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Evaluating the Loss of Profitability and Declining Milk Production in the Australian Dairy Industry

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Abstract

The question explored is whether and, if so, why a significant proportion of dairy farm businesses in Australia have lost their competitiveness compared to other major dairy producers in the world. Since 2001 the Australian dairy industry has been contracting in size (reducing total milk production), unlike any of the other major exporting countries outside the European Union. Although many reasons have been proposed to explain this contraction in milk supply, it could reasonably be interpreted as confirmation that a significant proportion of Australian dairy farmers are not sufficiently profitable to maintain and grow their businesses. In this paper, comparisons between dairy farmers in six countries (Australia, New Zealand, United States, Argentina, Uruguay and South Africa) are utilised to determine whether factors “outside the farm gate” can explain the loss in profitability in the industry, and to determine what factors “inside the farm gate” are involved. Factors examined include milk price, weather/drought, industry deregulation, farm size and production system including pasture harvest and major cost centres. This paper proposes that the choice of production system by farmers is the primary determinant of the loss in profitability within the Australian industry and the contraction in milk supply. Furthermore, if in the future a lower cost of production system is adopted by Australian dairy farmers on their farms, these individual farms will improve their profitability and, if this is done by significant numbers of dairy farmers, the Australian dairy industry could return to a position of annual increases in milk supply of 2-3 per cent.

Key words: dairy farming, profitability, production system, cost of production.

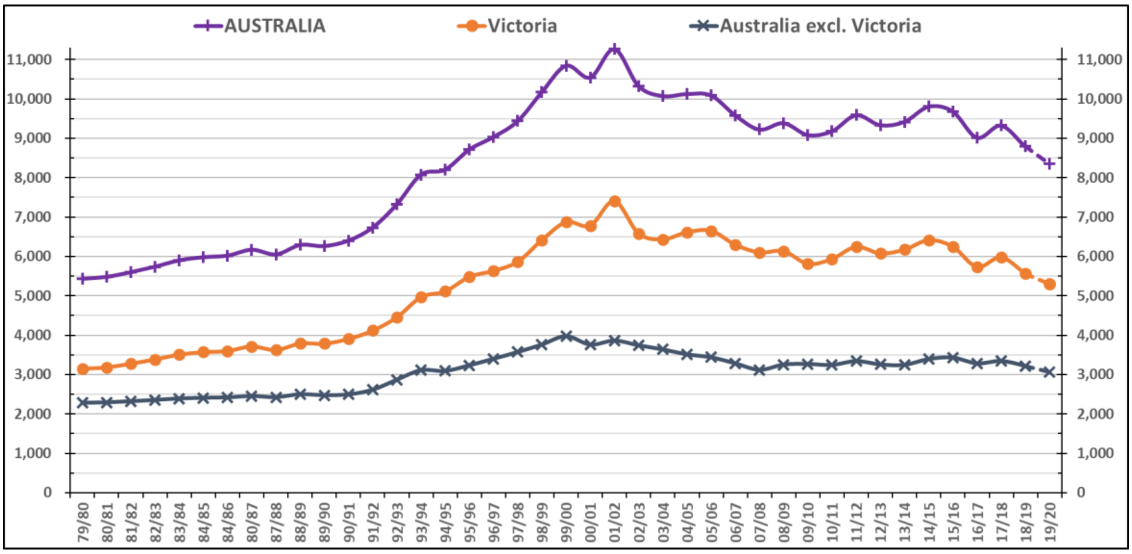
Introduction

The dairy industry in Australia, as well as internationally, has gone through significant periods of change over the last 20-30 years. The overall trend has included the freeing up of international trade in dairy products and the reduction in tariffs and other domestic support to dairy farmers (e.g. European Union’s removal of quotas, increasing number of international free trade agreements, deregulation of the Australian dairy market). However, livestock agriculture continues to have major limitations to free trade internationally and, at times, experiences the re-imposition of tariffs and other restrictions to international trade (e.g. Russia sanctions imposed on foreign dairy products in 2014).

Dairy farming is one of the most complex businesses to manage given the mix of ruminant livestock (cattle) and pasture/crop production along with the impact of weather and a range of other environmental challenges. In addition, there is a high proportion of variable costs in dairy farming, which means managers must continuously consider multiple production factors (milk, livestock and pasture/crops) as well as a wide range of cost factors to ensure they can trade profitably. Given dairy farmers are predominantly "price-takers" with very few farmers marketing their own milk directly to consumers, it is essential for farmers to base their business on producing milk at a low cost. This is particularly relevant for Australian dairy farmers as New Zealand farmers are one of the lowest, if not the lowest, cost producers of milk in the world. Therefore, with little freight cost to be added to New Zealand exports, the Australian dairy industry must compete with New Zealand-sourced milk products within the Australian domestic market as well as on the international market.

After a lengthy period of growth in national milk production and in export volumes of milk products through until 1999/2000, the Australian dairy industry has been in steady decline since. This two-decade period of decline confirms that there are some structural problems impeding profitability that are limiting dairy farmers' ability to invest in and grow their businesses. Over the 20 years from 1980-2000, the Australian dairy industry had a compound annual growth rate (CAGR) in milk production of 3.2 per cent, composed of a CAGR of 1.5 per cent for the first decade (1980-1990) and a CAGR of 5 per cent for the second decade (1990-2000). These CAGRs were similar to the New Zealand dairy industry over the same period. In contrast, for the last 20 years from 2000-2020, the Australian dairy industry will have a negative CAGR of around -1.2 per cent, composed of a CAGR of -1.3 per cent for the first decade (2000-2010) and a CAGR of -1.1 per cent for the second decade (2010-2020). These milk production trends are outlined in Figures 1 and 2.

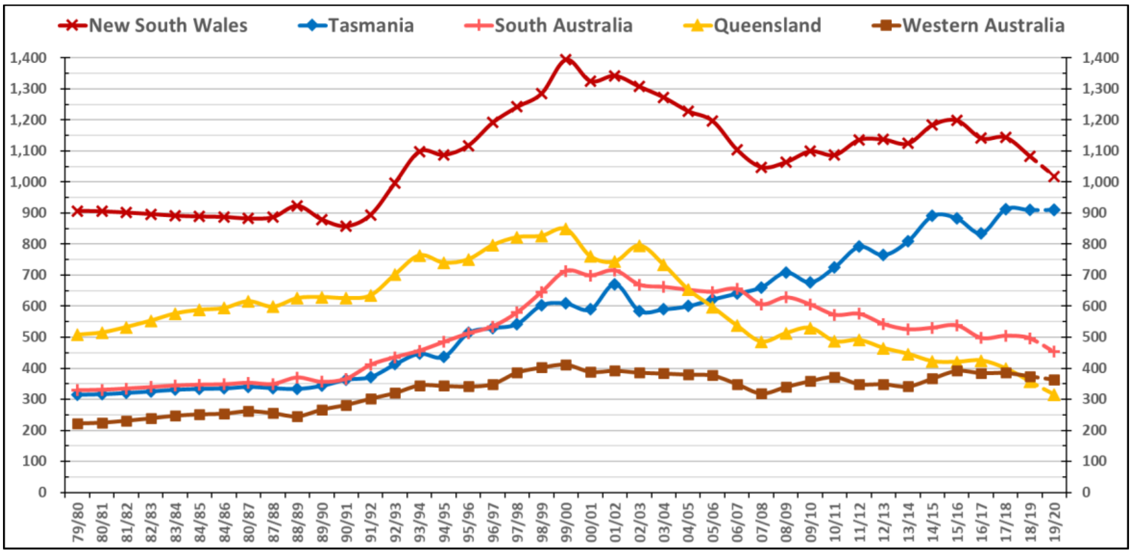
Figure 1. Milk production (m litres) for Australia, Victoria and all of Australia excluding Victoria, 1979-2019



Source: Dairy Australia

The only Australian state that has followed a different trajectory in milk production is Tasmania, which has maintained a positive growth rate in milk production throughout the 40-year period. Tasmania matched the growth rate of the rest of the industry over the first 20 years (1980-2000) with a CAGR of 3.1 per cent, and then for the last 20 years has had a CAGR of around 2.4 per cent. This raises the question as to what might be providing the conditions that are resulting in sound increases in milk production in Tasmania while impeding growth in milk supply in the rest of Australia (AUS).

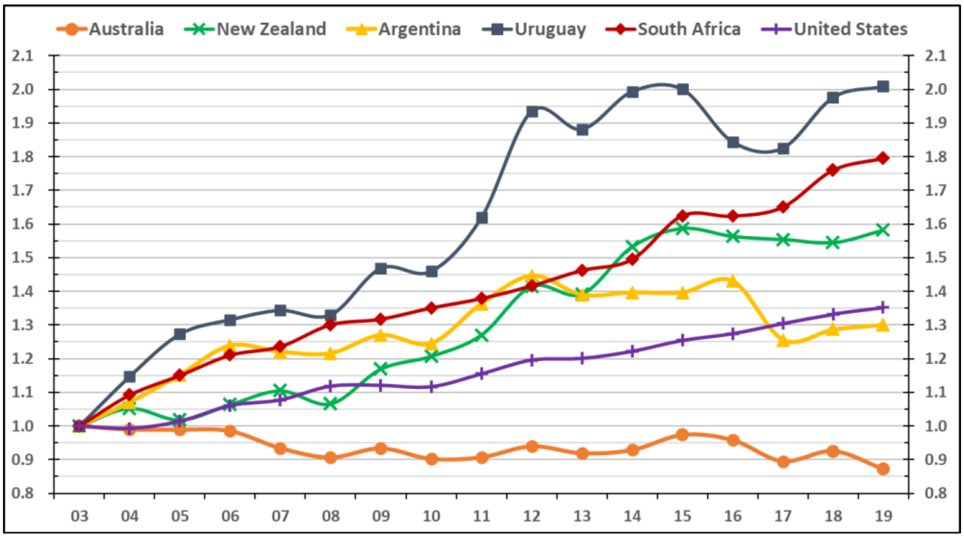
Figure 2. Milk production (m litres) for New South Wales, Tasmania, South Australia, Queensland and Western Australia, 1979-2019



Source: Dairy Australia

This also presents the question as to whether other significant international milk producers are increasing their milk supply or are experiencing similar declines to AUS. Figure 3 outlines the growth rate in milk "solids" (solids = weight of fat plus protein, also see Definitions) production over the period from 2003-2019 for five of the most significant dairy exporting countries in the world plus South Africa.

Figure 3. Growth in milk "solids" (fat plus protein) production from 2002/03 to 2018/19 using 2002/03 as base of 1.0



Source: Dairy Australia, DairyNZ, MAGYP, INALE, MPO, USDA

This figure highlights AUS's uncommon position of consistently declining milk production over this period. New Zealand (NZ), United States (US) and South Africa (RSA) have been consistently increasing milk supply at sound rates, while Uruguay (URU) has the highest growth rate overall notwithstanding milk production has largely plateaued since 2012. Argentina (ARG) increased milk supply through until 2012, though since then a similar declining trend to AUS appears to be emerging. The variations in annual growth rates of milk production for these countries is further described in Table 1.

Table 1. CAGR of annual solids corrected milk (SCM) production from 2002/03 to 2018/19

Milk production	Australia	New Zealand	Argentina	Uruguay	South Africa	United States
CAGR 2003-2019	-0.9%	2.9%	1.7%	4.5%	3.7%	1.9%

Source: Dairy Australia, DairyNZ, MAGYP, INALE, MPO, USDA

Each of the five countries being compared to AUS have relevance to this study as outlined in Table 2. Five of the six countries are significant milk exporting countries, with the fifth one (RSA) having a domestic market focus similar to New South Wales (NSW), Queensland (QLD) and Western Australia (WA). Five of the six countries would be described as having a predominantly "hot" temperate climate, with the fifth one (NZ) having climate more similar to Tasmania (TAS). All six countries have a comparatively low level of government support or "interference" in the market.

Table 2. Categorisation of countries and AUS states for milk market focus, climate and level of government support or subsidies

MILK MARKET	**Primary export focus**	**Combined export and domestic focus**	**Primary domestic focus**
Country	New Zealand, Uruguay	Australia, Argentina, United States	South Africa
Australian State	Tasmania	Victoria, South Australia	New South Wales, Queensland, Western Australia
CLIMATE	**"Cool" temperate**	**"Hot" temperate**	**Subtropical**
Country	New Zealand	Australia, Argentina, Uruguay, South Africa, United States	
Australian State	Tasmania	Victoria, New South Wales, South Australia, Western Australia	Queensland
GOVERNMENT SUPPORT / SUBSIDIES	**Very little to none**	**Some (not substantial)**	**Substantial**
Country	Australia, New Zealand, Uruguay, South Africa	Argentina, United States	

Profitability in Dairy Farming has been Declining in Australia

Growth in any industry or individual business requires a level of profitability that enables the business owners to reinvest in their business. There also needs to be a sustainable level of profitability to motivate participants and new investors to deploy their capital in the industry. The lack of sustainable levels of profitability across all states in AUS except for Tasmania can be inferred from the decline in annual milk production.

Table 3 outlines the methodology utilised for calculating operating profit, which is similar to the methodology described by Hemme et al. (2014). Financing and lease/rent costs were excluded from this calculation of operating profit, other than where a lease/rent cost pertains to support land area utilised for livestock production (e.g. heifer growth) or feed production which, as a result, was included as a direct cost. Capital growth of assets was excluded from the calculation.

Table 4 outlines the sources of data for each of the six countries and the methodology utilised for standardising the data, as well as the average annual number of farms in each dataset. Data for AUS, NZ and RSA were all processed through Red Sky Agricultural (Red Sky) software, with additional sources of data from AUS and NZ utilised to improve the reliability of the Red Sky data. Data for

ARG, URU and US were converted into a similar format for calculating operating profit (and other ratios).

Table 3. Definitions of operating revenue and expenses utilised in calculation of operating profit

Operating profit calculation	Definitions
Operating revenue	Milk sales + Livestock revenue[1] + Other non-milk revenue
[1] Livestock revenue	Livestock sales - livestock purchases + (closing numbers - opening numbers) x closing value per head
Operating expenses	Administration fees & overheads[2] + Animal health + Breeding & herd testing + Dairy shed expenses + Depreciation[3] + Electricity + Fertiliser + Freight + Irrigation + Pasture maintenance & renovation + Repairs & maintenance + Total supplement expenses[4] + Vehicle expenses + Management & labour expenses[5]
[2] Administration fees & overheads	Includes all office expenses plus professional fees plus rates, licences, levies and insurance
[3] Depreciation	Based on straight line depreciation over economic life of asset
[4] Total supplement expenses	Includes all concentrate and forage expenses (excluding pasture grown on dairy farm) fed to cows and growing heifers plus green feed crops grazed in-situ plus all expenses for grazing/support area utilised for cows and growing heifers as well as supplement production
[5] Management & labour expenses	Includes all direct labour expenses plus market salary value of any management provided by owner/family plus market hourly rate value of any labour provided by owner/family
Operating profit	Operating revenue - Operating expenses

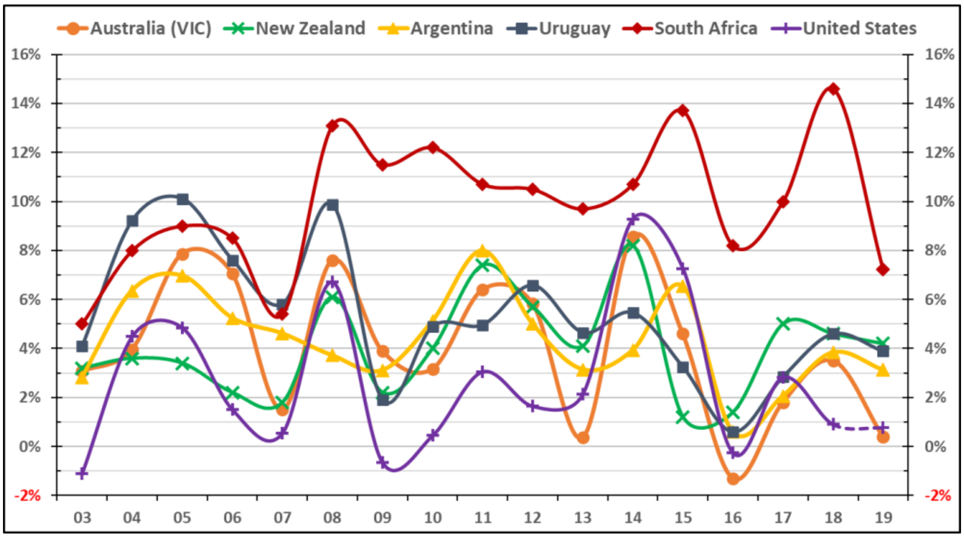
Table 4. Data sources and basis for converting data to a standardised format

Country	Data source and conversion to standardised format
Australia	Developed from a mix of Red Sky data plus Dairy Farm Monitor Project benchmark data for Victoria, Tasmania, South Australia and Western Australia. Data for New South Wales was entirely sourced from Dairy Farm Monitor Project benchmark data for the period 2012-2018, with data for 2003-2011 calculated from trends in other Australian states. Data for Queensland was entirely sourced from QDAS benchmark data. Red Sky, Dairy Farm Monitor Project and QDAS utilise a similar format for calculating benchmarks. Average annual number of farms solely in Red Sky dataset approx 80, in Dairy Farm Monitor Project dataset for Victoria approx 75, Tasmania approx 35, New South Wales approx 32, South Australia approx 21, Western Australia approx 27, and in Queensland QDAS dataset approx 88.
New Zealand	Developed from a mix of Red Sky data plus DairyBase benchmark data. Red Sky and DairyBase utilise a similar format for calculating benchmarks. Average annual number of farms in Red Sky dataset approx 90 and in DairyBase approx 650.
Argentina	Developed from benchmark data provided by AACREA, with this converted into a similar format as utilised by Red Sky, DairyBase and Dairy Farm Monitor Project. Average annual number of farms in dataset approx 230.
Uruguay	Developed from benchmark data provided by FUCREA, with this converted into a similar format as utilised by Red Sky, DairyBase and Dairy Farm Monitor Project. Average annual number of farms in dataset approx 65.
South Africa	Developed from Red Sky data. Average annual number of farms in dataset approx 50.
United States	Developed from benchmark data provided by Genske Mulder, with this converted into a similar format as utilised by Red Sky, DairyBase and Dairy Farm Monitor Project. Average annual number of farms in dataset estimated at 350.

Where datasets for an industry are provided voluntarily by business owners, it is rare to have those businesses performing in the bottom 10-15 per cent. It is also commonplace that those who contribute have somewhat larger farms than the average for the industry. This is evident with all the datasets utilised for this study. The AUS, NZ, ARG and URU datasets all have farms contributing from a wide range of production systems and from a wide area within each country and region, so these can be considered to represent their respective region within the constraints outlined. The RSA data is primarily drawn from a narrower physical region and predominantly from a single consultancy business. This may create more bias, although there are a wide range of production systems represented within the dataset and the consultancy business would be considered as supportive of the most common farming principles. The US data is primarily from farms that are very significantly above average in size and so may have the most significant positive deviation from the true average in financial performance.

Figure 4 compares profitability across the six countries based on return on total capital invested, where *return on total capital = operating profit divided by the total value of all assets employed* (regardless of ownership/financing structure). Changes in asset values, including appreciation of land values, were not included in this calculation of return on total capital and would be additional to the returns reported. The 2003 year was selected as the commencement year for comparisons on the basis that robust data were available for the countries from this year onwards. Over the period 2003-2019, AUS profitability (represented by Victoria) has both progressively reduced in absolute terms and compared to the other countries.

Figure 4. Profitability expressed as return on total capital (excluding capital growth) with AUS represented by Victoria, 2003-2019

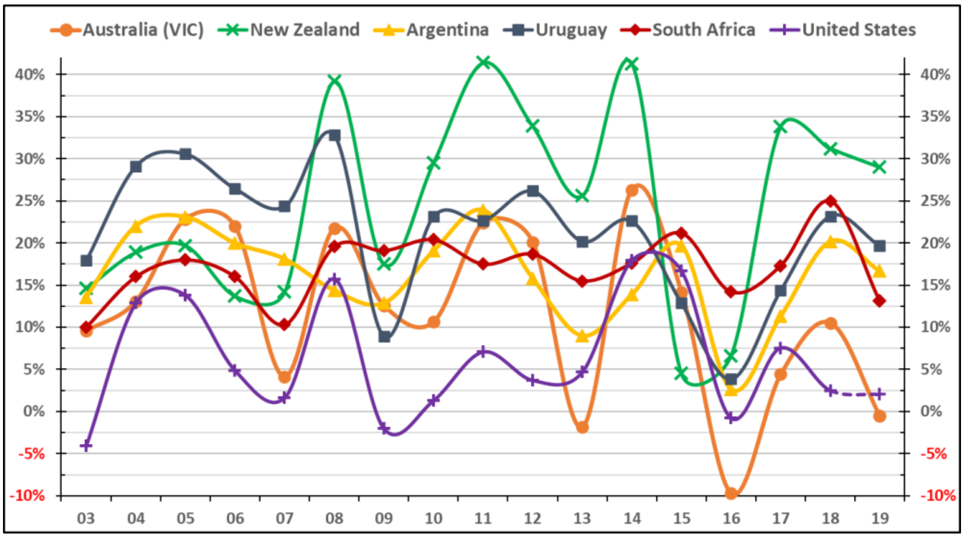


Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, USDA, Genske Mulder

Figure 5 compares operating profit margin across the same six countries, where *operating profit margin = operating profit divided by operating revenue*. This ratio outlines the percentage of total revenue retained as profit (before financing costs are deducted) and, if converted into a decimal, will describe the proportion of each unit of revenue retained as profit (i.e. 20 per cent operating profit margin equates to 20 cents in each dollar of revenue retained as profit). As with return on total capital, the operating profit margin for AUS (Victorian) dairy farmers has progressively reduced in absolute terms and has reduced compared to all other countries. A lower operating profit margin results in changes in commodity prices or weather conditions having a greater impact on profitability. This means a majority of AUS farmers now carry a higher level of business risk than farmers from the other five countries.

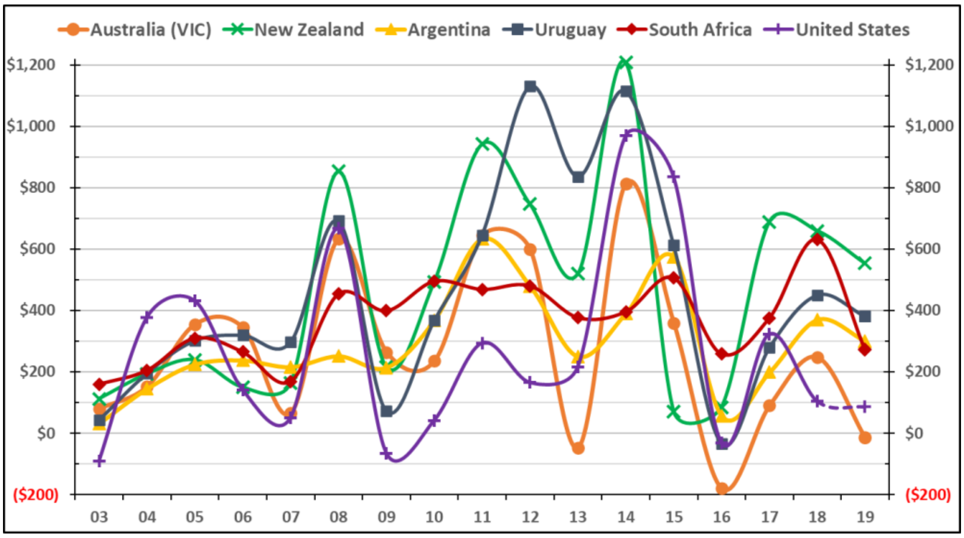
Figure 6 compares profitability across the same six countries based on profit per cow in USD, where *profit per cow = operating profit divided by total cows in herd*. All ratios referencing cow numbers relate to the total number of cows in the herd, including both milking and dry cows. All ratios reported in USD are converted into USD based on average foreign exchange rates for each year. Financial results have not been adjusted for inflation.

Figure 5. Operating profit margin with AUS represented by Victoria, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, USDA, Genske Mulder

Figure 6. Profitability expressed as profit per cow in USD with AUS represented by Victoria, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, USDA, Genske Mulder

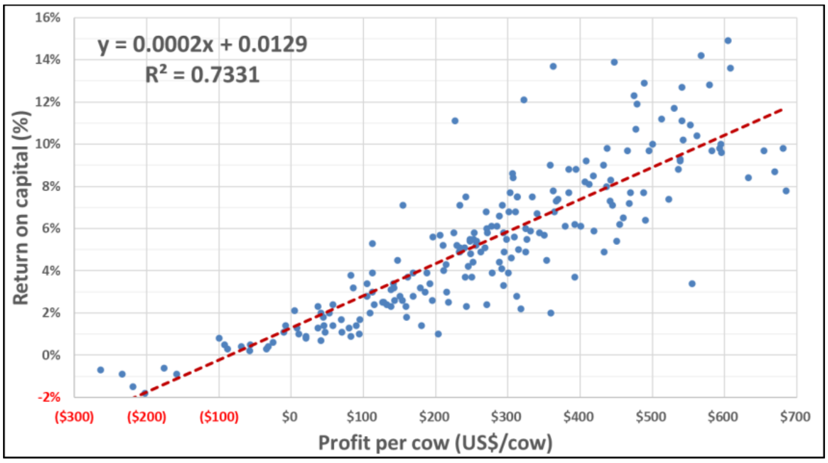
For the period from 2011-2016, ARG had foreign exchange controls that resulted in differences between the official domestic and international 'blue' value of the Argentinian peso. To allow for more meaningful international comparisons over this period, the official domestic value was utilised.

Again, profitability per cow for many AUS (Victorian) dairy farmers has progressively fallen behind other countries, with many recent years producing near zero or below zero profitability. AUS dairy farmers carry higher levels of debt per cow than the other countries listed with the exception of NZ farmers, so when financing costs are included, a majority of AUS dairy farmers have struggled to break even in recent years and have at times suffered significant losses.

Although profit per cow is not a complete measure of business profitability, given that it refers only to a portion of the capital employed in the business (i.e. the cows), there is a strong correlation between profit per cow and return on total capital.

Figure 7, along with the other statistical graphs in this paper, are based on 207 sets of Australian dairy farm data from 2005/06 (AUS Red Sky Dairy Data). All the sets of farm data were processed through Red Sky software, so they have all been analysed using a uniform methodology. The farm data were primarily sourced from four States; Victoria (VIC), TAS, South Australia (SA) and WA, although there were a small number of datasets from southern NSW. The VIC (and southern NSW) datasets were primarily collected by Red Sky Agricultural (Red Sky) or Intelact (independent consultants). There were also some datasets collected by Red Sky or Intelact in TAS, SA and WA, although the majority of these data were collected as part of industry-funded projects.

Figure 7. Impact of profit per cow (USD/cow) on profit (expressed as return on total capital)



Source: Red Sky including several industry-funded data collection programs

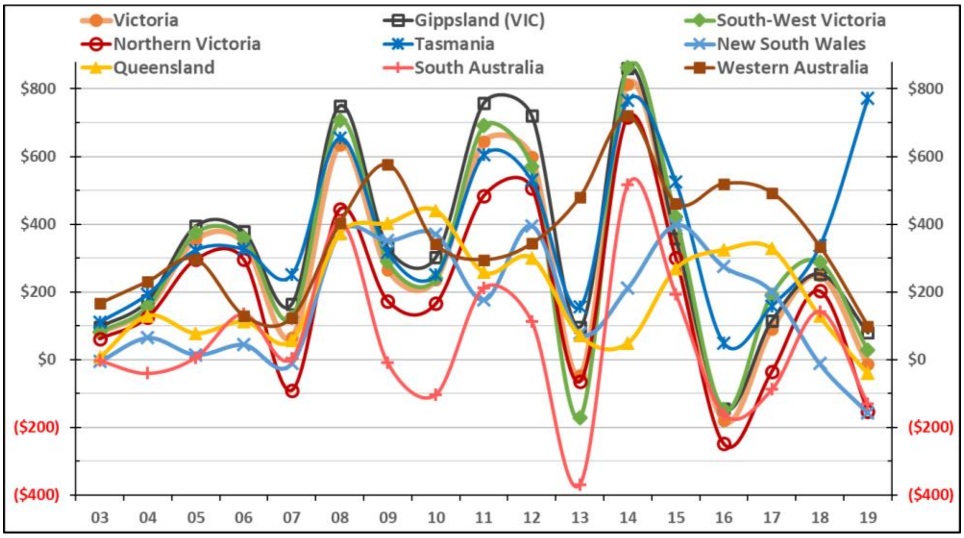
The statistical analysis quoted in this paper was completed by G. Tuñon of Progressive Dairy Solutions. A Gompertz model was used to analyse the quadratic relationships in Figures 12 and 29 using the formula: y = alpha x exp (-beta x exp (-gamma x independent variable)). As Figure 7 confirms, variations in profit per cow in this dataset could explain 73 per cent of the variation in profit expressed as return on total capital. This would suggest that profit per cow is a relevant proxy for economic profit (excluding capital growth).

As Figure 8 outlines, the lack of profitability for VIC farmers is similar to most other states, although over the last 4-5 years TAS has delivered higher levels of profitability than VIC. Gippsland and South-West Victoria have generally out-performed Northern Victoria, with this becoming more significant in the last 3-4 years. SA is the state with the poorest financial performance if the entire 17-year period is reviewed, while WA is one of the better performers over the last 3-4 years. Although there is a reasonable amount of variation in profitability between states and regions, in aggregate, these levels of profitability would appear to be too low to sustain a dairy industry sufficiently profitable to grow.

Are Milk Prices in Australia a Contributing Factor?

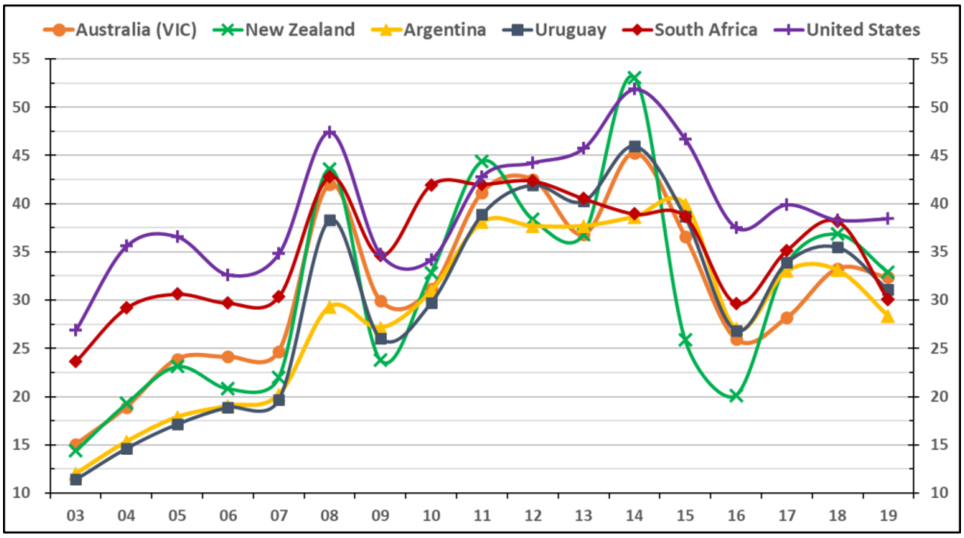
As Figure 9 outlines, AUS (VIC) dairy farmers have effectively been paid a competitive milk price over the entire period from 2003-2019 compared to other major exporting countries like NZ, ARG and URU. Although the RSA dairy industry is entirely domestic-focused and their farmers received a premium above international prices for their milk supply through to 2007, in recent years this premium has largely disappeared. Over this same period, TAS farmers received a similar milk price to VIC farmers. Milk prices and other milk ratios reported in "energy corrected milk" (ECM) were corrected to 4.0 per cent fat and 3.3 per cent protein (see formula and description of ECM under Definitions).

Figure 8. Profitability per cow expressed in USD for all states of AUS plus three regions in VIC, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, QDAS

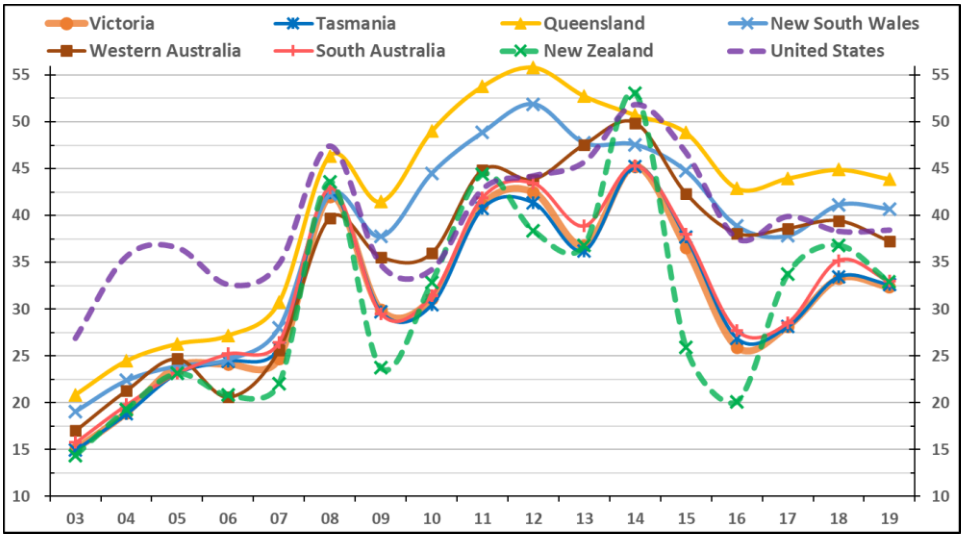
Figure 9. Milk prices expressed in USD cents/litre and ECM (4.0% fat, 3.3% protein), 2003-2019



Source: Dairy Australia, DairyNZ, MAGYP, INALE, MPO, USDA

Given that, over the 2003-2019 period, farmers in NZ, ARG, URU, RSA and TAS received a similar milk price to AUS (VIC) farmers and have increased their milk supply, whereas AUS milk supply declined, it is reasonable to conclude that milk price is not a relevant contributing factor to this decline. Figure 10 outlines the milk price for all states in AUS and compares these with NZ and US. What this graph confirms is that, from around 2008, dairy farmers in NSW, QLD and WA received milk prices similar to or above the prices paid in US. This was a substantial premium above internationally-traded milk prices and above the price received in VIC, TAS and SA as well as in ARG, URU and RSA. However, these comparatively high milk prices were not sufficient to arrest declines in milk production in NSW and QLD.

Figure 10. Milk prices for states of AUS plus NZ and US expressed in USD cents/litre and ECM, 2003-2019



Source: Dairy Australia, DairyNZ, USDA

Is Weather and/or Drought in Australia a Contributing Factor?

It is difficult to sustain an argument that weather, or drought specifically, is a significant factor in explaining the decline in AUS milk production over the last 20 years. In agricultural industries with sustainable levels of profitability, the impact of drought or other severe weather events is to reduce or eliminate growth for a period, but to be followed by a period of above trend growth as the industry recovers. This is the pattern of growth that had been evident in the AUS dairy industry prior to 2000, and is evident in other countries with a pasture-based dairy industry such as NZ, ARG, URU and RSA.

It is possible that dry weather and/or drought may have had a greater impact on Northern Victoria, NSW and QLD over the period 2000-2019 as compared with 1980-2000, although there were still some severe drought conditions in the earlier period and these more localised severe conditions would not explain the decline in milk production across the entire country with the exception of TAS. In addition, farmers in continental southern hemisphere countries such as ARG, URU and RSA would also contend that weather conditions have been more severe in the last 20 years compared to the previous 20-year period, and yet these countries, unlike AUS, have continued to grow their milk supply.

There may be a basis for contending that Northern Victoria, as well as parts of NSW and SA that are reliant on Murray-Darling basin irrigation water, have been negatively impacted by changes in water policy and competing irrigated land uses over the last 20 years, significantly compounding the impact of drought. These changes would appear to have both increased the cost of water and reduced its availability, resulting in reductions in pasture production and increases in average feed costs. This may have prompted more significant changes in production systems than for most other regions, which may have accentuated the loss in profitability that is identified in this paper.

Is Deregulation of the Australia Dairy Industry in 2000 a Contributing Factor?

Arguably, it is difficult to sustain a proposition that deregulation is a significant factor in explaining the decline in AUS milk production over the last 20 years. Firstly, deregulation did not have a negative impact on VIC as milk price was already effectively set by international prices, and deregulation could have advantaged the state due to Victorian milk gaining access to new domestic markets, and in particular the NSW market. However, VIC's milk production has declined like all other states with the exception of TAS.

Secondly, as is outlined in Figure 10, the three domestically-focused states of NSW, QLD and WA received milk prices that were a relatively small (but significant) premium to those received in VIC, TAS and SA prior to 2008, with these prices being significantly lower than in US. However, since 2008, NSW, QLD and WA have usually received milk prices that have a much larger premium to the prices received in VIC, TAS and SA than was received historically, and these prices have usually been similar to, or higher than, the prices received by farmers in US. So, although there has been an impact from deregulation on the milk supply source and the marketing of milk products domestically, it would appear that there has not been a negative impact on the price of milk received in the domestically-focused states of NSW, QLD and WA, or across the whole country.

Is Size of Dairy Farm in Australia a Contributing Factor?

In most circumstances farm size is not a relevant factor in determining profitability for dairy farmers, especially for pasture-based farmers. This is due to the great majority of expenses (greater than 90 per cent) being directly related to either or both of the number of cows or the number of hectares being farmed. As a result, there are relatively minor economies of scale to be achieved as dairy farms increase in size. This is borne out by Figures 11 and 12 from the AUS Red Sky Dairy Data. Farm size based on area (hectares) or herd size (number of cows in herd) explain none of the variation in profit with neither relationship being significant.

Figure 11. Impact of farm area on profit

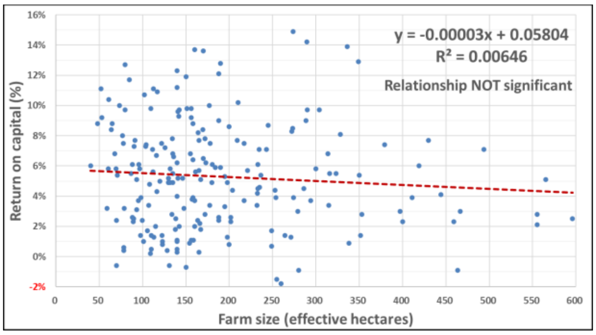
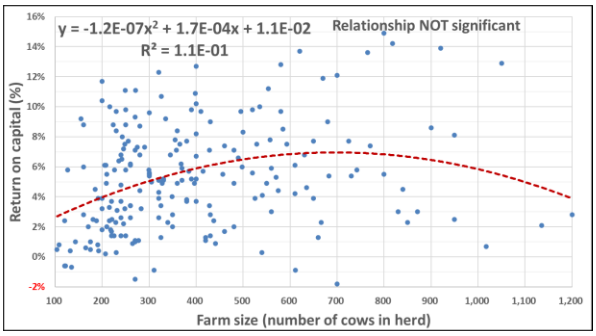


Figure 12. Impact of herd size on profit



Source: Red Sky including several industry-funded data collection programs

Very small farms (less than 80-100 cows) are likely to have decreasing levels of profitability as the capital (asset) cost per litre of milk is likely to increase significantly, and the management cost per litre is also likely to increase significantly. However, this is not a factor for AUS dairy farmers as the average farm size is over 270 cows and the great majority of farms have over 100 cows. In addition, as outlined in Table 5, AUS dairy farms are on average larger than ARG, URU and US dairy farms (though smaller than NZ and RSA farms), so farm size does not explain the loss in profitability compared to that of farms in these other countries.

Table 5. Average number of cows in herd

Avg. No. Cows in Herd	Australia	New Zealand	Argentina	Uruguay	South Africa	United States
2017/18	271	431	160	2014 150 est.	2014 353	234
2018/19	276	435	162 est.	158 est.	370 est.	236 est.

Source: Dairy Australia, DairyNZ, SENASA, INALE, Milk South Africa, USDA

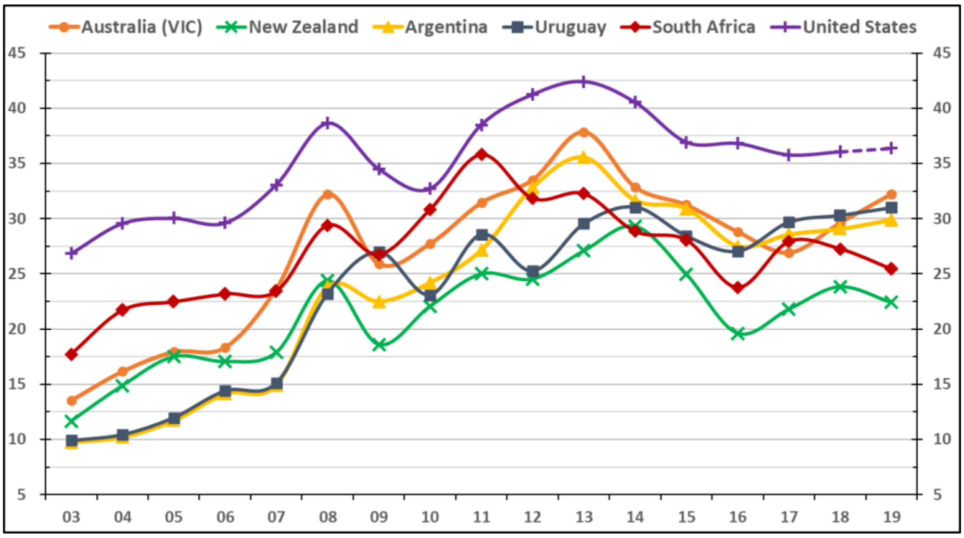
Given milk price, weather/drought, deregulation of the dairy industry and farm size do not appear to be significant factors in the loss of profitability for AUS dairy farmers, the problem would appear to be related to changes in the production system from earlier years and compared to NZ. The production system is a useful comparator because it encompasses the number of cows farmed per hectare, the level of milk production per cow, and the mix of feeds in the diet, as well as having an impact on most other areas of expense.

Cost of Production has been Increasing significantly in Australia

For all export-focused dairy industries, maintaining a cost of production that is competitive with other export-focused countries is essential for medium-term profitability. This has also become significantly more relevant for all domestic-focused dairy industries if they are exposed to imports of dairy products. So dairy farmers in RSA, for instance, have found that their milk prices may lag trends in international prices, and not have the extreme highs and lows in milk price, but their milk price does now have a comparatively low premium to internationally-traded prices. This narrowing of the differences between international milk prices regardless of hemisphere or region appears to have been accelerated over the period from 2007-2013 by the huge increase in imports of milk products by China, and the huge increase in exports of milk products by US.

Over the period under study (2003-2019), the "accounting" cost of production for milk in AUS (VIC) has increased rapidly, with this rate of increase being much higher than in a number of other countries, as outlined in Figure 13. Over the period of 2003-2006 (as well as before this period), AUS (VIC) cost of production was similar to NZ, and over this period AUS had competitive levels of profitability compared to NZ. However, over the ensuing period from 2007-2019, AUS cost of production has increased at a much higher rate than in NZ (or US and RSA). *Accounting cost of production is calculated from operating expenses minus livestock revenue minus other non-milk revenue*. No opportunity cost of capital is included. This methodology allows cost of production per litre (or "solids" = fat + protein) to be directly compared to milk price, with the difference being the profit margin prior to debt servicing.

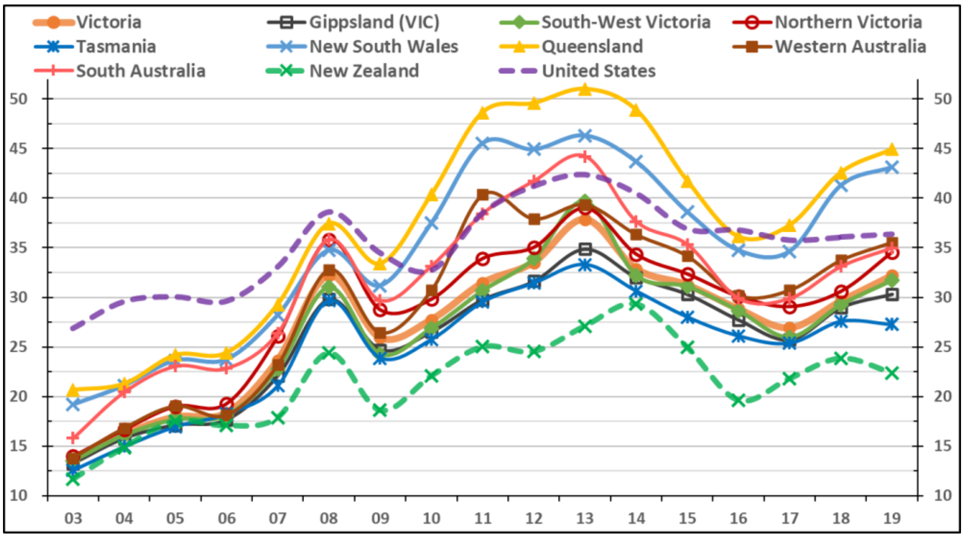
Figure 13. Cost of production expressed in USD cents/litre and ECM with AUS represented by VIC, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, USDA, Genske Mulder

Figure 14 outlines how this trend of higher increases in cost of production, compared to some other key international competitors, has occurred across all states and across all three major dairying regions in VIC. Again, this graph confirms how the southern states of AUS (including WA but excluding SA), had a competitive cost of production to NZ for the period of 2003-2006. However, all states and regions, including TAS and Gippsland, have significantly lost their competitiveness with NZ over the ensuing years. In the period of 2003-2006, NSW and QLD were not competitive with NZ but did have a much lower cost of production than US. Nevertheless, since that time, the cost of production in these two states has increased so that it is now consistently higher than in US.

Figure 14. Cost of production for regions of AUS, NZ and US expressed in USD cents/litre and ECM, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, QDAS, DairyBase, USDA, Genske Mulder

This comparatively high rate of increase in cost of production in AUS (VIC) is further outlined in Table 6. Although an increase in cost of production over time in absolute (not inflation-adjusted) terms is to be expected, as it would be for any industry, the management strategy to minimise this impact is to secure productivity improvements. The comparatively high increase in cost of production for the AUS dairy industry, in particular when compared to NZ, RSA and US, would indicate that productivity gains have not been secured and/or there have been productivity losses.

Table 6. CAGR of cost of production from 2002/03 to 2018/19 with AUS represented by VIC.

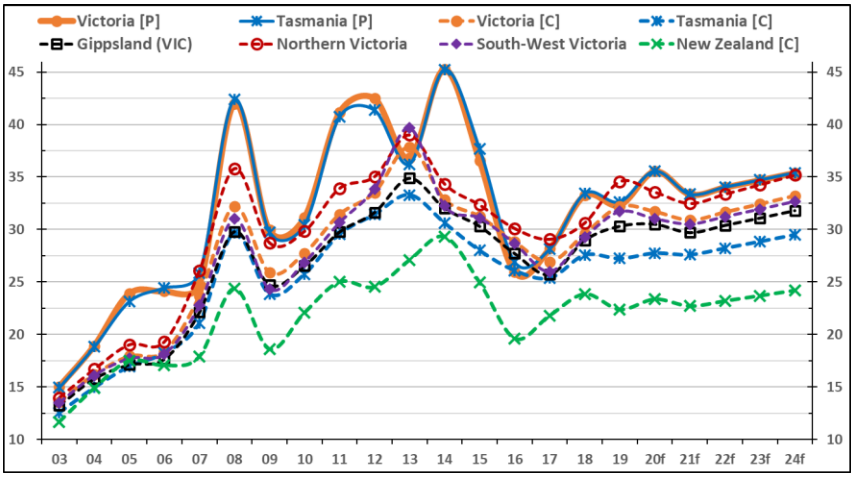
Cost of production	Australia	New Zealand	Argentina	Uruguay	South Africa	United States
CAGR 2003-2019	5.6%	4.2%	7.3%	7.4%	2.3%	1.9%

Source: Red Sky, Dairy Farm Monitor Project, DairyBase, USDA, Genske Mulder

Figure 15 is intended to highlight the two key issues with AUS's rapidly increasing cost of production. Firstly, this has resulted in loss of economic competitiveness with countries such as NZ, with this loss in competitiveness extending to TAS even though it retains the lowest cost of production in AUS. And secondly, this has resulted in the margin between milk price and cost of production narrowing to such a degree that the AUS dairy industry is no longer sufficiently profitable to sustain itself.

Although accounting cost of production includes all cash and non-cash operating costs (including imputed costs such as owner/family labour), it does not include a cost of capital. An opportunity cost of capital should be included from an economic perspective as it ensures a more complete assessment of differing farm types, regions and countries. For instance, NZ has the lowest accounting cost of production within the study group but is known to have very high land values which will impact on its "economic" cost of production. To calculate economic cost of production, the opportunity cost of capital for land has been set as the long-term lease (or rental) cost for land. The most common basis of rural land leases is a rate of return on the improved capital land value. It was not possible to reference reliable data on lease rates for the countries in the study, so the rates utilised and outlined in Table 7 are based on a mix of benchmark data and the knowledge of experienced participants in the relevant countries.

Figure 15. Milk price (solid line) for VIC and TAS versus Cost of production (dotted line) for VIC, TAS, VIC regions and NZ, 2003-2019. Milk price and cost of production expressed in USD cents/litre and ECM.



Source: Red Sky, Dairy Farm Monitor Project, DairyBase

Table 7. Lease cost of dairy land

Land lease/rent rates	Australia	New Zealand	Argentina	Uruguay	South Africa	United States
Percent of land value	4.00%	3.50%	3.00%	3.50%	7.00%	2.75%

Source: mix of benchmark data and local industry participants

The opportunity cost of capital for all non-land assets has been calculated from the risk-free cost of capital plus a premium. The risk-free cost of capital has been based on the 10-year bond yields for AUS, NZ, US and RSA. ARG and URU do not have 10-year bonds for this period, so a premium of 4.0 per cent to the US 10-year bond yield was used for ARG, and a premium of 3.5 per cent for URU. In all cases the annual risk-free cost of capital was an average of that year's bond yield plus the previous four years. These interest rates are outlined in Table 8.

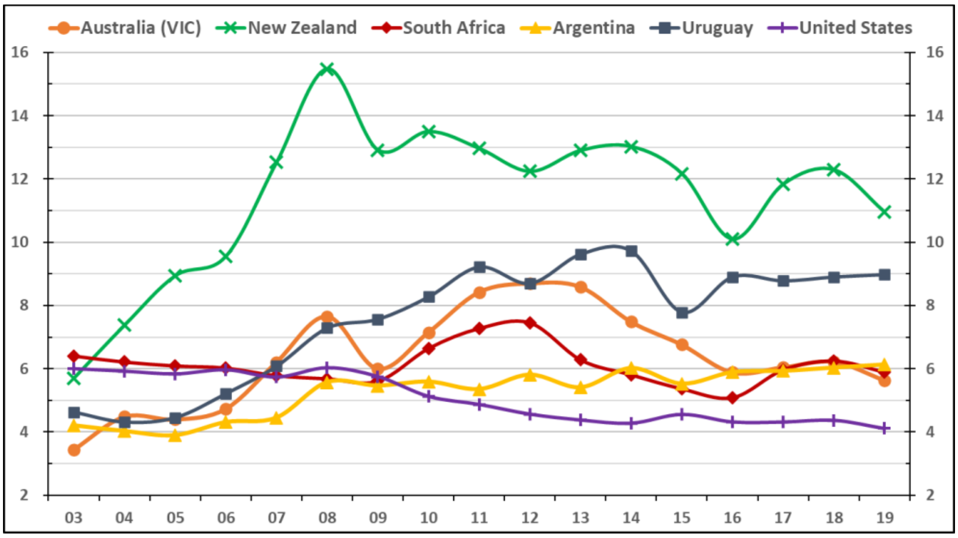
Table 8. Annual 10-year bond rates based on 5-year rolling average

YEAR	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Australia	5.8%	5.8%	5.6%	5.5%	5.5%	5.7%	5.6%	5.6%	5.6%	5.2%	4.6%	4.4%	4.6%	4.1%	3.8%	3.6%	3.3%
New Zealand	6.4%	6.5%	6.3%	6.1%	6.0%	6.1%	5.9%	5.9%	5.8%	5.4%	4.9%	4.7%	4.7%	4.3%	4.0%	3.9%	3.4%
United States	5.1%	4.9%	4.5%	4.4%	4.4%	4.3%	4.1%	3.9%	3.5%	2.9%	2.6%	2.5%	2.3%	2.1%	2.2%	2.3%	2.2%
Argentina	9.1%	8.9%	8.5%	8.4%	8.4%	8.3%	8.1%	7.9%	7.5%	6.9%	6.6%	6.5%	6.3%	6.1%	6.2%	6.3%	6.2%
Uruguay	8.6%	8.4%	8.0%	7.9%	7.9%	7.8%	7.6%	7.4%	7.0%	6.4%	6.1%	6.0%	5.8%	5.6%	5.7%	5.8%	5.7%
South Africa	13.1%	11.7%	10.6%	9.6%	8.9%	8.6%	8.4%	8.5%	8.6%	8.5%	8.0%	7.9%	8.3%	8.4%	8.6%	9.0%	9.1%

Source: OFX (OzForex Limited)

For this analysis, a premium of 2 per cent above the risk-free cost of capital has been used to calculate the opportunity cost of capital for non-land dairy assets. Livestock contribute the largest portion of these assets. Figure 16 outlines the opportunity cost of total capital per litre by country.

Figure 16. Opportunity cost of capital of dairy farm assets expressed in USD cents/litre and ECM with AUS represented by VIC, 2003-2019

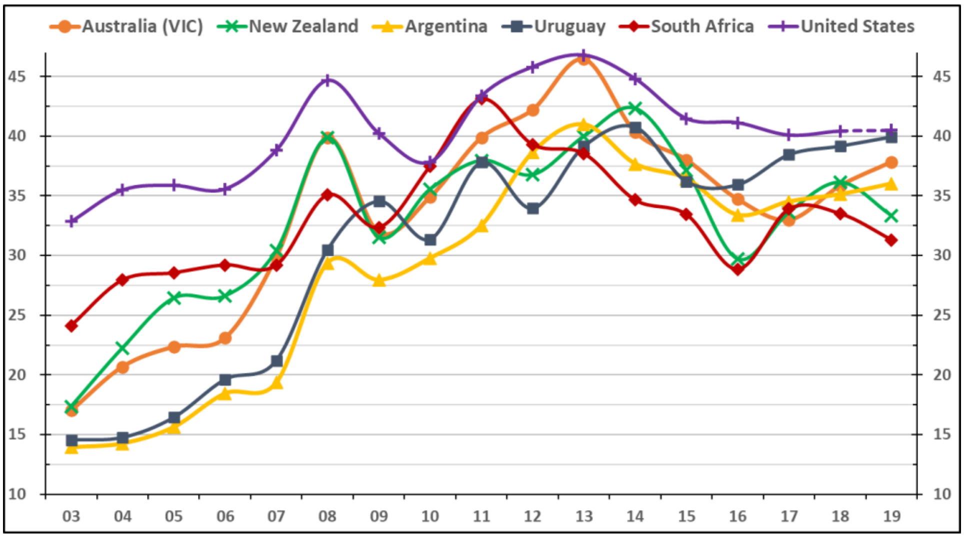


Source: Red Sky

This highlights how NZ has bid up the value of assets over the period 2003-2008, in particular the price of land, to the extent that this did erode its advantage in accounting cost of production. This opportunity cost of capital per litre peaked at around 15 USc/litre in 2008, although it has been steadily decreasing since that time. US is in the strongest position with regards to cost of capital, with this being less than 5 c/litre since 2011. The opportunity cost of capital per litre for VIC (AUS) peaked at a little under 9 c/litre in 2011-2013 with all other states peaking at higher levels including NSW and QLD at 13-14 c/litre. Since then it has been decreasing with VIC averaging around 6 c/litre since 2016, and the other states between 6-10 c/litre.

Figure 17 outlines the economic cost of production (accounting cost of production plus opportunity cost of capital) for the six countries in the study.

Figure 17. Economic cost of production expressed in USD cents/litre and ECM with AUS represented by VIC, 2003-2019

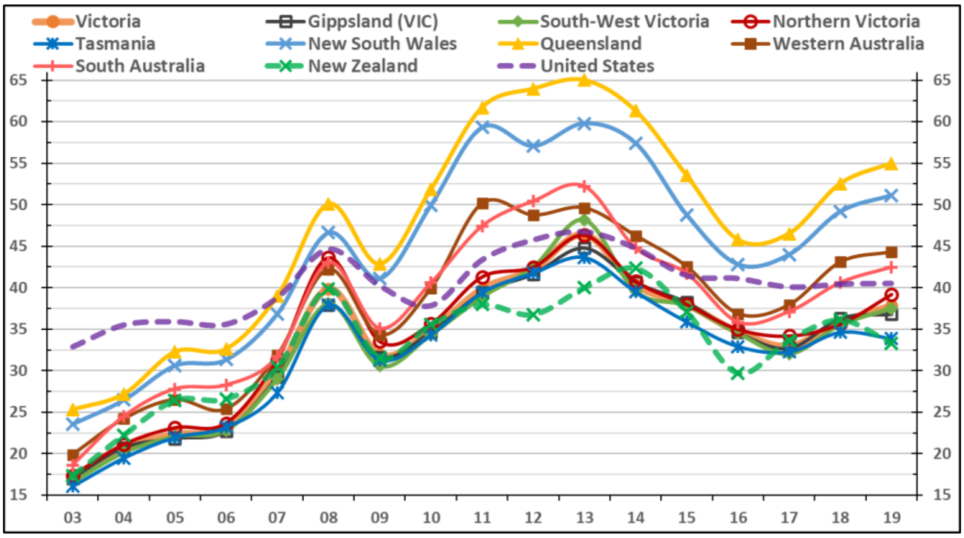


Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, USDA, Genske Mulder

There are a number of noteworthy trends highlighted by this figure. US has the highest economic cost of production throughout the entire period. RSA commences the period (2003-2006) with the second highest economic cost of production and from 2013 onwards has the lowest cost of production. ARG and URU had the lowest economic cost of production in the initial period (2003-2007), although URU ended the period (2016-2019) with the second highest cost of production, and ARG was the third highest along with AUS. NZ generally had the third highest economic cost of production from 2002-2008 and then improved its position to generally having the second lowest cost of production from 2016-2019. AUS (VIC) had a significantly lower economic cost of production compared to both NZ and RSA in the initial period (2003-2006) although, from 2012 onwards, most often had a higher economic cost of production than both these countries.

Figure 18 outlines the trends in economic cost of production across all states and across all three major dairying regions in VIC, with NZ and US data also included. The most noteworthy trends are as follows. The economic cost of production for NSW and QLD was relatively close to the rest of AUS (and NZ) in the initial period (2003-2008), and then from 2008 onwards had a substantially higher cost of production than the rest of AUS as well as US. SA and WA have the next highest economic cost of production after NSW and QLD, with it initially being a small margin above the rest of AUS (and NZ) while being substantially lower than US. However, from 2010 onwards, the cost of production for these two states was significantly higher than the rest of AUS (and NZ), and was most often higher than the US. VIC and TAS had a lower economic cost of production than NZ in the initial period (2003-2006) and then from 2011 onwards most often had a higher cost of production than NZ, though TAS did have a similar, or at times lower, cost of production to NZ from 2014-2019.

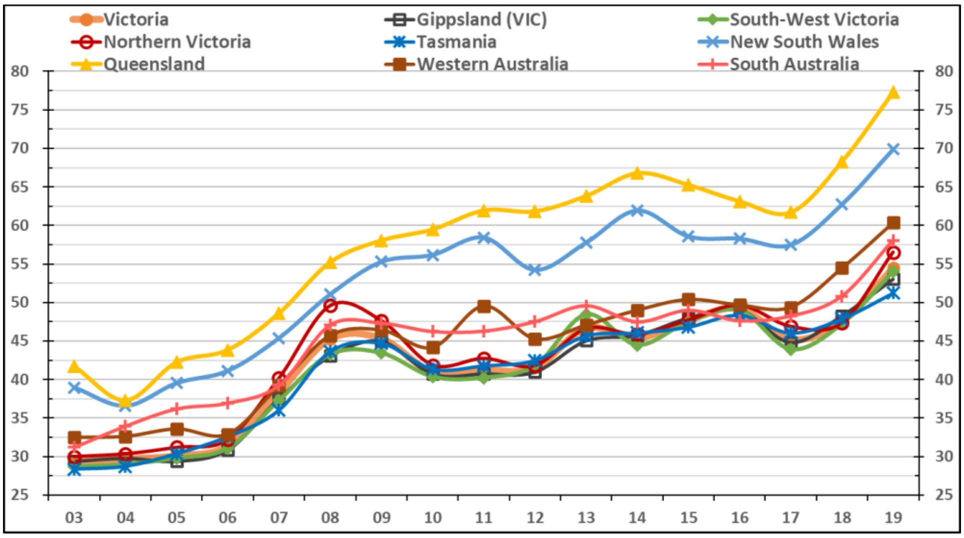
Figure 18. Economic cost of production for states of AUS plus three regions in VIC as well as NZ and US expressed in USD cents/litre and ECM, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, QDAS, DairyBase, USDA, Genske Mulder

Figure 19 further outlines the trends in economic cost of production across all states and across all three major dairying regions in VIC. In this graph the costs are expressed in Australian dollars and are based on the actual fat and protein percentages for the milk produced in each state. The same major trends are evident as they were in Figure 18.

Figure 19. Economic cost of production for states of AUS plus three regions in VIC expressed in AUD cents/litre, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, QDAS

What is Driving the Comparatively High Increases in Cost of Production in Australia?

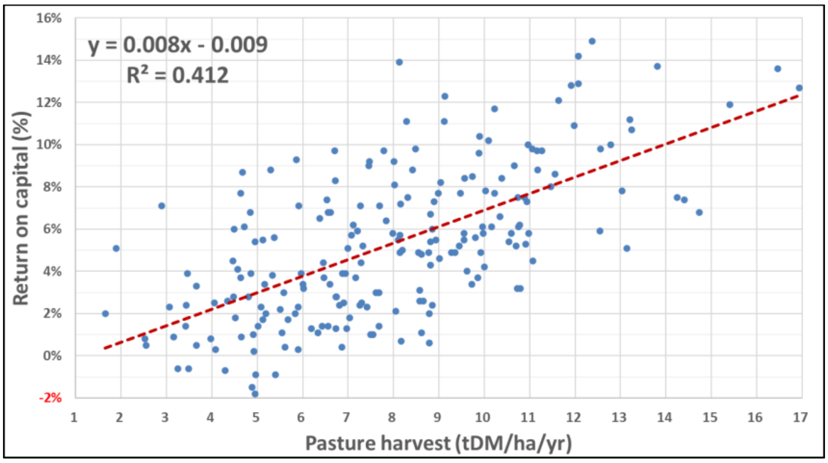
Is lower pasture growth and lower pasture harvest impacting on cost of production?

Pasture harvest has a strong positive correlation with profit for pasture-based dairy farms, where "pasture harvest" includes all pasture and other crops consumed by the cows in-situ as well as any pasture mechanically harvested on the dairy farm, and where "pasture-based" refers to farms where cows consistently walk to paddocks and harvest the pasture themselves. There is no minimum percentage level of pasture in the diet required for the definition of being pasture-based. However, in practice it is rare to see pasture-based farms with less than 25-30 per cent pasture in the diet (excluding periods of severe drought) as, below these levels, farmers will usually decide to stop having their cows expending energy to walk to paddocks and graze small amounts of pasture, but rather confine them to a feedlot and maximise feed conversion to milk. This positive relationship between increasing pasture harvest and increasing profit is normally the physical ratio with the highest coefficient of determination (R^2) in dairy farming. This has been reported previously by Dillon et al. (2005). Figure 20 is from the AUS Red Sky Dairy Data. For this dataset, variations in pasture harvest explain 41 per cent of the variation in profit.

NZ has a natural advantage in this area of pasture harvest, with the climate in NZ providing much higher pasture growth rates than most regions of AUS as well as providing higher quality pasture (i.e. higher energy per kilogram of dry matter) due to the country's more southerly latitude.

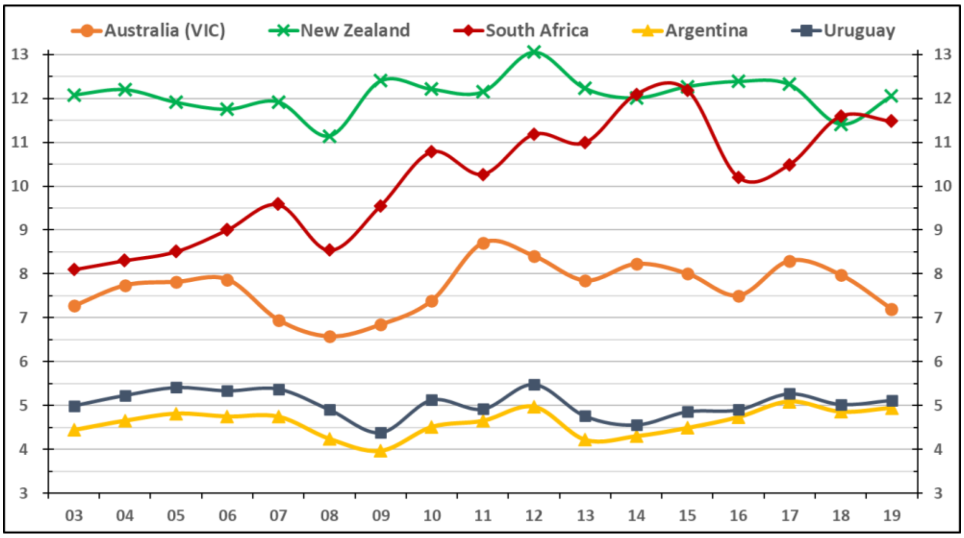
Figure 21 outlines the variations in pasture harvest across the five pasture-based countries in this study. NZ's position as the most efficient pasture-based dairy producer in the world is based on consistently having the lowest accounting cost of production of any country, supported by the highest level of pasture harvest. Although NZ has the highest level of pasture harvest, the only country that has substantially changed pasture harvest over the period from 2003-2019 is RSA. However, AUS, ARG and URU all had a competitive cost of production and level of profitability compared to NZ in the early period from 2003-2006, and any loss of competitiveness would appear to be unrelated to absolute levels of pasture harvest. The improvement in pasture harvest in RSA, which has a similar climate to NSW and WA, was due to an industry-wide focus on improving pasture production and utilisation, including increasing the farm area under irrigation.

Figure 20. Impact of increasing pasture harvest in tonnes of dry matter of pasture per hectare per year (tDM/ha/yr) on profit (expressed as return on total capital)



Source: Red Sky including several industry-funded data collection programs

Figure 21. Pasture harvest in tonnes dry matter per hectare per year with AUS represented by VIC, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA

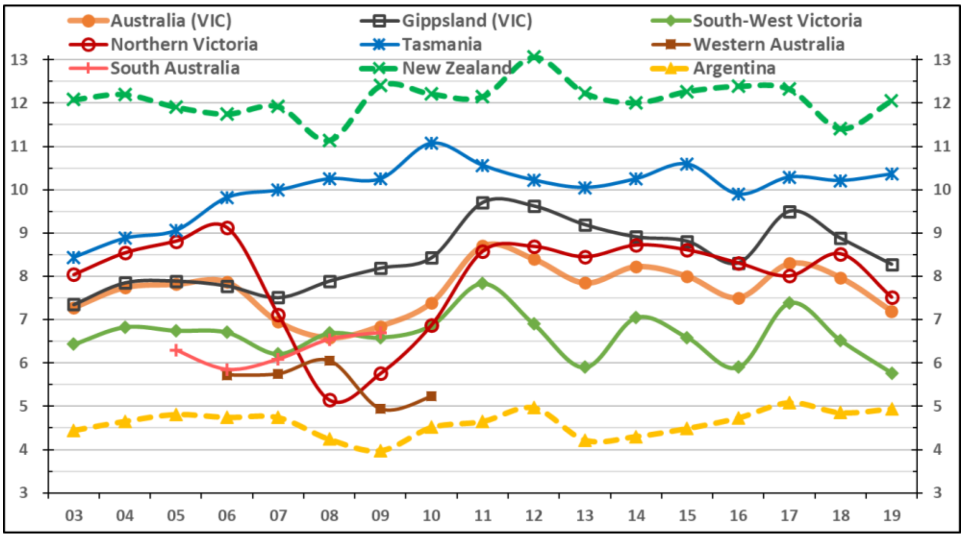
Figure 22 outlines the pasture harvest across the three main dairy regions in VIC (AUS) as well as TAS and compares these with NZ and ARG. SA and WA are included for the five years for which comparative data is available, while NSW and QLD have average levels of pasture harvest between the VIC average and ARG. In all states there will be large variations between regions and then within each region, with this additionally being dependent on whether farms have access to water for irrigation.

Table 9 compares the annual growth rates in pasture harvest over the period from 2003-2019 for VIC, TAS, NZ, ARG, URU and RSA. This confirms that both VIC and TAS have made more progress in increasing pasture harvest over this period than NZ. If Northern Victoria were excluded from the VIC data, then the positive trend would be increased further. This provides further confirmation that AUS's loss in profitability from rapidly increasing cost of production is not related to pasture harvest.

What changes in production systems have been occurring?

Dairy farm production systems can be defined by the percentage of pasture in the cows' total diet, which is based on the proportion of energy supplied by pasture compared to supplements.

Figure 22. Pasture harvest in tonnes dry matter per hectare per year for VIC, VIC regions, TAS, NZ and ARG, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA

Table 9. CAGR of pasture harvest in tonnes dry matter per hectare per year, 2003- 2019

Pasture harvest	Victoria (AUS)	Tasmania (AUS)	New Zealand	Argentina	Uruguay	South Africa
CAGR 2003-2019	0.7%	1.3%	0.1%	0.7%	0.2%	2.2%

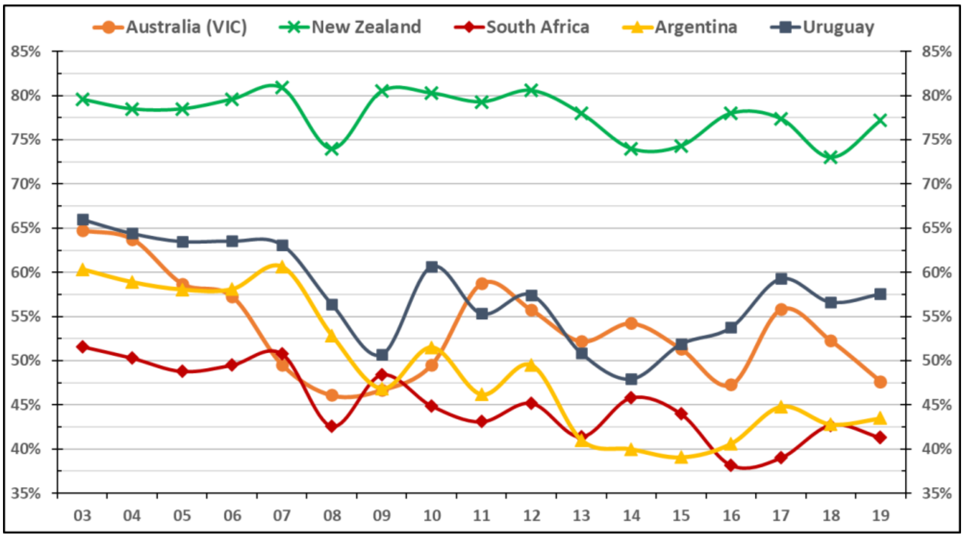
Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA

This can range from near 100 per cent for some farms in countries like NZ to 0 per cent for farms that run a confinement or feedlot production system like the majority of US farms. The type (genotype) of cow that suits a diet mostly comprising pasture, and which needs to walk to and from paddocks twice a day as well as harvest the pasture in the paddock themselves, is quite different to the type of cow that suits being confined in a feedlot and is provided all the feed it requires without moving outside its pen. These differences in genotype have been documented by Harris and Kolver (2001).

Farmers in many countries have little choice about the production system they can utilise. Many countries are either too close to, or too far from, the equator to grow the temperate pasture required for pasture-based milk production or to farm Bos Taurus dairy breeds outside barns. Conversely, a country like NZ can have a suitable climate for farming cows outdoors on pasture but have very little suitable arable ground for grain production (resulting in grain being very expensive), which economically creates a focus on optimising pasture production. In the southern hemisphere, countries like AUS, ARG, URU and RSA all have a suitable climate and suitable land for both pasture and crop production. This provides farmers with a choice of whether to focus primarily on pasture production and breed cows that suit this production system or to focus primarily on milk production and breed cows that suit this production system.

Figure 23 outlines the percentage of pasture in the cow's diet, with US not included as there is no pasture in almost all US cows' diet. AUS is represented by VIC. Although the percentage of pasture in the diet has reduced for all countries over time, there has been little change in NZ. The two countries with the highest reduction of pasture in the diet is AUS (VIC) and ARG, with URU having the next most significant change. ARG is the other country besides AUS that has experienced the greatest increase in cost of production and loss of profitability. In the case of AUS (VIC), pasture as a percentage of the diet has decreased from 60-70 per cent in 2003-2004 to 45-55 per cent in more recent years. This would have had a significant impact on cost of production due to pasture having a substantially lower cost than supplements (i.e. concentrates and forages excluding pasture).

Figure 23. Pasture as percentage of cow's diet (US not on graph as 0 per cent), 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA

Table 10 outlines the variation in cost of pasture versus concentrates and forage (excluding pasture). This confirms that pasture is usually around 25-35 per cent of the average cost of supplements. Conversely this can be expressed as the average cost of supplements usually being 200-300 per cent higher than the direct consumed cost of pasture. These comparisons are calculated on the direct consumed cost of each feed category. With pasture, the direct costs include pasture maintenance and renovation (including green feed crops grazed in situ), fertiliser (including nitrogen), all pasture irrigation costs, and the direct silage and hay costs for pasture conserved on the dairy farm. With forages and concentrates, these costs include the purchase or production cost plus storage costs. Wastages are included in the calculations for forages and concentrates, whereas pasture is calculated on a consumed basis (i.e. after wastage).

Table 10. Pasture, concentrate and forage cost expressed in USD per tonne dry matter plus ratios of concentrate and forage cost as multiples of pasture cost. Forage cost excludes any pasture cost

2010-2019	Pasture Cost	Concentrate Cost	Concentrate to Pasture Ratio	Forage Cost	Forage to Pasture Ratio
Victoria (AUS)	$97	$329	3.4	$183	1.9
Tasmania (AUS)	$69	$376	5.5	$192	2.8
New Zealand	$43	$284	6.6	$231	5.4
South Africa	$88	$336	3.8	$142	1.6

Source: Red Sky, Dairy Farm Monitor Project, DairyBase

In reviewing the variation in costs in Table 10 for the period 2010-2019, the ratio of concentrate to pasture cost of 3.4 in VIC is equivalent to describing concentrates as 240 per cent more costly than pasture. For TAS the ratio of concentrate to pasture cost of 5.5 is equivalent to describing concentrates as 450 per cent more costly than pasture. Although the forage cost has a much lower ratio in both states, forage (excluding pasture) was still 90 per cent more costly than pasture in VIC and 180 per cent more costly than pasture in TAS.

Table 11 outlines the change in pasture as a percentage of the cow's diet over the period from 2003-2019 for VIC, TAS, NZ, ARG, URU and RSA. This confirms how little the NZ production system has changed over time with a decrease in pasture percentage of the diet of just 2-3 per cent. Although TAS has had a significantly larger decrease in pasture percentage in the diet compared to NZ, it is AUS (VIC) and ARG where the much larger decreases have occurred. And it is VIC (along with the balance of mainland AUS), as well as ARG, where the steepest increases in cost of production and loss of profitability have occurred.

Table 11. Change in pasture as percentage of cow's diet from 2002/03 to 2018/19

Pasture as per cent of cow's diet	Victoria (AUS)	Tasmania (AUS)	New Zealand	Argentina	Uruguay	South Africa
Change 2003-2019	-17.1%	-6.4%	-2.4%	-16.8%	-8.4%	-10.3%

Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA

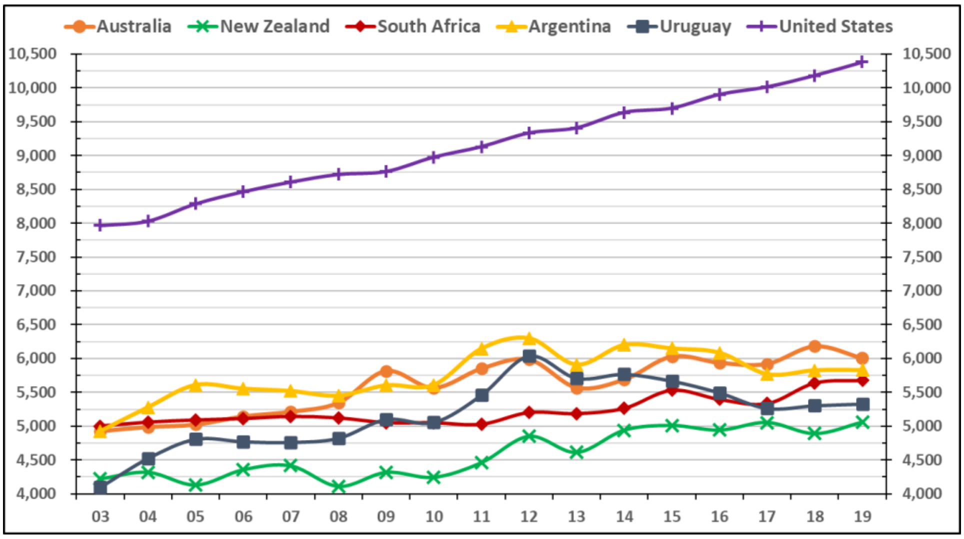
Having identified that changes in the dairy production system in AUS is the primary factor that has negatively impacted on cost of production and profitability, the remainder of this paper focusses on what the impacts are of changing production systems.

Impacts of Changing Dairy Production Systems

How has milk production per cow been changing?

All countries included in this analysis have been increasing milk production per cow. As Figure 24 reveals, US is the outstanding performer given the significant continuous improvements in milk production per cow being attained year-on-year. It is this performance by US farmers that supports the proposition that they have the most efficient dairy animal production system in the world.

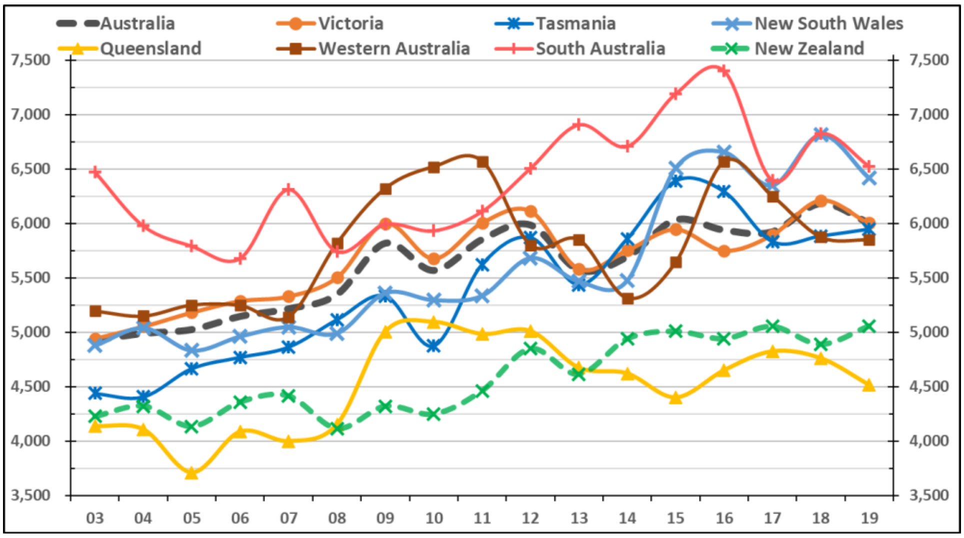
Figure 24. Milk production per cow expressed in litres (ECM), 2003-2019



Source: Dairy Australia, DairyNZ, MPO, AACREA, FUCREA, USDA

Figure 25 outlines milk production per cow for all the states of AUS as well as for AUS as a whole and for NZ. This level of milk production is energy-corrected to 4.0 per cent fat and 3.3 per cent protein. Although NZ farmers have one of the lowest levels of milk production per cow, they have one of the highest levels of profitability. SA has the highest level of milk production per cow and on average has the lowest level of profitability of the group.

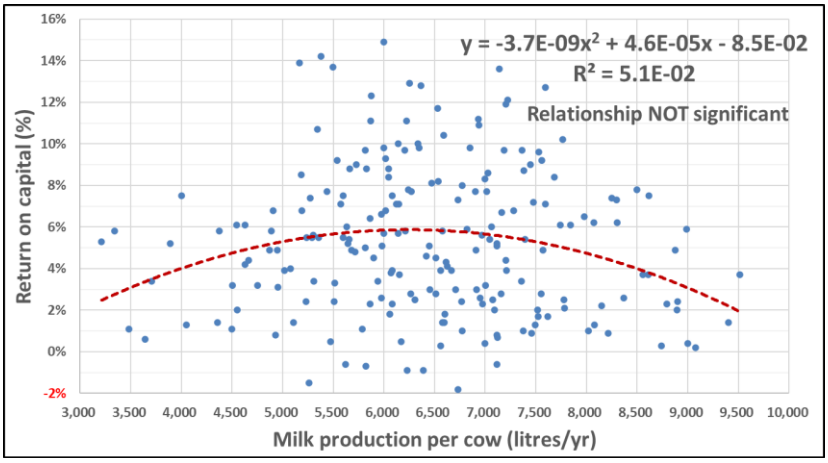
Figure 25. Milk production per cow for AUS, AUS states and NZ expressed in litres (ECM), 2003-2019



Source: Dairy Australia, DairyNZ

Although US milk production per cow is around 100 per cent higher than NZ and 55-65 per cent higher than the other four countries in the group, US farmers have a much lower level of profitability than NZ and RSA farmers despite receiving much higher prices for their milk. This outcome is possible, as it is with SA's higher milk production per cow and lower profitability compared to the other AUS states, due to there *not* being a significant positive relationship between increasing milk production per cow and increasing profit in pasture-based dairy farming. Figure 26 is from the AUS Red Sky Dairy Data. This confirms that variations in milk production per cow could not explain any of the variation in profit (expressed as return on total capital) for these farms.

Figure 26. Impact of increasing milk production (ECM litres per cow) on profit (expressed as return on total capital)

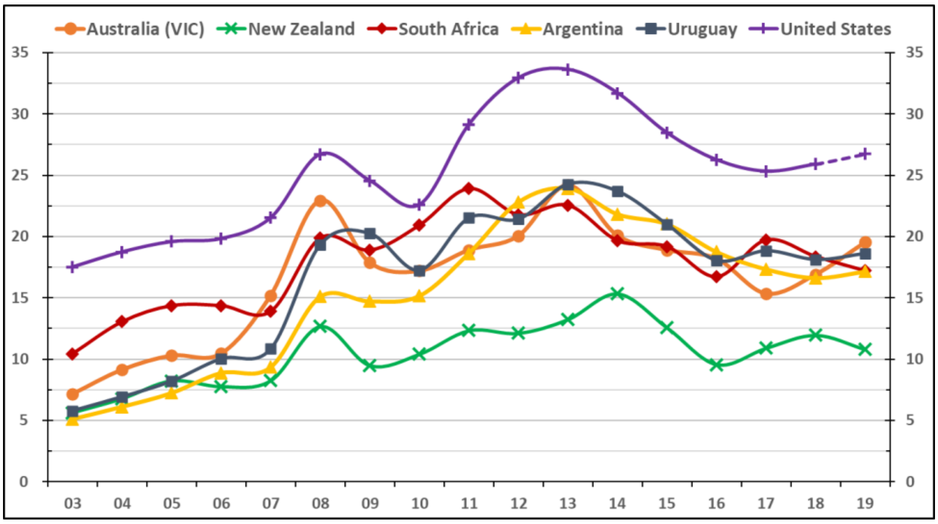


Source: Red Sky including several industry-funded data collection programs

What is the impact on farm business costs as pasture comprises less of the diet?

As previously detailed, where pasture becomes a lower percentage of the diet, the average cost of feed increases on a per tonne basis due to pasture being a much lower cost feed than all other feeds. This increase in average cost of feed per tonne also increases the average cost of feed per litre as outlined in Figure 27. Total feed cost includes all concentrate, forage and pasture costs, where pasture costs include pasture maintenance and renovation (including green feed crops grazed in situ), fertiliser (including nitrogen), pasture irrigation costs, and direct silage and hay costs for pasture conserved on dairy farm.

Figure 27. Total feed cost expressed in USD cents/litre and ECM, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, Genske Mulder

Although the costs per tonne of concentrates and forages (particularly maize/corn and lucerne/alfalfa) are lower in US than almost all other countries around the world, the total cost of feed per litre in US is substantially higher than almost all temperate pasture-based dairying countries. The total cost of feed per litre is the largest cost centre for a dairy business. As Table 12 outlines, it usually comprises around 40-60 per cent of total costs for pasture-based farms and 60-70 per cent of costs for confinement (feedlot) farms. As a result, it has the largest (dominant) impact on cost of production.

Table 12. Primary cost areas expressed as USD cents/litre and as percentage of total expenses

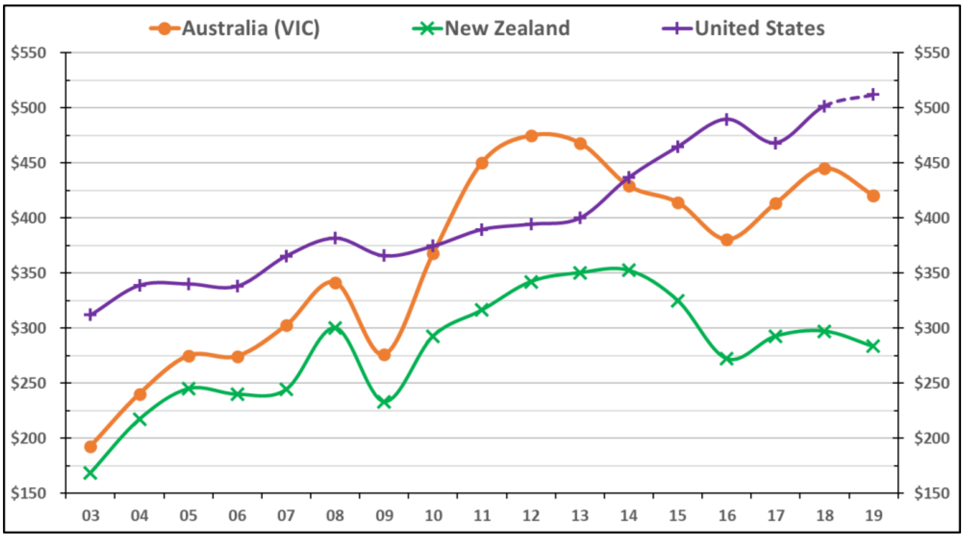
2010-2019	Total Expenses per Litre	Total Feed Cost/litre	Total Labour Cost/litre	"All Other" Costs/litre	Feed Cost as % Total Exp.	Labour Cost as % Total Exp.	"Other" Costs as % Total Exp.
Victoria (AUS)	34.0	18.9	6.6	8.5	55.6%	19.4%	24.9%
Tasmania (AUS)	31.7	15.8	7.1	8.8	49.8%	22.4%	27.8%
New Zealand	27.0	11.9	6.0	9.1	44.1%	22.2%	33.7%
United States	41.9	28.3	4.6	9.0	67.5%	10.9%	21.6%
Argentina	32.9	19.3	6.1	7.4	58.8%	18.5%	22.6%
Uruguay	36.6	20.3	6.3	10.0	55.4%	17.3%	27.3%
South Africa	32.3	20.0	3.8	8.5	61.9%	11.9%	26.2%

Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, Genske Mulder

Labour cost is the second largest cost in a dairy business. Labour includes all management cost as well as an imputed cost for owner/operator “family” labour. In AUS, NZ, ARG and URU, labour costs comprise 17-23 per cent of total operating expenses. In US, the percentage is lower at around 11 per cent, although it is 11 per cent of a much higher value for total operating expenses. RSA is the other country where labour cost is a lower percentage of total operating expenses at around 12-13 per cent. RSA is unusual in having a first-world dairy farming infrastructure with a developing-country labour pool.

One of the operational realities of targeting high milk production per cow, as in US, is that the cow's daily needs must be addressed in a more complete way throughout the day. As the cows are performing at a much higher level, their feed intake must be maintained, and the consistency and quality of feed must be maintained. The type (genotype) of cow suited to this production system will partition a higher proportion of its energy intake to milk production at the expense of liveweight maintenance, which results in more difficulty (and more cost) to get the cow pregnant. In many instances, the cows in these high milk production systems will be milked three times per day rather than two times per day. All of these extra activities and additional monitoring of the cows result in higher labour costs. Figure 28 outlines the variations in labour cost per cow between AUS (VIC), NZ and US. Over the period 2003-2019, AUS labour costs have moved from being closer to NZ to now being closer to US. This has been further impacted by the high hourly rate for staff on AUS dairy farms, which is higher than all other countries in the study including US.

Figure 28. Labour cost per cow expressed in USD/cow, 2003-2019



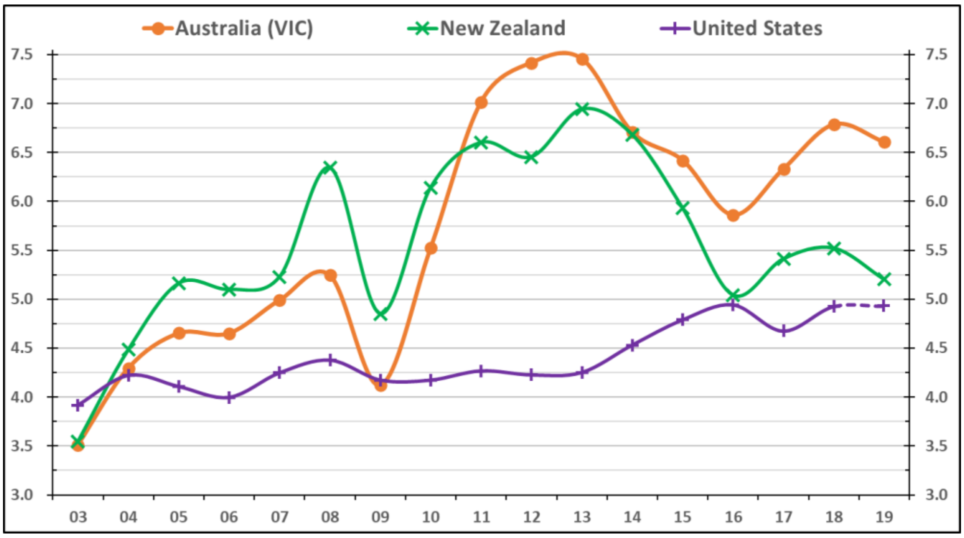
Source: Red Sky, Dairy Farm Monitor Project, DairyBase, Genske Mulder

When this labour cost is assessed on the basis of cents per litre (Figure 29) rather than dollars per cow, the much higher US cost per cow becomes the lowest cost per litre (excluding RSA). NZ had a similar cost to the US in 2003-2004 and again at the end of the period (2016-2019). AUS (VIC) also had a similar cost to the US in 2003-2004, but now has a much higher cost than both NZ and US.

Figure 30 compares how total operating expenses per litre have varied for the six countries in the study during 2003-2019. Total operating expenses includes all feed costs, all labour costs, all other operating costs including depreciation, and only excludes financing costs (including rent/lease costs). Since 2009, NZ has had the lowest operating expenses per litre, while US has the highest expenses for the entire period. ARG and URU commence the period with the lowest operating expenses per litre and from 2012 have the next highest expenses after US. AUS (VIC) commences the period with similar operating expenses per litre to NZ and lower expenses than RSA but has progressively increased expenses to a level that is higher than both these countries.

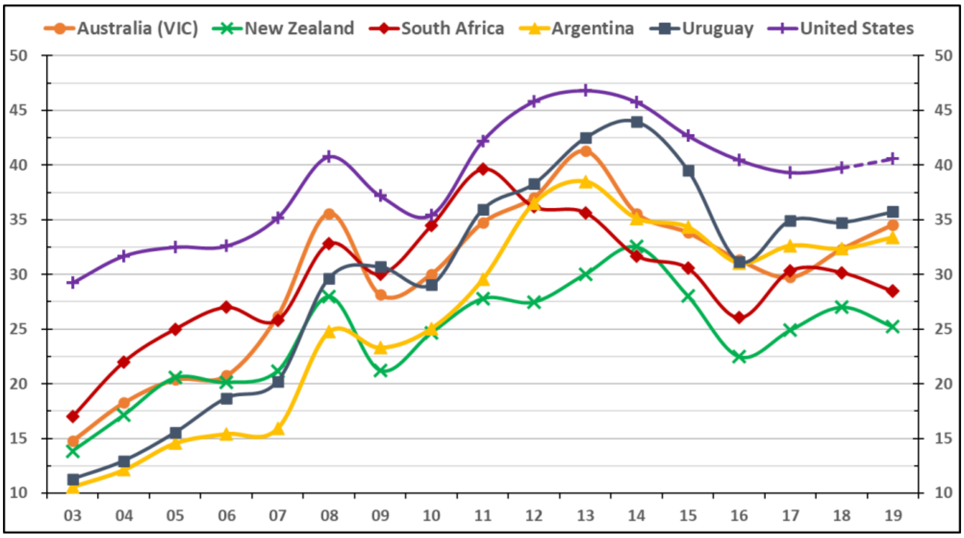
The result of the changes in production systems is that RSA has emerged since 2013 as the country with the next lowest accounting cost of production after NZ, while from 2013 the high cost of production in AUS, ARG and URU has resulted in farmers in these countries not having a sufficient profit margin to sustain their businesses or their industry. US cost of production is too high for the industry in that country to be profitable at international milk prices; however, the significantly higher milk prices received by US farmers compared to the other countries in the study group does mean the US industry retains sustainable (though more volatile) levels of profit.

Figure 29. Labour cost per litre expressed in USD cents/litre and ECM, 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, Genske Mulder

Figure 30. Total operating expenses in USD cents/litre, 2003-2019

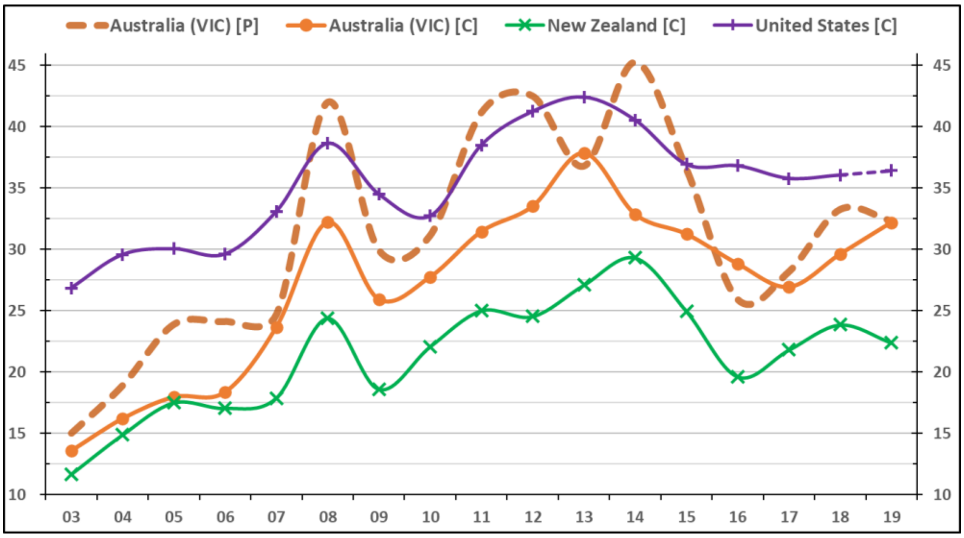


Source: Red Sky, Dairy Farm Monitor Project, DairyBase, AACREA, FUCREA, Genske Mulder

Figure 31 includes the AUS (VIC) milk price as a dashed line, which is similar to the NZ milk price as well as the price received by the other countries in the study group with the exclusion of US. The other data in the figure represent the cost of production for AUS (VIC), NZ and US. This figure further highlights how the VIC (and AUS) dairy industry has lost both its competitiveness with NZ and no longer has a sustainable margin between cost of production and milk price. When debt servicing is added to the operating expenses, the majority of AUS dairy farmers can no longer produce a profit at trendline internationally traded milk prices.

Most US farmers also could not produce a profit at internationally-traded milk prices, and the more that AUS dairy farmers adopt US-type production systems (and the cow type that excels in this system), the less profitable they will become. It should also be noted that the US has some of the lowest, if not the lowest, cost of concentrates and good quality forages (particularly maize/corn and lucerne/alfalfa) of any country in the world. When AUS farmers adopt US-type production systems, their cost of feed will most often be higher than in US, and so their cost of production would be even higher than US. Regrettably, the data presented in this paper, as well as much of the research, extension and commentary in Australia, confirms that the country has been adopting a production system that will continue to increase cost of production and reduce profitability.

Figure 31. VIC (AUS) milk price [P] versus VIC, NZ and US cost of production [C] (USD cents/litre and ECM), 2003-2019



Source: Red Sky, Dairy Farm Monitor Project, DairyBase, Genske Mulder

Conclusions

Decreasing pasture as a percentage of the cow's diet results in an increase in both accounting and economic cost of production. This increase in cost of production is primarily due to the increase in total feed cost per litre and due to the lower-cost pasture being replaced with higher-cost supplement. The production system change that is implemented when farmers decrease the percentage of pasture in the cow's diet, and increase the percentage of supplements (primarily concentrates) in the cow's diet, is associated with the breeding of cows that are more efficient converters of concentrate into milk, though less efficient at harvesting pasture as well as becoming pregnant and calving within a 12-month cycle.

Over the last 20 years, a majority of Australian dairy farmers have been changing their production system and targeting higher milk production per cow from feeding higher amounts of concentrate per cow on both an absolute and percentage-of-total-diet basis. The adoption of this production system, that has as its ultimate expression the US confinement (feedlot) production system, has resulted in the average cost of production in AUS increasing to such an extent that there is no longer a sustainable profit margin for a majority of dairy farmers to be consistently profitable. This trend is evident across the entire country, including TAS, although TAS does have a lower cost of production than all other states. In contrast to AUS, NZ has largely retained a high percentage of pasture in the cow's diet and has retained a world-leading position of producing milk at a low cost. Although pasture harvest per hectare in NZ is little changed over the last 20 years, the NZ dairy industry has retained a high level of profitability by maintaining their low-cost production system.

Although it may appear inconsistent for a majority of AUS farmers to have been adopting higher cost of production systems over a 20 year period, in most instances this will have been done through multiple small changes in their production system in response to perceived opportunities (e.g. higher milk price or lower concentrate price) or business challenges (e.g. changeable climate or high cost/low availability of irrigation water). The comparative complexity of pasture-based dairy businesses, including the counter-intuitive nature of some important business performance relationships (e.g. improved biological efficiency of the cow and the production of more milk per cow does not correlate with improvements in financial efficiency or profit), along with the confounding impact on annual financial outcomes from variation in climate, can mask the full impact of changes in business strategy for many years.

For the Australian dairy industry to regain a sustainable level of profitability, a majority of farmers will need to move their production system back to the production system that was most common in the 1990s. This would involve significantly increasing the percentage of pasture in the diet, which for Victorian farmers might mean increasing pasture as a percentage of the diet from 45-55 per cent to 60-70 per cent. This will require a significant associated reduction in the rate of supplement feeding.

A change in the production system of this scale will result in two major farm business challenges. Firstly, in most instances this will require a reduction in stocking rate (fewer cows per hectare), and with the additional reduction in milk production per cow (from a lower concentrate feeding rate), will reduce milk production per hectare and as a result reduce revenue per hectare. Although this reduction in revenue that is associated with the production system change would be undertaken to improve cost of production and improve business profitability, this remains a significant challenge to manage.

The second major challenge for many farmers would be that a 15 per cent decrease in supplement as a percentage of the cow's diet (say from 50 per cent to 35 per cent) could convert into a reduction in concentrate feeding rate of 2.0-2.5 kg per cow per day. For many farms, a reduction in concentrate feeding rate of this scale would result in the cows losing too much bodyweight and being unable to efficiently produce milk or get pregnant. As a result, there may be a majority of Australian dairy farmers that would need to start breeding the type of cow that can efficiently produce milk with a high percentage of pasture in the diet, and this could take 5-10 years to achieve.

Regardless of the challenges, it is important that Australian dairy farmers do adopt low cost of production systems as this would appear to be the only avenue for these farmers, and the dairy industry as a whole, to return to sustainable levels of profitability. Significant improvements in milk price in the future are unlikely as Australian milk prices have been consistently competitive with international milk prices over the last 20 years (see Figure 9). It would also appear unrealistic to expect the Australian government to restrict the flow of milk products into the country, which means Australian dairy farmers and milk processors will need to continue to compete with milk products produced in other countries, including low cost-of-production milk products from NZ.

If there is a positive aspect to the challenge that the Australian dairy industry is facing, it is that the majority of the industry has been profitable and internationally competitive in the past with this centered amongst the approximate 80 per cent of national milk production that is produced in the south-east of AUS. To regain this position would not require newly acquired skills or technologically advanced products or new research. It primarily requires dairy farmers to utilise their existing skills to implement the production systems that were more commonly in operation 20-30 years ago. If this were to be successfully implemented, it could be expected to result in annualised increases in Australian milk production of 2-3 per cent as was attained prior to 2000 and as has been regularly attained by countries such as NZ, ARG, URU, RSA and US.

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Hemme, T., Uddin, M.M. and Ndambi, O.A. (2014), 'Benchmarking cost of production in 46 countries', *Journal of Reviews on Global Economics*, 3, 254-270.

Sources of Data

AACREA (Asociación Argentina de Consorcios Regionales de Experimentación Agrícola) www.crea.org.ar; producer-owned organisation in Argentina that has as its main purpose to help producers improve the economic and financial results of their farm business. AACREA has the largest dataset of dairy farm performance in Argentina.

Dairy Australia www.dairyaustralia.com.au.

Dairy Farm Monitor Project (Australia) www.dairyaustralia.com.au/farm/farm-business-management/dairy-farm-monitor-project.

DairyBase (New Zealand) www.dairynz.co.nz/business/dairybase.

DairyNZ www.dairynz.co.nz.

FUCREA (Federación Uruguaya de Grupos CREA) www.fucrea.org; producer-owned organisation in Uruguay that has as its main purpose to help producers improve the economic and financial results of their farm business. FUCREA has the largest dataset of dairy farm performance in Uruguay.

Genske Mulder (United States) www.genskemulder.com; the largest dairy farm accountancy practice in United States. Genske Mulder produce benchmark data for dairies in Arizona, California, Colorado, Idaho, New Mexico, Texas and Washington and in the regions of the Upper Midwest and Lower Midwest.

INALE (Instituto Nacional de la Leche) www.inale.org; the Uruguayan National Milk Institute is a non-state public entity with its main task being to advise the government on dairy policy. The aim is to contribute to a joint public-private partnership aimed at the development of the Uruguayan dairy industry.

MAGYP (Ministerio de Agricultura, Ganadería y Pesca) www.argentina.gob.ar/agricultura-ganaderia-y-pesca; the Argentinian government's Ministry of Agriculture, Livestock and Fishing.

QDAS (Queensland Dairy Accounting Scheme); benchmarking analysis undertaken by Queensland Department of Agriculture and Fisheries www.daf.qld.gov.au with funding from Dairy Australia.

Red Sky Agricultural ('Red Sky') www.redskyagri.com; commercial provider of farm business analysis and benchmarking software that is primarily operating in Australia, New Zealand and South Africa. Red Sky's major shareholder is the author of this paper.

SENASA (Servicio Nacional de Sanidad y Calidad Agroalimentaria) www.argentina.gob.ar/senasa; the Argentinian government's National Service of Agri-Food Health and Quality.

USDA (United States Department of Agriculture) www.usda.gov.

Definitions

Energy Corrected Milk (ECM): determines the amount of energy in the milk based upon milk, fat and protein and adjusted to 4.0 per cent fat and 3.3 per cent protein. ECM formula = milk production x ((0.383 x fat% + 0.242 x protein% + 0.7832) / 3.1138). AUS and US report true protein, whereas NZ, ARG, URU and RSA report total protein, so non-protein nitrogen was assumed to be 5.5 per cent of total protein to correct for this. Converting all milk ratios to energy corrected milk is required due to the otherwise confounding impact of the wide range in fat and protein per cent internationally as a result of differing cow types, diets and production systems. This formula is used by the Dairy International Farm Comparison Network, as outlined in the following: https://dairymarkets.org/PubPod/Reference/Library/Energy%20Corrected%20Milk.

Solids: refers to the combined weight of fat plus protein in the milk. These are the two saleable components that primarily impact on the price paid for milk. Utilising solids rather than litres to determine the growth rate in milk production for each country eliminates the confounding impact of changes in fat and protein percentages in each country over the period from 2003-2019.