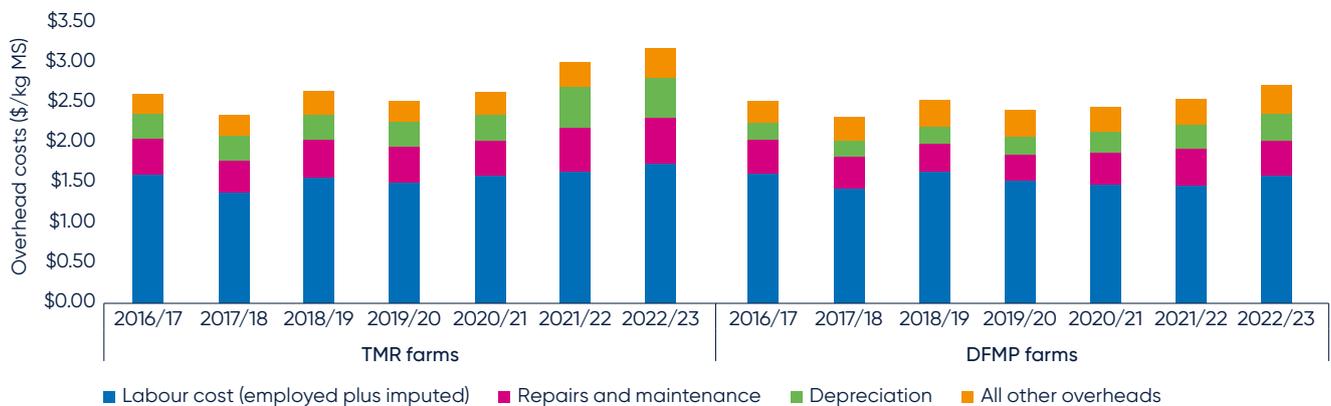
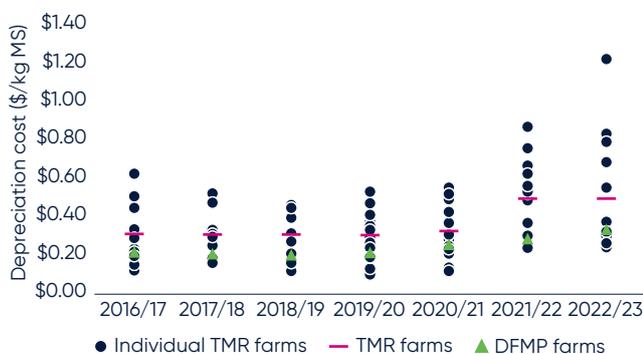


Figure 17 shows that TMR farms had higher average depreciation costs than DFMP farms in each year. This was mostly attributable to all TMR farms completing their transition and the larger capital requirements – including significant buildings and an increased amount of owned machinery and equipment. The way significant buildings were handled in the DFMP input spreadsheets changed in 2021/22 and corresponded to the jump in depreciation costs.

In 2022/23, the depreciation costs were higher for the TMR group at \$0.50/kg MS compared to DFMP average of \$0.34/kg MS. The two TMR farms with the highest depreciation cost (\$/kg MS) in 2022/23 were flood affected, having lower milk production to dilute down their fixed depreciation cost. The 5 TMR farms that all had a depreciation cost (\$/kg MS) higher than the TMR average were also the 5 farms with the lowest per cow production in 2022/23. The value of assets for the TMR farms is presented in the capital section.

**Figure 17.** The annual depreciation costs for each of the TMR farms and average TMR and DFMP farms between 2016/17 and 2022/23

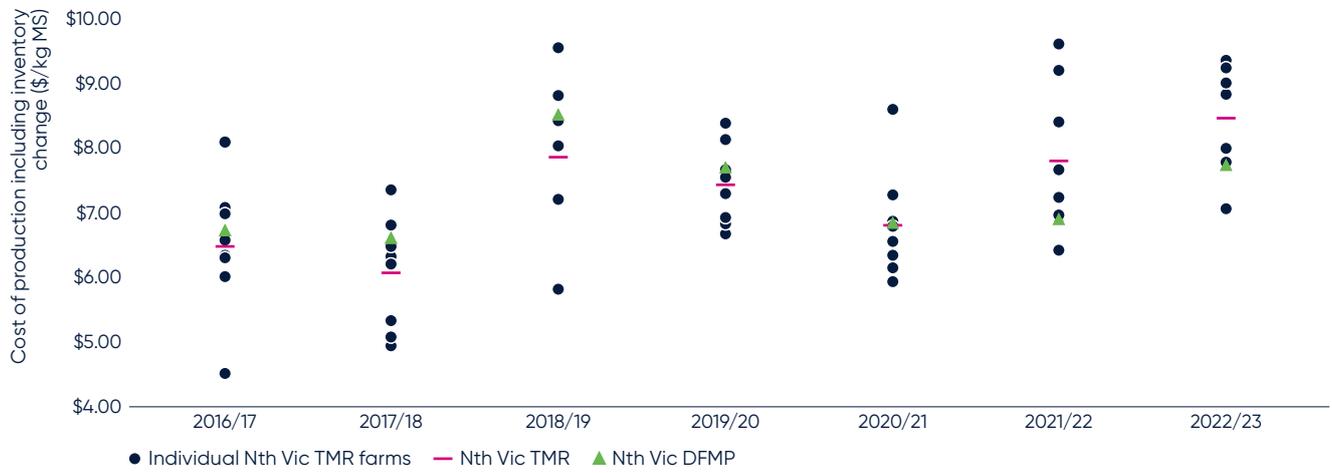


### Cost of production

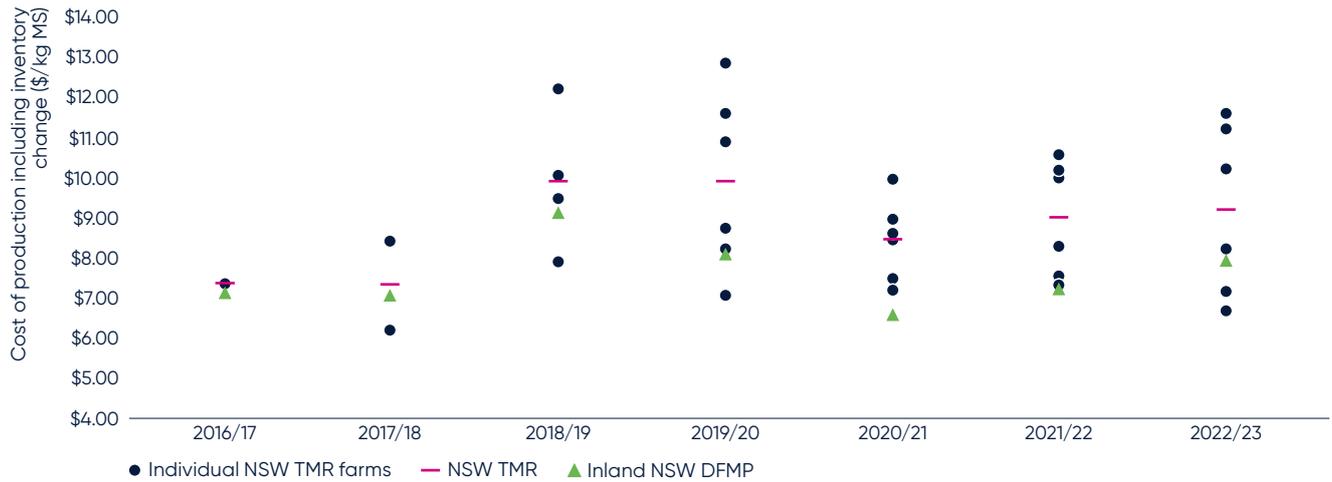
Investment in TMR production systems led to higher cost of production for the Nth Vic TMR farms relative to the Nth Vic DFMP farms across the 7-year analysis period (Figure 18). In 2021/22 and 2022/23 water prices declined but all other feed prices were high. The cost of production for the Nth Vic TMR group was on average \$0.35/kg MS lower (5.1%) in the first 5 years than the Nth Vic DFMP average and then \$0.81/kg MS (10%) higher in the last 2 years. Although the Nth Vic TMR farms had higher gross farm income (6% higher in the final two years) it was not enough to fully offset the increased costs. The 2-year time frame was when most of the TMR farms finished transitioning. One Nth Vic TMR farm was not included in Figure 18 for 2022/23 due to a significant one-off trading position (not related to the milking operation) that significantly distorted their cost of production (\$/kg MS).

The cost of production also increased for the NSW TMR farms relative to the inland NSW DFMP (Figure 19). However, due to some of the NSW TMR farms not having their data included for all years, it was more difficult to draw a reliable conclusion. Finance and capital expenditure was not included in the analysis and are additional costs for businesses. The rising cost of production is a concern and a risk not only to these TMR farms but to many DFMP farms.

**Figure 18.** The cost of production including change of inventory (\$/kg MS) for each Nth Vic TMR farm, and average Nth Vic TMR and Nth Vic DFMP farms between 2016/17 and 2022/23



**Figure 19.** The cost of production including change of inventory (\$/kg MS) for each NSW TMR farm, and average NSW TMR and inland NSW DFMP farms between 2016/17 and 2022/23



# Financial performance

## Key points

In the most recent years (2021/22 and 2022/23) there was greater variation in profit and returns between individual TMR farms in the respective regions, than in earlier years.

The small sample of TMR farms saw one farm skew the average results in any given year.

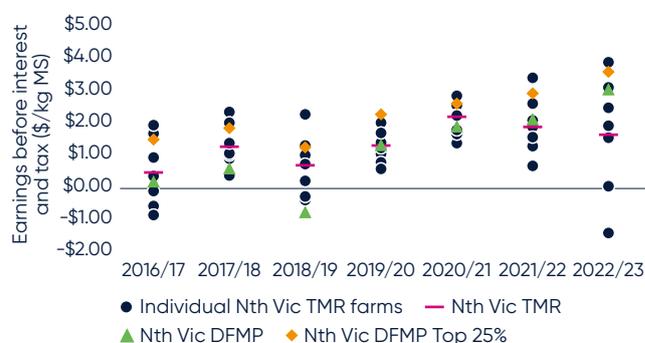
When comparing the economic performance of farms, using ratio's instead of total numbers is common to account for scale and to make meaningful comparisons between farms and regions. For example, a common way of comparing farm profitability is to use the measurement of earnings before interest and tax per kg MS (EBIT \$/kg MS). Individual farms may aim for the highest total profit (total dollars) as a more desirable outcome for their circumstance, rather than having the highest profit margin (\$/kg MS). When most farms choose to intensify and adopt a production system such as TMR, they try and produce more units (milk solids) often at lower margins. This allows for the total profit of the farm to increase, at possibly higher risk (due to smaller margins per unit).

## Profit and returns

### Northern Victoria

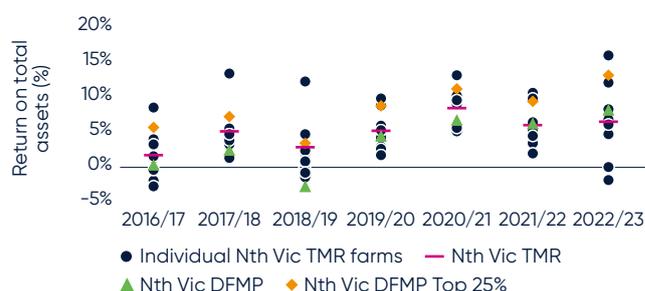
The Nth Vic TMR farms had higher returns than the Nth Vic DFMP farms in the first 5 years (Figure 20). In recent years (2021/22 and 2022/23), a larger spread of profit between individual Nth Vic TMR farms and lower average profit margin compared to Nth Vic DFMP farms was observed. Average TMR farm profit was influenced by higher milk prices and input costs, except for irrigation water, and all farms finishing their transition to TMR. The ability to control costs (particularly feed costs) in 2021/22 and 2022/23 was the biggest influence on the large spread of profit in these years, along with declining milk production in 2022/23. This meant that the grazing based farms kept feed costs under control while irrigation water costs were lower. With a small data set of TMR farms, one TMR farm in 2022/23 negatively skewed the average EBIT of the TMR farms by \$0.47/kg MS.

**Figure 20.** Earnings before interest and tax (EBIT) (\$/kg MS) for each Nth Vic TMR farm and average Nth Vic TMR, Nth Vic DFMP and Nth Vic DFMP Top 25% farms between 2016/17 and 2022/23



The return on total assets for Nth Vic (Figure 21) showed a similar trend to EBIT (Figure 20) where the TMR farms were more profitable than the DFMP farms in the first 5 years, until the profit declined relative to the DFMP farms in the last 2 years. The Nth Vic DFMP Top 25% recorded higher average profits and returns than the Nth Vic TMR and Nth Vic DFMP groups in all years. Some individual Nth Vic TMR farm performance was higher than this top performing group average highlighting there were high (and lower) returns among the Nth Vic TMR group. The lower average profit for the Nth Vic TMR farms appeared to be the main driver of the lower return on total assets in 2021/22 and 2022/23 on the TMR farms rather than the increasing value of their assets.

**Figure 21.** Return on total assets for each of the Nth Vic TMR farms and average Nth Vic TMR, Nth Vic DFMP and Nth Vic DFMP Top 25% farms between 2016/17 and 2022/23

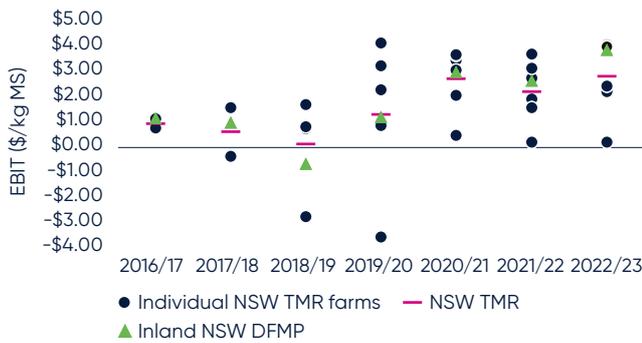


### Inland NSW

Profit for the NSW TMR farms followed a similar trend to Nth Vic TMR farms. In the last two years (2021/22 and 2022/23) the profit gap (EBIT \$/kg MS) widened between the TMR farms and the inland NSW DFMP average (Figure 22). The EBIT gap was \$0.43/kg MS in 2021/22 and \$1.05/kg MS in 2022/23.

The higher gross farm income on the TMR farms compared to the inland NSW DFMP (\$1.18/kg MS higher in 2021/22 and \$0.05/kg MS higher in 2022/23) was not enough to limit the impact of the higher cost of production on the TMR farms compared to the inland NSW DFMP (\$1.75/kg MS higher in 2021/22 and \$1.24/kg MS in 2022/23).

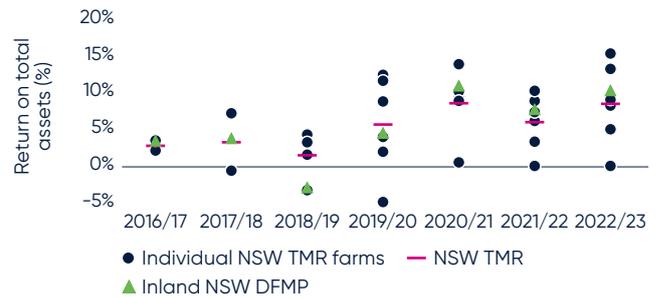
**Figure 22.** Earnings before interest and tax (EBIT) (\$/kg MS) for each NSW TMR farm, and average NSW TMR and inland NSW DFMP farms between 2016/17 and 2022/23



The average returns for the NSW TMR farms were higher than the inland NSW DFMP farms in 2018/19 and 2019/20 – years of dry conditions, drought and high feed costs. In the following 3 years (2020/21 to 2022/23) the inland NSW DFMP farms recorded higher returns than the NSW TMR farms (Figure 23). The gap in average return on total assets between the NSW TMR farms and the inland NSW DFMP group remained similar in the last two years. While there was a change of farms in both the inland NSW DFMP and NSW TMR groups, the change of farms in the NSW TMR group with differing asset values relative to production, saw no change to the gap in returns.

Figure 23 shows a larger spread of returns between individual NSW TMR farms in the last two years (2021/22 and 2022/23) compared to earlier years. Challenges of implementing the TMR system and the timing of the developments which coincided with adverse seasonal conditions partially contributed to this divergence. Other NSW TMR farms capitalised on rising milk prices.

**Figure 23.** Return on total assets for each of the NSW TMR farms, and average NSW TMR and inland NSW DFMP farms between 2016/17 and 2022/23



# Capital

## Key points

There were higher capital requirements on intensive systems.

While the TMR farms had higher debt levels, the value of assets increased by more than the total debt, resulting in the average equity increasing over the 7 years.

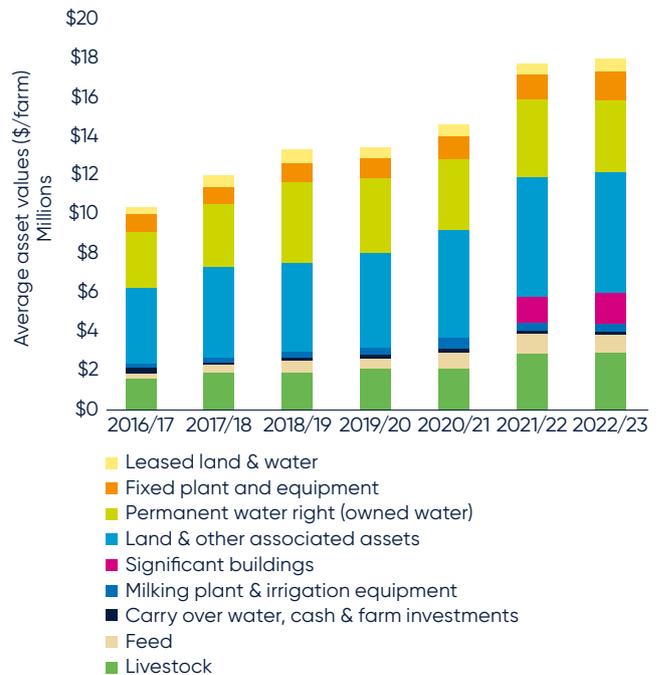
One of the biggest barriers for many farms considering an investment in cattle feeding and housing infrastructure is the capital required. The large capital requirements were evident on the TMR farms. The average value of their business assets grew from \$10 million in 2016/17 to \$18 million in 2022/23 in (Figure 24). This was due to a combination of capital appreciation and growth between years. Investment in asset items such as cattle housing and feeding infrastructure and other related assets on the TMR farms contributed to higher asset values between years. Some took a staged approach to increasing their assets, investing in land and permanent water before investing in the housing and feeding infrastructure in later years.

The accounting method for significant buildings (such as contained housing facilities and feedpads) changed in 2021/22. Prior to 2021/22 the value of the significant building was included in the land and other associated assets. In 2022/23, significant buildings made up about \$2 million of total assets on Nth Vic TMR farms and \$1.4 million on NSW TMR farms. This was calculated as the total amount spent to construct the significant buildings (excluding the labour component) and depreciating the assets over 20 years. This value of significant buildings has not yet been tested against the value derived in the real estate market. Most lenders consider these significant buildings to have a much lower value than the values used by this project due to the lending criteria established by financial institutions (to manage risk). If the lenders values were used, the value of the assets and the equity would be lower.

The total level of debt increased every year for the TMR group (Figure 26) as greater borrowings were used for long-term, short-term and equipment loans. The average long-term liabilities (farm land and infrastructure loans) increased by \$1.13 million (32% increase), short-term liabilities by \$117,000 (101%) and equipment loans by \$319,000 (83%) over the 7 years.

Average equity increased from \$6 million in 2016/17 to \$12 million in 2022/23. The value of assets increased by more than the total debt, resulting in the average equity increasing from 61% in 2016/17 to 69% in 2022/23.

**Figure 24.** Average assets values for the TMR farms between 2016/17 and 2022/23



**Figure 25.** Average total equity, total liabilities and equity percentage for the TMR farms between 2016/17 and 2022/23



# Finance costs

Interest costs on finance were influenced by the amount of debt and the interest rate. The interest rate declined from 2016 until 2021 before rapidly increasing in 2022/23, as depicted by the cash interest rate in Figure 26.

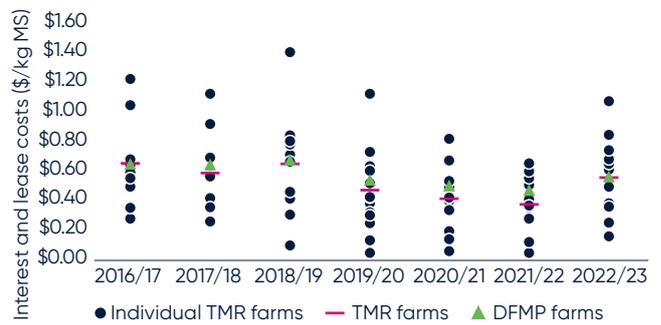
**Figure 26.** The cash interest rate in Australia (Source: Reserve Bank of Australia)



Despite average total borrowings (loans) increasing by 39% across the 7-years on TMR farms (Figure 25), the interest and lease servicing costs (\$/kg MS) (Figure 27) for these farms declined over the first 6 years due to growing milk production, diluting the cost (\$/kg MS). This reversed in 2022/23 with interest rate rises during the year, increased borrowings and the decline in milk production (Figure 4 and Figure 5).

In most years the TMR farms had lower interest and lease costs compared to the DFMP farms. This was the effect of higher milk production diluting the higher total interest and lease costs. Similar to depreciation costs, the lower milk production in 2022/23 increased the interest and lease costs when expressed per kg MS.

**Figure 27.** Interest and lease costs for each of the TMR farms, and average TMR and DFMP farms between 2016/17 and 2022/23



When comparing interest and lease costs in isolation, the cashflow risk associated with finance costs was not fully considered. The value of equipment loans on TMR farms grew by \$319,000 (83%) across the 7 years. Equipment loans have short-term finance options that require the principal to be paid back over short time frames can place additional pressure on cashflow. The impact on cashflow could not be estimated for the TMR farms due to the accrual data collection.

# Risk

## Key points

The wide range of return and risk for both the TMR and DFMP farms suggests that many factors influence profitability and risk, in conjunction with the production system.

There is often a lag between a farm making a significant on-farm development and reaping its benefits. The transition period presents additional risks which need to be managed well.

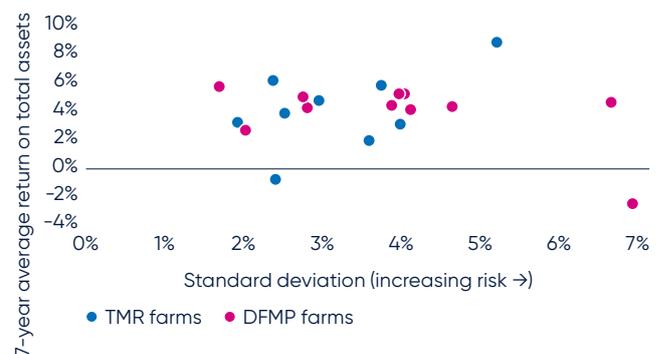
*Note, only those individual TMR and DFMP farms who participated in each of the 7 years were included in the risk section. There were 9 TMR farms (7 Vic and 2 NSW) and 12 DFMP farms (9 Nth Vic and 3 inland NSW).*

The large capital development in cattle housing and feeding infrastructure was a vulnerable stage for some TMR farms and presented additional risks to manage. Ho *et al.* (2012) analysed the productivity gains of a dairy farm over 40 years and demonstrated that when the dairy farm undertook a large development (such as implementing grain feeding), several years were needed to capture the advantages of the technology on farm business performance. As the majority of the TMR farms were transitioning to TMR production system during the 7-year period, it was possible that they would not all be immediately profitable. The lag between timing of the investment and reaping its benefits is an important consideration for an individual farm manager. The TMR production system involves a large capital investment, takes considerable costs to run, and additionally requires a new skill set to effectively manage. Each of these three factors are significant risks and need to be managed well during the transition to a TMR production system.

This section looked at the average return on total assets for individual TMR and DFMP farms that participated for 7 years and considered the other major part of the returns story – the risk associated with the venture. Here, risk was defined as the variability of annual returns around the average. Studies have quantified dispersion around average returns using both standard deviation and coefficient of variation (CoV), which allows comparisons between production systems (Tocker *et al.* 2022) and other investments in the economy (cited in Malcolm *et al.* 2005). A robust business not only strives for a high average return but also seeks to minimise variability around these returns.

Figure 28 illustrates average annual return (vertical axis), and standard deviation around this average (horizontal axis) for each of the TMR farms and those DFMP farms who participated in each of the 7 years. Ideally, businesses would have higher average annual return and lower standard deviations, towards the top left corner of the figure. However, higher average returns for individual farms were often associated with higher risk (Figure 28) – this is true, to varying degrees, for all investments (Heard *et al.* 2017). This suggests that many factors, along with the type of production system a farm adopts, influences an individual farm's profitability and risk. Successful businesses have demonstrated they can manage risk, prosper and grow.

**Figure 28.** Average and standard deviation of annual returns for individual TMR farms and DFMP farms that have participated for 7 years

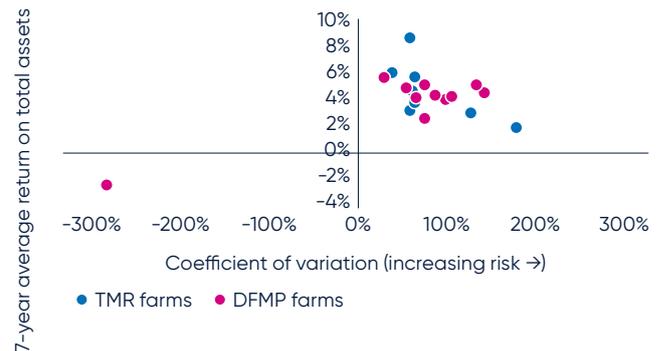


While standard deviation is a measure of the amount of variation within a dataset, CoV is a ratio of the standard deviation to the average return, allowing better comparisons between business with differing capital investments (Figure 29). Using CoV as the measure of variability, the TMR farm with the lowest risk relative to return managed quite different farming systems across the 7 years. Early on, the farm operated as a TMR production system and with an additional grazing herd. By the end of the analysis period, they no longer managed a grazing herd and operated as a TMR. Comparing this farm with the other TMR's should be done judiciously. The TMR farm with the second highest average returns operated as a TMR for the duration of the study.

The DFMP farm with negative returns and highest risk (Figure 29) was a small farm with a large component of imputed labour. This farm business also made a series of major changes which corresponded with challenging seasonal conditions, contributing to their lower returns and higher risk. At the other end of the scale, the farm

with the highest returns also had the lowest risk. It was a well-run DFMP farm with good management. Several TMR farms who transitioned during the 7-year analysis period had similar risk (around 60% CoV of annual return on total assets).

**Figure 29.** Average return on total assets and coefficient of variation for individual TMR farms and DFMP farms that have participated for 7 years



## Further research

Many of the TMR farms finished transitioning in the last couple of years. It is likely the TMR farms are on a learning curve and will continue to refine their new systems and find efficiencies with time. Further monitoring and tracking would be beneficial to see the improvements in farm performance as farmers improve their management of the TMR production systems.

With the existing data capture and analysis, some physical metrics were not reported. Metrics such as feed conversion efficiency would provide insights into how TMR farms are managing risks within their business. There would be benefit from investigating ways to collect data required for these metrics, through approaches such as farmer case studies.

Further research is required to validate and retrospectively analyse greenhouse gas emission data for the NSW TMR farms. An expanded greenhouse gas emissions dataset for intensive farms (farms from Victoria and NSW) would provide a more comprehensive and robust dataset for this cohort of dairy farms. It would also help inform emission reduction options relevant for these dairy farmers. For example, the third edition National Guidelines Dairy Feedpads and Contained Housing (2024) recommend various manure management systems for TMR farms, including anaerobic digestion, to mitigate greenhouse gas emissions from these sources. More accurate greenhouse gas emissions information provides crucial insights into the factors influencing greenhouse gas emissions on TMR farms and contribute to the ongoing efforts to achieve sustainability targets set by the Australian dairy industry.

# Conclusion

This project found that feeding system intensification required a larger capital investment and management of different risks compared to pasture-grazing. An economic analysis of 15 TMR farms across a 7-year period (8 farms in Nth Vic and 7 farms in inland NSW) revealed that the average returns remained within a range of between 2% and 9%. This was comparable with the average returns for the DFMP farms which ranged between -2% and 9% over the same period.

The significant investment and transition to intensify the production system increased the total costs, cost of production, and price risk (milk and purchased feed) on TMR farms. However, the extra efficiencies that were gained in areas of their business such as milk production and water use efficiency, helped to partially offset the extra costs. The TMR farms tended to actively manage these price risks through multiple year milk price contracts and/or by increasing on-farm fodder inventories.

While a preliminary estimate of greenhouse gas emissions was conducted, further investigation is required.

Most of the TMR farms in this study finished transitioning in the last 2 to 3 years. Continuing to find efficiencies and manage the risks will enable these systems to navigate changes in their operating environment. Further monitoring is required to gain a comprehensive understanding of the profitability, sustainability, and risk management of these production systems over time. This will help ensure the future resilience of the Australian dairy industry.

# Glossary

All other farm income	Income to the farm from all sources except milk. Includes livestock trading profit, dividends, interest payments received, and rent from farm houses.	Farm feed conversion	Total tonnes of feed fed (homegrown and purchased) divided by the milk solids produced. Note that feed fed to all livestock classes are included in the tonnes of feed fed.
Asset	Anything managed by the farm, whether it is owned or not. Assets include owned and leased land and buildings, plant and machinery, fixtures and fittings, trading stock, farm investments (i.e., Farm Management Deposits), debtors, and cash.	Fat and protein corrected milk (FPCM)	Milk composition standardised for fat and protein to allow comparisons based on nutritional content.
Average	The sum of all values in a category divided by the number of summed values unless an exclusion has been specified.	Feed costs	Cost of fertiliser, irrigation (including effluent), hay and silage making, fuel and oil, pasture improvement, fodder purchases, grain/concentrates, agistment and lease costs associated with any of the above costs, and feed inventory change.
Coefficient of variation (CoV)	Ratio of standard deviation to the average return. It measures the dispersion around the average.	Feed inventory change	An estimate of the feed on hand at the start and end of the financial year to capture feed used in the production of milk and livestock.
Concentrates	Refers to feeds with a concentrated source of energy such as grains, pellets and other grain mixes.	Full time equivalent (FTE)	Standardised labour unit. Equal to 2,400 hours a year. Calculated as 50 hours a week for 48 weeks a year.
Cost of production	The cost of producing the main product of the business; milk. Usually expressed in terms of the main enterprise output i.e. dollars per kg MS. Cost of production including inventory changes; variable costs plus cash and non-cash overhead costs, accounting for feed and inventory change and livestock inventory change minus livestock purchases.	Gross farm income	Farm income including milk sales, livestock trading and other income such as income from grants and rebates.
Depreciation	Decrease in value over time of capital asset, usually as a result of using the asset. Depreciation is a non-cash cost of the business but reduces the book value of the asset and is therefore a cost.	Herd costs	Cost of artificial insemination (AI) and herd tests, animal health and calf rearing.
Earnings before interest and tax (EBIT)	Gross income minus total variable and total overhead costs.	Imputed labour cost	An allocated allowance for the cost of owner/operator, family, and sharefarmer time in the business. Also referred to as unpaid labour.
Employed labour cost	Cash cost of any paid employee, including on-costs such as superannuation and Workcover. Also referred to as paid labour.	Interest and lease costs	Total interest plus total lease costs paid.
Equity	Total assets minus total liabilities. Equal to the total value of capital invested in the farm business by the owner/ operator(s).	Labour cost	Cost of the labour resource on farm. Includes both imputed and employed labour costs.
Equity per cent	Total equity as a percentage of the total assets owned. The proportion of the total assets owned by the business.	Labour efficiency	FTEs per kg MS. Measures productivity of the total labour resources in the business.
		Liability	Money owed to someone else, e.g., family or a financial institute such as a bank.

Livestock trading profit	An estimate of the annual contribution to gross farm income by accounting for the changes in the number and value of livestock during the year. It is calculated as the trading income from sales minus purchases, plus changes in the value and number of livestock on hand at the start and end of the year, and accounting for births and deaths.
Milk income	Income from the sale of milk. This is net of compulsory levies and charges.
Net farm income	Earnings before interest and tax (EBIT) minus interest and lease costs. The amount of profit available for capital investment, loan principal repayments and tax.
Number of milkers	Total number of cows milked for at least three months.
Other income	Income to the farm from other farm owned assets and farm business related external sources. Includes milk factory dividends, interest payments received, and rent from farm cottages.
Overhead costs	All fixed costs incurred by the farm business that do not vary with the level of production. These include cash overhead costs such as employed labour and non-cash costs such as imputed owner-operator labour, family labour and depreciation of plant and equipment. It excludes interest, lease costs, capital expenditure, principal repayments, drawings, and tax.
Real terms	Dollar values or interest rates that have no inflation component.
Return on equity (ROE)	Net farm income divided by the value of total equity.
Return on total assets (ROTA)	Earnings before interest and tax divided by the value of total assets under management, including owned and leased land.
Shed costs	Cost of shed power and dairy supplies such as filter socks, rubberware, vacuum pump oil etc.
Top 25%	Regional or State average for the Top 25% of participant farms ranked by return on total assets; can also be referred to as the top group, top performers within a region or the state.
Total usable area	Total hectares managed minus the area of land which is of little or no value for livestock production e.g., house and shed area.
Total water use efficiency (WUE)	Homegrown feed consumed or harvested per 100 mm water 'applied' (rainfall and irrigation) to the usable hectares on the farm.

Variable costs	All costs that vary with the size of production in the enterprise e.g., herd, shed and feed costs (including feed and water inventory change).
Water inventory change	An estimate of the values irrigation water on hand at the start and end of the financial year to capture water used in the production of pasture and crops.

#### Feeding Systems:

Low bail	Low bail is defined by the one-tonne annual cap of grain or concentrates fed in the dairy bail – i.e. cows are fed up to one tonne of grain and concentrate in the dairy at milking time throughout lactation and livestock graze pasture all year round.
Moderate – High bail	The level of grain or concentrate fed in the bail is more significant than one tonne per annum, and livestock graze pasture all year round.
Partial mixed ration	In the partial mixed ration (PMR) system, livestock animals graze on pasture for most of the year, if not all of the year, while being fed a PMR on a feed pad.
Hybrid system	Hybrid systems are classified as grazing pasture for fewer than nine months of the year while feeding a partial mixed ration on a feed pad with grain or concentrates.
Total mixed ration	A total mixed ration or TMR is classified by zero-grazing, where cows are contained and fed a TMR throughout the year.

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# Appendix

**Table 1.** Average financial performance for Nth Vic TMR farms between 2016/17 and 2022/23

\$/kg MS	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Milk income (net)	6.21	6.80	7.61	7.87	7.83	7.98	9.71
Livestock trading profit	0.59	0.92	0.69	0.79	0.87	1.43	1.15
All other income	0.09	0.11	0.34	0.07	0.15	0.35	0.39
<b>Gross farm income</b>	<b>6.89</b>	<b>7.82</b>	<b>8.64</b>	<b>8.74</b>	<b>8.85</b>	<b>9.76</b>	<b>11.24</b>
Total herd costs	0.40	0.37	0.33	0.39	0.36	0.49	0.46
Total shed costs	0.22	0.21	0.20	0.22	0.20	0.24	0.26
Homegrown feed costs	1.41	1.22	1.97	1.35	1.64	1.79	1.97
Purchased feed costs	2.57	2.33	3.10	3.38	2.93	3.21	3.35
Feed and water inventory change	-0.73	0.11	0.00	-0.11	-0.75	-0.58	0.30
Total feed costs	3.25	3.66	5.07	4.62	3.82	4.41	5.62
<b>Total variable costs</b>	<b>3.87</b>	<b>4.24</b>	<b>5.60</b>	<b>5.22</b>	<b>4.38</b>	<b>5.14</b>	<b>6.33</b>
Total labour cost (employed and imputed)	1.56	1.36	1.32	1.29	1.35	1.41	1.77
All other overheads	0.98	0.93	0.99	0.89	0.90	1.31	1.47
<b>Total overhead costs</b>	<b>2.54</b>	<b>2.29</b>	<b>2.32</b>	<b>2.18</b>	<b>2.25</b>	<b>2.72</b>	<b>3.24</b>
<b>Earnings before interest and tax</b>	<b>0.49</b>	<b>1.29</b>	<b>0.72</b>	<b>1.33</b>	<b>2.22</b>	<b>1.90</b>	<b>1.67</b>
Interest and lease costs	0.62	0.55	0.53	0.42	0.40	0.32	0.47
<b>Net farm income</b>	<b>-0.13</b>	<b>0.74</b>	<b>0.19</b>	<b>0.91</b>	<b>1.82</b>	<b>1.59</b>	<b>1.19</b>
<b>Return on total assets</b>	<b>2.1%</b>	<b>5.9%</b>	<b>3.3%</b>	<b>5.8%</b>	<b>9.4%</b>	<b>6.4%</b>	<b>6.6%</b>
<b>Return on equity</b>	<b>-0.8%</b>	<b>6.3%</b>	<b>1.5%</b>	<b>6.4%</b>	<b>13.5%</b>	<b>8.1%</b>	<b>7.7%</b>

**Table 2.** Average financial performance for Nth Vic DFMP farms between 2016/17 and 2022/23

<b>\$/kg MS</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>	<b>2019/20</b>	<b>2020/21</b>	<b>2021/22</b>	<b>2022/23</b>
Milk income (net)	5.93	6.69	7.06	8.27	7.77	8.03	9.97
Livestock trading profit	0.61	0.68	0.48	0.61	0.75	0.92	0.81
All other income	0.12	0.06	0.08	0.12	0.12	0.05	0.08
<b>Gross farm income</b>	<b>6.67</b>	<b>7.42</b>	<b>7.62</b>	<b>9.00</b>	<b>8.64</b>	<b>8.99</b>	<b>10.86</b>
Total herd costs	0.38	0.38	0.36	0.34	0.32	0.38	0.35
Total shed costs	0.24	0.23	0.24	0.22	0.22	0.22	0.25
Homegrown feed costs	1.43	1.48	1.98	1.50	1.64	1.48	1.49
Purchased feed costs	2.32	2.22	3.23	3.55	2.59	2.46	3.19
Feed and water inventory change	-0.28	0.24	0.12	-0.27	-0.40	-0.15	-0.04
Total feed costs	3.29	3.79	5.17	4.68	3.70	3.69	4.48
<b>Total variable costs</b>	<b>3.90</b>	<b>4.40</b>	<b>5.77</b>	<b>5.24</b>	<b>4.24</b>	<b>4.29</b>	<b>5.07</b>
Total labour cost (employed and imputed)	1.67	1.55	1.71	1.52	1.52	1.51	1.60
All other overheads	0.88	0.85	0.87	0.89	0.97	1.05	1.12
<b>Total overhead costs</b>	<b>2.55</b>	<b>2.40</b>	<b>2.57</b>	<b>2.42</b>	<b>2.49</b>	<b>2.56</b>	<b>2.72</b>
<b>Earnings before interest and tax</b>	<b>0.22</b>	<b>0.62</b>	<b>-0.72</b>	<b>1.35</b>	<b>1.91</b>	<b>2.14</b>	<b>3.07</b>
Interest and lease costs	0.70	0.68	0.69	0.54	0.53	0.47	0.62
<b>Net farm income</b>	<b>-0.48</b>	<b>-0.06</b>	<b>-1.42</b>	<b>0.81</b>	<b>1.38</b>	<b>1.67</b>	<b>2.47</b>
<b>Return on total assets</b>	<b>0.4%</b>	<b>2.5%</b>	<b>-2.7%</b>	<b>4.5%</b>	<b>6.8%</b>	<b>6.3%</b>	<b>8.3%</b>
<b>Return on equity</b>	<b>-4.2%</b>	<b>0.6%</b>	<b>-10.5%</b>	<b>3.9%</b>	<b>8.6%</b>	<b>8.2%</b>	<b>12.8%</b>

**Table 3.** Average financial performance for Nth Vic DFMP Top 25% farms between 2016/17 and 2022/23

<b>\$/kg MS</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>	<b>2019/20</b>	<b>2020/21</b>	<b>2021/22</b>	<b>2022/23</b>
Milk income (net)	6.10	6.90	7.25	8.05	7.65	8.05	10.06
Livestock trading profit	0.79	0.71	0.39	0.79	0.78	1.02	0.82
All other income	0.07	0.04	0.17	0.07	0.17	0.02	0.14
<b>Gross farm income</b>	<b>6.96</b>	<b>7.65</b>	<b>7.81</b>	<b>8.90</b>	<b>8.60</b>	<b>9.09</b>	<b>11.02</b>
Total herd costs	0.33	0.30	0.31	0.26	0.32	0.27	0.29
Total shed costs	0.19	0.21	0.21	0.20	0.19	0.21	0.25
Homegrown feed costs	1.41	1.34	1.72	1.53	1.75	1.11	1.34
Purchased feed costs	1.93	1.99	2.39	2.96	2.66	2.41	3.42
Feed and water inventory change	-0.29	0.16	-0.09	-0.33	-0.76	0.10	-0.13
Total feed costs	2.90	3.41	3.94	4.06	3.47	3.47	4.60
<b>Total variable costs</b>	<b>3.42</b>	<b>3.92</b>	<b>4.46</b>	<b>4.53</b>	<b>3.97</b>	<b>3.95</b>	<b>5.14</b>
Total labour cost (employed and imputed)	1.34	1.19	1.25	1.29	1.21	1.27	1.37
All other overheads	0.68	0.68	0.82	0.79	0.78	0.91	0.89
<b>Total overhead costs</b>	<b>2.02</b>	<b>1.87</b>	<b>2.07</b>	<b>2.07</b>	<b>1.99</b>	<b>2.18</b>	<b>2.26</b>
<b>Earnings before interest and tax</b>	<b>1.52</b>	<b>1.86</b>	<b>1.27</b>	<b>2.30</b>	<b>2.64</b>	<b>2.95</b>	<b>3.62</b>
Interest and lease costs	0.67	0.79	0.55	0.39	0.41	0.26	0.49
<b>Net farm income</b>	<b>0.85</b>	<b>1.07</b>	<b>0.73</b>	<b>1.91</b>	<b>2.22</b>	<b>2.68</b>	<b>3.12</b>
<b>Return on total assets</b>	<b>5.8%</b>	<b>7.3%</b>	<b>3.5%</b>	<b>8.8%</b>	<b>11.3%</b>	<b>9.5%</b>	<b>13.3%</b>
<b>Return on equity</b>	<b>5.9%</b>	<b>12.8%</b>	<b>4.1%</b>	<b>11.3%</b>	<b>15.1%</b>	<b>12.7%</b>	<b>26.2%</b>

**Table 4.** Average financial performance for NSW TMR farms between 2016/17 and 2022/23

<b>\$/kg MS</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>	<b>2019/20</b>	<b>2020/21</b>	<b>2021/22</b>	<b>2022/23</b>
Milk income (net)	7.29	7.19	8.50	9.18	9.26	9.02	10.62
Livestock trading profit	1.45	0.62	0.87	1.30	1.27	1.72	1.50
All other income	0.05	0.12	0.56	0.36	0.33	0.31	0.06
<b>Gross farm income</b>	<b>8.79</b>	<b>7.93</b>	<b>9.93</b>	<b>10.83</b>	<b>10.87</b>	<b>11.05</b>	<b>12.18</b>
Total herd costs	0.59	0.43	0.35	0.36	0.40	0.40	0.45
Total shed costs	0.32	0.33	0.36	0.40	0.39	0.36	0.33
Homegrown feed costs	1.13	1.36	2.04	1.14	1.52	1.65	1.64
Purchased feed costs	3.09	2.86	3.80	4.98	3.41	3.49	3.59
Feed and water inventory change	-0.22	-0.22	0.02	-0.33	-0.75	-0.47	0.24
Total feed costs	4.00	4.00	5.86	5.79	4.18	4.66	5.47
<b>Total variable costs</b>	<b>4.92</b>	<b>4.76</b>	<b>6.57</b>	<b>6.54</b>	<b>4.97</b>	<b>5.42</b>	<b>6.25</b>
Total labour cost (employed and imputed)	1.78	1.47	2.00	1.79	1.92	1.96	1.73
All other overheads	1.13	1.07	1.22	1.17	1.24	1.44	1.37
<b>Total overhead costs</b>	<b>2.91</b>	<b>2.54</b>	<b>3.22</b>	<b>2.96</b>	<b>3.15</b>	<b>3.40</b>	<b>3.11</b>
<b>Earnings before interest and tax</b>	<b>0.96</b>	<b>0.62</b>	<b>0.14</b>	<b>1.33</b>	<b>2.74</b>	<b>2.23</b>	<b>2.83</b>
Interest and lease costs	0.79	0.75	0.87	0.56	0.45	0.45	0.67
<b>Net farm income</b>	<b>0.17</b>	<b>-0.12</b>	<b>-0.73</b>	<b>0.77</b>	<b>2.30</b>	<b>1.77</b>	<b>2.15</b>
<b>Return on total assets</b>	<b>3.0%</b>	<b>3.4%</b>	<b>1.6%</b>	<b>5.8%</b>	<b>8.8%</b>	<b>6.2%</b>	<b>8.7%</b>
<b>Return on equity</b>	<b>1.4%</b>	<b>3.4%</b>	<b>0.0%</b>	<b>6.7%</b>	<b>11.7%</b>	<b>7.4%</b>	<b>11.8%</b>

**Table 5.** Average financial performance for inland NSW DFMP farms between 2016/17 and 2022/23

<b>\$/kg MS</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>	<b>2019/20</b>	<b>2020/21</b>	<b>2021/22</b>	<b>2022/23</b>
Milk income (net)	7.05	7.53	7.61	8.48	8.66	8.66	10.89
Livestock trading profit	1.03	0.77	0.36	0.63	0.85	1.14	1.19
All other income	0.10	0.01	0.03	0.03	0.19	0.06	0.05
<b>Gross farm income</b>	<b>8.18</b>	<b>8.31</b>	<b>8.00</b>	<b>9.13</b>	<b>9.70</b>	<b>9.86</b>	<b>12.13</b>
Total herd costs	0.41	0.34	0.25	0.26	0.30	0.35	0.44
Total shed costs	0.26	0.22	0.25	0.23	0.23	0.24	0.27
Homegrown feed costs	1.65	1.79	2.44	1.59	1.64	1.88	1.95
Purchased feed costs	2.47	2.20	3.15	3.77	2.71	2.65	3.09
Feed and water inventory change	-0.22	0.07	0.50	-0.02	-0.58	-0.47	-0.47
Total feed costs	3.39	4.05	5.80	5.02	3.64	3.78	4.37
<b>Total variable costs</b>	<b>4.05</b>	<b>4.61</b>	<b>6.30</b>	<b>5.50</b>	<b>4.17</b>	<b>4.37</b>	<b>5.07</b>
Total labour cost (employed and imputed)	2.18	1.69	1.38	1.36	1.49	1.55	1.92
All other overheads	0.79	1.01	0.95	1.06	1.05	1.28	1.27
<b>Total overhead costs</b>	<b>2.96</b>	<b>2.71</b>	<b>2.33</b>	<b>2.42</b>	<b>2.53</b>	<b>2.83</b>	<b>3.19</b>
<b>Earnings before interest and tax</b>	<b>1.16</b>	<b>0.99</b>	<b>-0.63</b>	<b>1.21</b>	<b>3.00</b>	<b>2.66</b>	<b>3.87</b>
Interest and lease costs	0.51	0.55	0.61	0.57	0.40	0.50	0.36
<b>Net farm income</b>	<b>0.65</b>	<b>0.44</b>	<b>-1.12</b>	<b>0.75</b>	<b>2.60</b>	<b>2.16</b>	<b>3.51</b>
<b>Return on total assets</b>	<b>3.7%</b>	<b>4.0%</b>	<b>-2.7%</b>	<b>4.7%</b>	<b>11.1%</b>	<b>8.0%</b>	<b>10.5%</b>
<b>Return on equity</b>	<b>2.2%</b>	<b>2.0%</b>	<b>-8.9%</b>	<b>3.6%</b>	<b>16.4%</b>	<b>9.9%</b>	<b>12.6%</b>

**Table 6.** Average financial performance for TMR farms between 2016/17 and 2022/23

<b>\$/kg MS</b>	<b>2016/17</b>	<b>2017/18</b>	<b>2018/19</b>	<b>2019/20</b>	<b>2020/21</b>	<b>2021/22</b>	<b>2022/23</b>
Milk income (net)	6.42	6.88	7.93	8.43	8.45	8.43	10.10
Livestock trading profit	0.76	0.86	0.76	1.01	1.04	1.56	1.30
All other income	0.08	0.11	0.42	0.19	0.23	0.33	0.25
<b>Gross farm income</b>	<b>7.27</b>	<b>7.84</b>	<b>9.11</b>	<b>9.63</b>	<b>9.71</b>	<b>10.31</b>	<b>11.65</b>
Total herd costs	0.44	0.38	0.34	0.37	0.38	0.45	0.46
Total shed costs	0.24	0.24	0.26	0.30	0.28	0.29	0.29
Homegrown feed costs	1.35	1.25	1.99	1.26	1.63	1.73	1.82
Purchased feed costs	2.85	2.56	3.37	4.07	3.16	3.34	3.52
Feed and water inventory change	-0.66	0.06	0.01	-0.20	-0.75	-0.53	0.27
Total feed costs	3.40	3.73	5.36	5.12	3.98	4.52	5.55
<b>Total variable costs</b>	<b>4.08</b>	<b>4.35</b>	<b>5.95</b>	<b>5.79</b>	<b>4.64</b>	<b>5.26</b>	<b>6.30</b>
Total labour cost (employed and imputed)	1.60	1.39	1.57	1.51	1.59	1.65	1.75
All other overheads	1.01	0.96	1.07	1.01	1.04	1.37	1.43
<b>Total overhead costs</b>	<b>2.61</b>	<b>2.34</b>	<b>2.64</b>	<b>2.52</b>	<b>2.63</b>	<b>3.01</b>	<b>3.18</b>
Earnings before interest and tax	0.58	1.16	0.51	1.33	2.44	2.04	2.16
Interest and lease costs	0.66	0.59	0.65	0.48	0.42	0.38	0.56
<b>Net farm income</b>	<b>-0.07</b>	<b>0.56</b>	<b>-0.14</b>	<b>0.85</b>	<b>2.03</b>	<b>1.66</b>	<b>1.61</b>
<b>Return on total assets</b>	<b>2.0%</b>	<b>4.8%</b>	<b>2.4%</b>	<b>5.5%</b>	<b>8.6%</b>	<b>6.1%</b>	<b>7.5%</b>
<b>Return on equity</b>	<b>-0.3%</b>	<b>5.1%</b>	<b>0.9%</b>	<b>6.2%</b>	<b>12.0%</b>	<b>7.6%</b>	<b>9.5%</b>

**Table 7.** Average physical performance of Nth Vic TMR farms between 2016/17 and 2022/23

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total usable area (ha)	583	580	653	679	701	701	704
Number of milkers (head)	629	687	777	836	890	913	922
Milk sold (kg MS/cow)	609	653	653	673	681	666	643
Homegrown feed as % of ME consumed	68%	57%	61%	45%	58%	62%	45%
Water use efficiency (t DM/100 mm/ha)	0.8	1.0	1.2	1.0	1.1	1.1	0.7
Labour efficiency (kg MS/labour unit)	58,023	64,247	67,220	66,792	68,488	67,872	60,367

**Table 8.** Average physical performance of Nth Vic DFMP farms between 2016/17 and 2022/23

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total usable area (ha)	211	202	203	219	222	254	238
Number of milkers (head)	321	325	331	341	345	338	341
Milk sold (kg MS/cow)	479	520	511	556	561	572	540
Homegrown feed as % of ME consumed	63%	58%	60%	48%	62%	63%	54%
Water use efficiency (t DM/100 mm/ha)	0.7	0.7	1.0	0.9	0.9	0.8	0.6
Labour efficiency (kg MS/labour unit)	52,090	55,325	51,308	57,721	57,910	57,175	54,874

**Table 9.** Average physical performance of Nth Vic DFMP Top 25% farms between 2016/17 and 2022/23

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total usable area (ha)	288	264	254	286	286	227	260
Number of milkers (head)	403	414	477	478	526	343	385
Milk sold (kg MS/cow)	457	530	520	569	575	597	560
Homegrown feed as % of ME consumed	78%	63%	68%	59%	63%	59%	48%
Water use efficiency (t DM/100 mm/ha)	0.8	0.7	1.1	1.1	1.0	0.8	0.7
Labour efficiency (kg MS/labour unit)	58,222	63,940	66,532	67,262	68,819	64,983	61,312

**Table 10.** Average physical performance of NSW TMR farms between 2016/17 and 2022/23

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total usable area (ha)	345	416	485	496	496	523	593
Number of milkers (head)	524	575	496	578	579	595	721
Milk sold (kg MS/cow)	553	565	621	653	653	645	603
Homegrown feed as % of ME consumed	58%	57%	74%	42%	67%	64%	45%
Labour efficiency (kg MS/labour unit)	47,354	51,968	42,483	47,764	46,664	46,203	52,691

**Table 11.** Average physical performance of inland NSW DFMP farms between 2016/17 and 2022/23

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total usable area (ha)	478	419	552	568	570	590	608
Number of milkers (head)	538	505	618	597	575	609	684
Milk sold (kg MS/cow)	513	523	571	597	608	611	565
Homegrown feed as % of ME consumed	70%	67%	53%	45%	73%	71%	66%
Labour efficiency (kg MS/labour unit)	46,317	48,678	57,507	60,620	56,798	54,928	50,333

**Table 12.** Average physical performance of TMR farms between 2016/17 and 2022/23

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total usable area (ha)	535	547	592	601	613	625	656
Number of milkers (head)	608	665	675	726	757	776	836
Milk sold (kg MS/cow)	598	636	642	662	669	657	626
Homegrown feed as % of ME consumed	66%	57%	66%	43%	62%	63%	45%
Labour efficiency (kg MS/labour unit)	55,889	61,791	58,225	59,735	59,135	58,585	57,078





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