



Profitability of Australian AMS farms 2015/16 to 2019/20

Final Report

Dan Armstrong (D-ARM Consulting)

September 2021



Background

This report was commissioned by the [Milking Edge project](#), an Australian dairy industry project by Dairy Australia, NSW Department of Primary Industries and DeLaval supporting farmers consider, invest and operate AMS successfully. Data collection, analysis and exploration were coordinated and conducted in a collaborative effort by Dan Armstrong (D-ARM Consulting), Kerry Kempton, Sheena Carter, Juan Gargiulo and Nicolas Lyons (NSW Department of Primary Industries).

If you have any further or follow up question or comment please contact Nicolas Lyons (0401 650 073 / nicolas.lyons@dpi.nsw.gov.au).

Introduction

Economic analysis to date of automatic milking systems (**AMS**) in Australia has been either based on a range of assumptions, overseas data, or data from isolated case study farms. We have now collected and analysed five years of data from a group of AMS farms in Australia.

The aims of this study were to:

- Collect data to verify the assumptions previously used and see if they are generally applicable across a range of AMS farms.
- Allow some limited comparisons between AMS and conventional milking systems (**CMS**) farms.
- Provide a base set of data to monitor change over time on AMS farms.
- Identify the potential for improved efficiency on some AMS farms.

This is a valuable dataset that has not been previously available and will hopefully inform the development of training and extension material and help validate/refine future analyses. It also provides the Australian dairy industry, and particularly those farmers considering the technology, a more realistic understanding of performance and profit.

Method

The study commenced in 2015/16 and finished in 2019/20. Over that period, nine farmers volunteered to participate in the study for the 2015/16 financial year, 12 farmers for the 2016/17 financial year, nine farmers for the 2017/18 year, eight farmers for the 2018/19 year and ten farmers 2019/20 year.

Over the 5 years of this project, we have engaged a total of 19 Australian AMS farms (~40% of AMS farms). Five farms have participated only one year, seven farms have participated over two years, two farms over three years, two other farms over four years and three farms have now participated every year. There was a significant geographic spread with farms located in NSW, Victoria, Tasmania, South Australia and Western Australia. The relatively small number of farms, the movement of farms in and out of the study between years, and the diversity between farms, mean that care needs to be taken in interpreting the results. However, this data provides many useful insights and will be valuable to the Australian dairy industry particularly as a basis for monitoring change over time.

Data was collected by experienced data collectors and went through a thorough validation process. The data was collected and analysed using either the Dairy Farm Monitor Project (DFMP) spreadsheet or DairyBase, and then exported into Excel for further analysis. The AMS farm data was compared with CMS farms participating in DFMP across Victoria, NSW and Tasmania.

Results and Discussion

Most of the findings are based on the financial year 2019/20, with comments, reflections and comparison to the previous years.

Physical Performance

The farms had between 2 and 16 automatic milking units each, which had been installed between 2009 and 2018. Farms with 3 or 4 units were most common. Herd sizes varied from approximately 90 to 800 cows (average 292) for 2019/20. Milk solids produced per farm in 2019/20 varied from approximately 30,000 kg to 339,000 kg (average 138,000 kg).

Overall Profitability

The return on total assets managed (**ROTA**) for the AMS farms varied from an average of 0.6% in 2015/16 to 2.4% in 2016/17, 0.9% in 2017/18, 2.2% in 2018/19 and 2.5% in 2019/20. A range of about -2% to 6% appears to be present in most years (**Table 1**), however, the range was narrower in 2018/19 (-0.7 to 3.4%) and broader in 2019/20 (-4 to 10%). In 2016/17, the profitability of the AMS farms did not appear to be markedly different to the average Victorian DFMP farms with the ROTA both averaging close to 2.5%. In 2017/18, the profitability of the AMS farms was lower than the DFMP in all States. In 2018/19, the profitability of the AMS farms was higher than the average Victorian and NSW DFMP farms, while in 2019/20 the average was similar to the NSW DFMP farms but lower than the average Victorian and Tasmanian farms (**Table 4**). Some of the farms were achieving well above the average ROTA of the Victorian DFMP farms, but most of the AMS farms had a lower ROTA than the average for Tasmania. It appears that AMS farms are generally not markedly different in profitability than CMS, but there appears to be potential for improved profitability on a number of the AMS farms (as there is for CMS farms).

Costs

The total variable costs (herd, shed and feed costs) generally do not appear to be substantially higher on AMS farms than CMS farms. The overhead costs generally appear to be much higher on AMS farms, mainly because of the much higher depreciation associated with the AMS units.

On average, the labour efficiency generally does not appear to be higher in the AMS than the CMS farms (**Table 6**). However, there were several AMS farms with exceptional labour efficiency (kg milk solids per labour unit) and very low labour costs (\$ per kg milk solids). In the last three years one AMS farm has achieved almost twice the labour efficiency and half the labour costs per kg of milk solids of the average Victorian DFMP farm. It appears that many of the AMS farms might still be in a development phase and have not captured the potential labour efficiency benefits yet (or they adopted AMS for reasons other than labour efficiency).

While the total variable costs were similar, on average, the AMS farms appear to have substantially higher power costs, most likely due to more power being used during peak periods (**Table 2**). However, it is important to recognise that the power costs are still a small proportion of total costs. Some AMS farms have responded by installing solar power systems, which have significantly reduced power costs. The demand pattern of AMS farms appears to be a better fit with the solar power generation pattern than CMS farms. Expenditure on dairy supplies also appeared to be higher on AMS farms. However, AMS farms appeared to spend less on herd testing probably explained by their systems providing a substantial amount of individual cow data on a daily basis.

Feed cost differences between AMS and the CMS farms are difficult to interpret due to variation across regions. However, the data does not indicate any general trend for feed costs to be markedly higher on AMS farms than CMS farms, which was often raised as a concern when the impact of voluntary milking on pasture utilisation was largely unknown. The data does not provide a conclusive comparison regarding pasture utilisation or consumption on CMS versus AMS farms, but it does provide evidence that adopting AMS will not necessarily lead to reduced

pasture utilisation. It appears that if best practice is applied to pasture management, similar levels of pasture utilisation could be achieved in AMS and CMS.

The milk solids production per kg of liveweight averaged 87% (with the highest being 109%) for the AMS farms in 2019/20 (**Table 6**). Milk production per kg of liveweight of 100% is generally considered to be high (the average in DFMP farms in 2019/20 for Victoria was 99% and for Tasmania 83%). This data indicates that AMS systems with potential for greater than 2 milkings/cow.day are not currently resulting in high cow efficiency. This issue appears to warrant further investigation.

Depreciation (in \$/kg MS) on the AMS farms is typically about twice that of the average CMS farms. On the small number of AMS farms with very high labour efficiency, the labour savings have compensated for the increased depreciation. However, this is not the case for many of the AMS farms in the study. While depreciation is a non-cash cost, and the calculation is based on some assumptions, it is important to include it in the economic analysis.

Repairs and maintenance costs for the AMS farms have always been higher than the CMS average but, this difference was more substantial in the 2019/20 data. This may be an aberration or, it could be due to the ageing of the AMS units as the study has progressed. It is likely that the consequences of neglecting maintenance are more costly on an AMS farm than a CMS farm. It would be useful to monitor trends with repairs and maintenance costs on AMS farms into the future.

Income

The milk income and gross farm income of the AMS farms had a wide range, but the average milk price per kg milk solids was higher than the average DFMP farms in Victoria and Tasmania. This can be due to about half of the AMS farms in the study being from areas outside of Victoria/Tasmania where the milk price is generally higher. There may also be a general trend for somewhat flatter supply patterns on many AMS farms.

Stage of Development and Profit

Most innovations on dairy farms result in a period of adjustment where there might be inefficiencies initially in the farm system. The adjustment required when adopting AMS is substantial and many of the farms in this study are recent adopters of AMS. Hence, it is likely that some of the farms in this study may make substantial improvements in profit in subsequent years. As data collected over several years has become available, there have (and will continue to) be opportunities to document some valuable insights from the evolution of case study farms over time.

Concluding comments

The data captured between 2015/16 and 2019/20 indicates that some Australian AMS farms can be relatively profitable, but there appears to be substantial potential for improvement in profitability on some AMS farms (as there is for CMS farms). Some of the farms were achieving well above the average ROTA of the Victorian DFMP farms, but most of the AMS farms had a lower ROTA than the average Tasmanian DFMP farms.

The total variable costs (herd, shed and feed costs) generally do not appear to be substantially higher on AMS farms than CMS farms. The overhead costs generally appear to be much higher on AMS farms, mainly because of much higher depreciation and repairs and maintenance costs associated with the robotic units. Having a better understanding of repairs and maintenance costs as the units get older would be useful. Also, understanding the longevity of the units better will aid in estimating depreciation.

On average, the labour efficiency generally does not appear to be higher in the AMS than CMS farms. However, there were a few AMS farms with exceptional labour efficiency (kg milk solids/labour unit) and very low labour costs per kg milk solids. On these farms the reduced labour costs outweigh the high depreciation and repairs and maintenance costs. Understanding why some AMS farms have achieved such high labour efficiency and others relatively low labour efficiency would be useful. It appears that many of the AMS farms are still in a development phase and have not captured the potential labour efficiency benefits as yet.

Feed cost differences between AMS and the DFMP farms are difficult to interpret due to variation across regions. However, the data does not indicate any general trend for feed costs to be dramatically higher on AMS farms than CMS farms. It would be good to analyse the pasture consumption and feed costs on the AMS farms in more detail as more data becomes available.

Most innovations on dairy farms result in a period of adjustment where there might be inefficiencies initially in the farm system. The adjustment required when adopting AMS is substantial and many of the farms in this study are recent adopters of AMS. Hence, it is likely that some of the farms in this study may make substantial improvements in profit in subsequent years. It would also be useful to monitor the adjustment period from CMS to AMS on more farms and investigate how long it is taking some of these farms to work through the inefficiencies in the new system before they see an improvement in profitability.

This is a valuable dataset that has not been previously available and will hopefully inform the development of training and extension material and help validate/refine future analyses. It also provides the Australian dairy industry, and particularly those farmers considering the technology, a more realistic understanding of performance and profit. It would be valuable to continue to document some valuable insights from the evolution of case study AMS farms over time.

Acknowledgements

We would like to acknowledge and thank the 19 Australian AMS farmers that have participated in this project. Without their data recording, co-operation and willingness to share information, this unique opportunity to document learnings for the benefit of the Australian dairy industry would not have been possible.

Table 1. Average income, costs and profit for the AMS farms (\$/kg milk solids) for 2015/16, 2016/17, 2017/18, 2018/19 and 2019/20. The numbers in brackets represent the range.

Profit Report	AMS Farms 2015/16	AMS Farms 2016/17	AMS Farms 2017/18	AMS Farms 2018/19	AMS Farms 2019/20
<u>Income</u>					
Milk Income (net of levies and charges)	6.52 (4.90 – 8.03)	6.29 (4.77 – 7.79)	6.62 (5.75 – 7.66)	7.16 (5.99 – 8.22)	7.51 (6.33 – 9.01)
Total Gross Farm Income	6.83 (4.28 – 8.93)	7.50 (5.20 – 10.09)	7.58 (6.26 – 9.06)	8.35 (6.33 – 10.58)	8.33 (7.30 – 10.31)
<u>Variable Costs</u>					
Herd Costs	0.24 (0.04 – 0.58)	0.25 (0.14 – 0.52)	0.31 (0.14 – 0.46)	0.31 (0.07 – 0.52)	0.26 (0.15 – 0.37)
Shed Costs	0.55 (0.28 – 1.13)	0.41 (0.26 – 0.64)	0.47 (0.30 – 0.69)	0.41 (0.27 – 0.80)	0.41 (0.21 – 0.89)
Feed Costs	2.79 (1.85 – 4.31)	2.57 (1.92 – 3.85)	3.21 (2.09 – 4.06)	3.41 (2.75 – 5.52)	3.54 (2.42 – 6.96)
Total Variable Costs	3.58 (2.24 – 5.23)	3.23 (2.50 – 4.56)	3.99 (2.76 – 4.83)	4.12 (3.26 – 6.40)	4.02 (2.29 – 7.61)
<u>Overhead Costs</u>					
Employed Labour Costs	0.38 (0 – 0.62)	0.51 (0 – 1.01)	0.36 (0 – 0.91)	0.35 (0.07 – 0.55)	0.42 (0 – 1.03)
Repairs and Maintenance	0.52 (0.17 – 0.91)	0.52 (0.30 – 0.88)	0.55 (0.26 – 0.79)	0.47 (0.21 – 1.00)	0.78 (0.37 – 1.85)
Other Overhead Costs	0.31 (0.09 – 0.47)	0.37 (0.05 – 0.89)	0.43 (0.16 – 0.83)	0.39 (0.17 – 0.71)	0.48 (0.19 – 1.40)
Imputed Labour Costs	1.11 (0.50 – 1.60)	1.17 (0.08 – 1.64)	1.31 (0.54 – 2.50)	1.20 (0.17 – 2.03)	1.48 (0.22 – 3.80)
Depreciation	0.87 (0.48 – 1.17)	0.87 (0.08 – 1.64)	0.76 (0.09 – 1.47)	0.77 (0.38 – 1.64)	0.72 (0.31 – 1.42)
Total Overhead Costs	3.19 (1.97 – 4.14)	3.44 (1.77 – 5.26)	3.41 (1.41 – 5.45)	3.18 (1.59 – 5.26)	3.88 (1.65 – 8.48)
TOTAL OPERATING COSTS (Variable and Overhead)	6.77 (5.16 – 8.97)	6.67 (4.56 – 8.95)	7.39 (5.21 – 9.28)	7.30 (4.85 – 11.08)	7.90 (3.94 – 13.08)
EARNINGS BEFORE INTEREST & TAX (EBIT)	0.07 (-1.05 – 1.36)	0.82 (-1.34 - 1.76)	0.18 (-1.72 – 1.68)	1.05 (-0.49 – 1.76)	0.43 (-4.91 – 3.68)
NET FARM INCOME	-0.90	-0.47	-1.24	-0.11	-0.56
RETURN ON TOTAL ASSETS (ROTA)	0.6% (-2.1% - 4.0%)	2.4% (-1.7% - 6.0%)	0.9% (-2.5% - 6.1%)	2.2% (-0.7% - 3.4%)	2.5% (-3.7% - 9.7%)
RETURN ON EQUITY (ROE)		-0.7%	-4%	-1%	1%

Table 2. Breakdown of Herd and Shed Costs for the AMS farms (\$/kg milk solids) for 2015/16, 2016/17, 2017/18, 2018/19 and 2019/20.

	AMS Farms 2015/16	AMS Farms 2016/17	AMS Farms 2017/18	AMS Farms 2018/19	AMS Farms 2019/20
<u>Herd Costs</u>					
Artificial Insemination and Herd Test Costs	0.05 (0 – 0.14)	0.05 (0 – 0.10)	0.07 (0.01 – 0.12)	0.06 (0 – 0.10)	0.08 (0.04 – 0.12)
Animal Health Costs	0.15 (0.03 – 0.43)	0.16 (0.05 – 0.50)	0.20 (0.06 – 0.39)	0.18 (0.04 – 0.50)	0.13 (0.03 – 0.23)
Calf Rearing Costs	0.03 (0 – 0.13)	0.03 (0 – 0.21)	0.04 (0 – 0.13)	0.06 (0 – 0.11)	0.05 (0 – 0.14)
<u>Shed Costs</u>					
Shed Power/Electricity	0.25 (0.15 – 0.44)	0.22 (0.15 – 0.34)	0.22 (0.14 – 0.35)	0.21 (0.12 – 0.41)	0.25 (0.11 – 0.78)
Dairy Supplies	0.28 (0.10 – 0.70)	0.18 (0.06 – 0.43)	0.24 (0.11 – 0.45)	0.20 (0.11 – 0.39)	0.16 (0.07 – 0.43)

Table 3. Labour efficiency for the AMS farms for 2015/16, 2016/17, 2017/18, 2018/19 and 2019/20.

	AMS Farms 2015/16	AMS Farms 2016/17	AMS Farms 2017/18	AMS Farms 2018/19	AMS Farms 2019/20
Labour Efficiency ('000s kg milk solids per full- time equivalent labour unit)	50 (36 – 110)	49 (20 – 91)	55 (18 – 106)	56 (25 – 94)	53 (19 – 99)
Total Labour Costs – Paid and Imputed (\$/kg milk solids)	1.49 (0.79 – 1.95)	1.68 (0.85 – 2.56)	1.67 (0.68 – 3.40)	1.55 (0.67 – 2.55)	1.90 (0.66 – 3.80)

Table 4. Income, costs and profit for the AMS farms (\$/kg milk solids) and for the average Dairy Farm Monitor Project (DFMP) farms in Victoria, NSW and Tasmania for 2019/20.

Profit Report	AMS Farms 2019/20	Vic DFMP average 2019/20	NSW DFMP average 2019/20	Tas DFMP average 2019/20
<u>Income</u>				
Milk Income (net of levies and charges)	7.51 (6.33 – 9.01)	7.15	8.88	7.09
Total Gross Farm Income	8.33 (7.30 – 10.31)	7.87	9.85	7.94
<u>Variable Costs</u>				
Herd Costs	0.26 (0.15 – 0.37)	0.32	0.37	0.28
Shed Costs	0.41 (0.21 – 0.89)	0.23	0.28	0.18
Feed Costs	3.54 (2.42 – 6.96)	3.33	4.79	2.68
Total Variable Costs	4.02 (2.29 – 7.61)	3.88	5.44	3.13
<u>Overhead Costs</u>				
Employed Labour Costs	0.42 (0 – 1.03)	0.59	1.13	0.86
Repairs and Maintenance	0.78 (0.37 – 1.85)	0.36	0.46	0.43
Other Overhead Costs	0.48 (0.19 – 1.40)	0.30	0.40	0.28
Imputed Labour Costs	1.48 (0.22 – 3.80)	0.83	1.00	0.44
Depreciation	0.72 (0.31 – 1.42)	0.24	0.37	0.30
Total Overhead Costs	3.88 (1.65 – 8.48)	2.31	3.35	2.31
TOTAL OPERATING COSTS (Variable and Overhead)	7.90 (3.94 – 13.08)	6.19	8.80	5.44
EARNINGS BEFORE INTEREST & TAX (EBIT)	0.43 (-4.91 – 3.68)	1.68	1.05	2.50
NET FARM INCOME	-0.56	1.14	0.46	1.92
RETURN ON TOTAL ASSETS (ROTA)	2.5% (-3.7% - 9.7%)	5.4%	2.7%	8.7%
RETURN ON EQUITY (ROE)	1%	8.3%	4.7%	15.4%

Table 5. Breakdown of Herd and Shed Costs for the AMS farms (\$/kg milk solids) and for the average Dairy Farm Monitor Project (DFMP) farms in Victoria, NSW and Tasmania in 2018/19.

	AMS Farms 2019/20	Vic DFMP average 2019/20	NSW DFMP average 2019/20	Tas DFMP average 2019/20
<u>Herd Costs</u>				
Artificial Insemination and Herd Test Costs	0.08 (0.04 – 0.12)	0.13	0.13	0.09
Animal Health Costs	0.13 (0.03 – 0.23)	0.14	0.18	0.13
Calf Rearing Costs	0.05 (0 – 0.14)	0.05	0.06	0.06
<u>Shed Costs</u>				
Shed Power/Electricity	0.25 (0.11 – 0.78)	0.13	0.15	0.10
Dairy Supplies	0.16 (0.07 – 0.43)	0.09	0.13	0.08

Table 6. Labour efficiency for the AMS farms and for the average Dairy Farm Monitor Project (DFMP) farms in Victoria, NSW and Tasmania in 2018/19.

	AMS Farms 2019/20	Vic DFMP average 2019/20	NSW DFMP average 2019/20	Tas DFMP average 2019/20
Cow Efficiency (kg milk solids/kg liveweight)	87% (66% – 109%)	99%	94%	83%
Labour Efficiency ('000s kg milk solids per full-time equivalent labour unit)	53 (19 – 99)	55	39	66
Total Labour Costs – Paid and Imputed (\$/kg milk solids)	1.90 (0.66 – 3.80)	1.43	2.13	1.30