A study of cow and farm benchmarks during a change from a pure-bred to cross-bred seasonally-calving pasture-based herd

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Introduction

The dairy industry is capturing increasing amounts of farm data. The challenge is how to convert the raw data into information that assists decision making and encourages an ongoing cycle of self-improvement. Benchmarking is the process of comparing performance against a known standard or against the performance of peers. To do this, benchmarks require raw farm data to be converted into measures that can be meaningfully compared between and within farms. For the most part, this is by dividing one farm total (such as farm milk production) by another farm total (such as number of milking cows) to yield an average rate (in this case the average milk production per cow) which can be compared to others.

The fundamental premise of benchmarking is that the suite of benchmarks obtained can be readily interpreted, and will identify areas for focus (and areas of good performance). Easy and complete data capture and collation into centralised databases facilitates benchmarking, making it easy to generate rates and ratios for comparison and encouraging participants into a cycle of continuous improvement. But this also introduces risk for uninformed users who may not understand how to interpret their benchmark(s). Some may erroneously focus on chasing individual benchmarks (where more or less is better) instead of focusing on what the combined benchmarks say about overall farm performance. A dairy farm is a complex system and the most successful farmers are those that do well across all key areas; not those that excel in one or two areas but do poorly in others. The economic principle of equi-marginal returns suggests the most successful and resilient farmer will have roughly equivalent performance across all their benchmarks and will almost certainly not excel in any. The problem is recognising excellence in overall performance from benchmarks.

DairyBase is the primary central repository of farm physical and financial data for the Australian dairy industry. It contains data from a diverse range of farming types and systems. Greater availability of data and increased ease in generating benchmarks has shifted the challenge to identifying which benchmarks to use and how to interpret them to assess overall performance. This report describes a case study to examine potential for disagreement between (limited) individual farm benchmarks and whole farm performance. The hypothesis is that per cow productivity and per hectare productivity may not be strongly correlated and farming system dependent.

The farming system used effectively determines which are the critical benchmarks and what are the appropriate targets for the system to use. Application of whole-of-industry aggregated data to determine benchmark targets is inappropriate. Only through the a system-based approach to interpretation of farm benchmarks can real problems be identified and appropriate corrective actions recommended.

This project aims were to demonstrate:

1. The importance of a system-level approach to benchmarking and interpretation;
2. The value of historical data in interpreting trends in farm performance; and
3. The value of *DairyBase* as a centralised, complete, maintained and accessible database

Real farm data was used to demonstrate how farming system changes affected individual benchmarks and to relate long-term trends in benchmarks to overall farm performance during the farming system change.

The two dairy farms owned by Dr Jakob Malmo in the Macalister Irrigation District have some of the most detailed farm physical and financial data within the Australian dairy industry. The complete data history extends back at least 20 years. This data, and Dr Malmo's detailed history of the farms, provided a near-perfect data set tor a benchmark trend analysis. Importantly, one of his farms converted from Holstein-Friesian cows to cross-breed cows around 10 years ago with the second farm beginning the conversion five years ago. Both farms have had stable management, constant spring-calving and feeding systems across the proposed study period. Dr Malmo has complete farm reproductive and disease records that support calculation of whole-of-life cow benchmarks.

The key farm benchmarks (production per cow, production per hectare, etc..) were calculated for each year of the retrospective study and compared against the overall farm financial performance (gross margin) for the farm that first implemented a cross-breeding program. Importantly, the change from Holstein-Friesian to cross-breeds at this Tinamba farm will be followed and the impact on individual benchmarks assessed. Some change are expected; such as a decline in per-cow lactation performance. Potentially no change or even an increase in average cow lifetime profitability and per hectare performance can be predicted. The

trends and relationships between per cow performance and per hectare performance and farm financial performance will specifically be described.

This research will encourage farmers to maintain continuous data collection such that long-term farm datasets can be used for benchmarking and to observe trends in benchmarks. Analysing benchmarks leads to better decisions that help drive farm profitability. This work will also demonstrate the value of *DairyBase* for effective whole-farm benchmarking and will encourage all *DairyBase* farmers to undertake similar analyses. This case study will be of assistance to both producers and advisers. The expected changes in per cow and per hectare performance and their relationship to overall farm profitability will be of great value for users of *DairyBase* and may form part of the 'train the trainer' material. This will demonstrate the importance of contextualising performance of an individual (and intermediary) benchmark with whole-farm performance.

Benchmark study

Farm history

The history of the Tinamba farm across the study period is as follows.

Cow changes

The original herd was pure-bred Friesian. A two-breed cross-breeding program began in the around 1998 with the introduction of Jersey into the mating program. The first home-bred cross-breeds entered the herd around 2000. The cross-breeding program changed to become a three-breed program around 2005 with the introduction of red-breed genetics. The herd composition has not yet stabilised to a three-breed cross; the proportion of three-breed animals continues to rise and a handful of pure-bred Friesian cows remains.

Farm physical changes

The farm has been expanding. This was primarily through the purchase of neighbours, the incorporation of beef farming sections into dairying, and access to land previously not available to the milking platform due to roads through construction of underpasses. The milking platform was originally 166 hectares from 2000 to 2010, increasing to 194 hectares in 2011 and then to 229 hectares in 2015[1].

Farming system

The farm has always been a pasture-based wholly seasonally-calving (spring) dairy farm. Grain feeding is used to supplement pasture. The average grain intake per milking cow is 1.7 tonnes per cow per year (with at least 1 tonne of supplement fed per cow each year). The average pasture/forage consumption by milking cows was 3.5 tonnes per cow per year. This places the farm feeding system into *System 2*—which is defined as pasture-based with grain feeding at more than 1 tonne DM per cow per year. The continual use of seasonal calving within feeding system 2 before, during and after the transition from pure-bred to cross-bred cows makes this an ideal study farm for examining the impact of the breed change on per-cow and per-hectare physical and financial benchmarks and on overall farm performance. The stocking rate history is presented in Figure 1. There was a strong upwards trend in stocking rate from 2000 until 2007. This was followed by a gradually declining trend in stocking rate.

[1]Note that minor fluctuations due to pasture renovation, leasing and transient grazing of beef areas also occurred

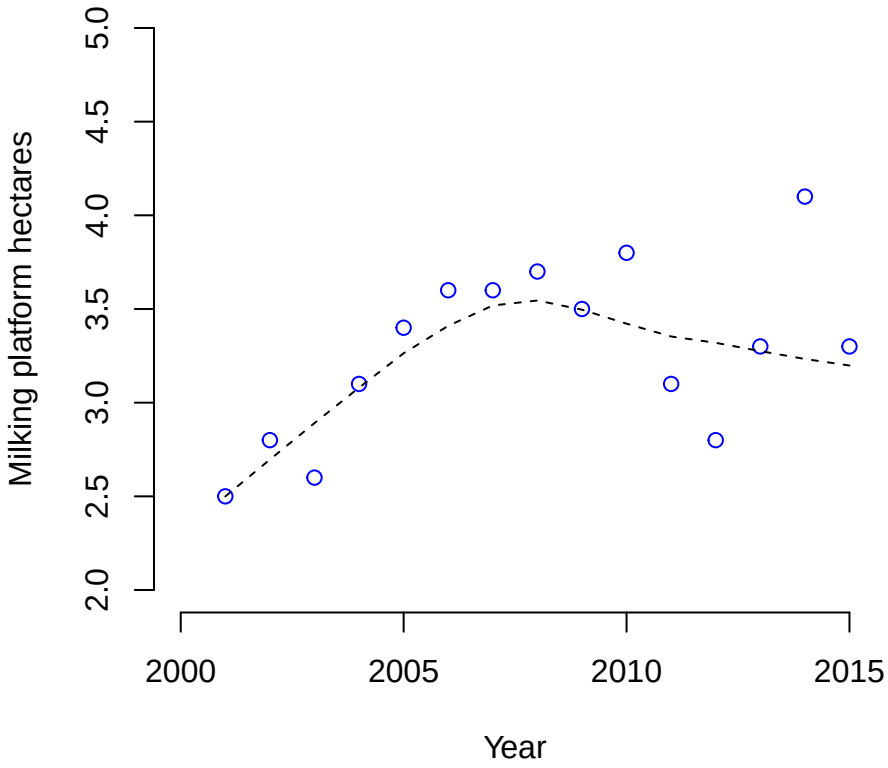

Figure 1: Milking platform stocking rate by year

Cow-level physical benchmarks

Breed

The change in herd breed composition is presented in Figure 2. The study period used was 2000–2015 as this includes a period when the herd was mostly Friesian and ends with the herd almost exclusively cross-bred[2]. Complete data existed for this period (*CashManager* was used for financial and physical records, *MISTRO* and *DairyData* for cow and herd records).

Production

Cow physical production is presented in Figure 3. The average lactation curve for each year was ranked. The lactation curves have not changed dramatically but there was a trend away from high litres, fat and protein per cow over time that is reflective of the reduction in pure-bred Friesian genetics in the herd. Genetic gain in production is present in the cross-breed and this became apparent after the herd breed composition had stabilised as predominately cross-breed but was almost certainly happening during the transition from pure-bred (high-producing) Friesian to cross-bred cows and reflects the effective sire selection process employed.

Feed intake

The average grain and pasture intakes per cow per year is presented in Figure 4[3].

[2] Three-way cross-breed cows currently make up around 20% of the herd

[3] 2007 was a drought year with limited irrigation water resulting in lower pasture production and necessitating purchase of more supplementary feed

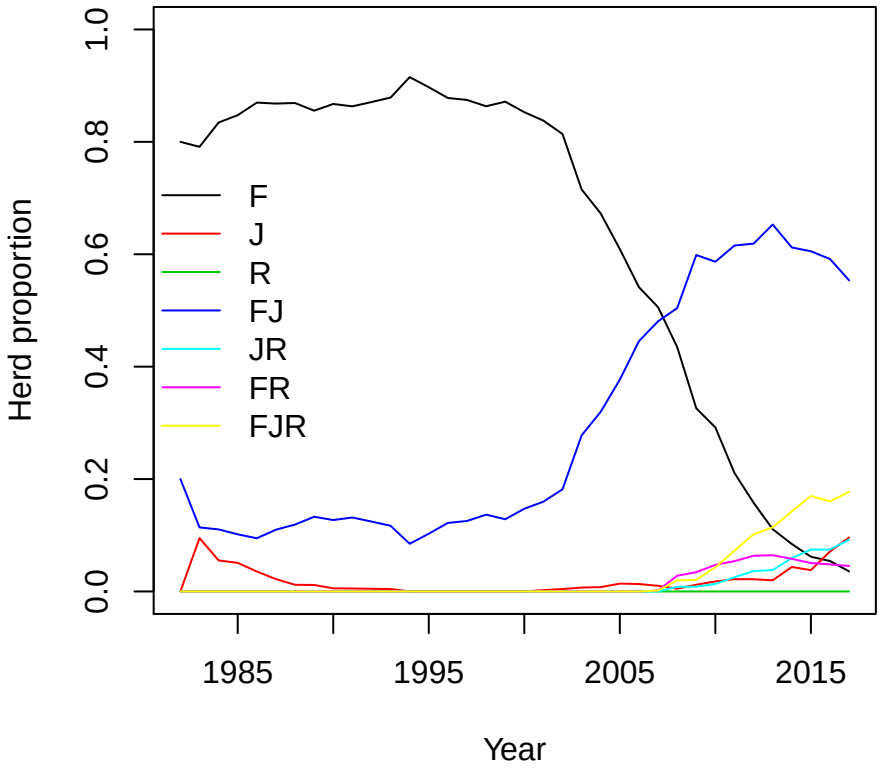

Figure 2: Herd breed composition by year

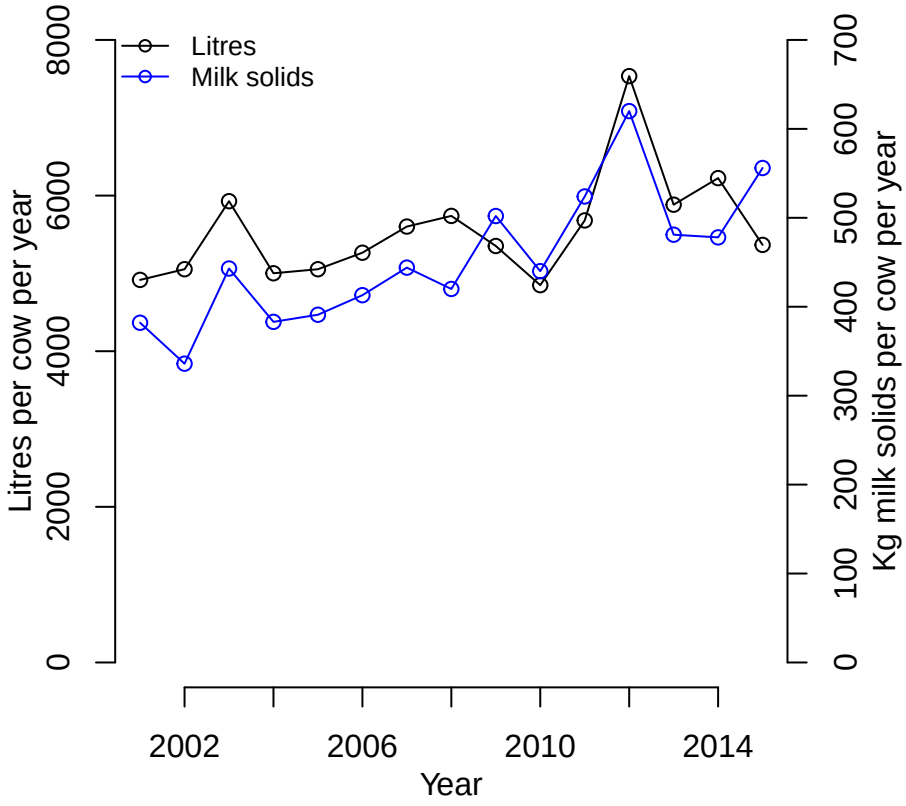

Figure 3: Average lactation milk and milk solids production per cow per year

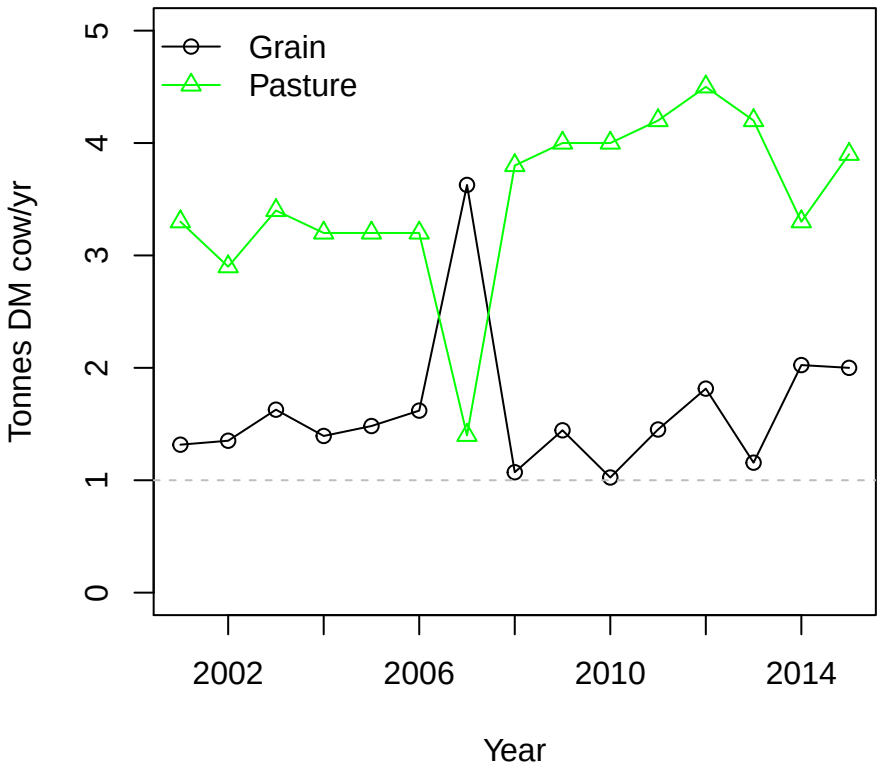

Figure 4: Tonnes consumed per cow per year

Reproduction

The trends in reproductive performance for three-week submission rate, first-service conception rate, six-week in-calf rate and not-in-calf rate by year is presented in Figures 5 to 8. The trend lines for the herd are presented as dashed lines of the same colour and for industry (median performance) for each measure is presented as dashed black lines. The herd has not experienced any appreciable decline in reproductive performance whilst the general industry trend has been for declining performance in each parameter.

Cow survival

Exploration of cow survival and lifetime production is limited to completed birth cohorts. This is those birth cohorts where all animals have left the herd[4]. This is presented in Figure 12. The proportion of the birth year cohort that were pure-bred animals is presented in Figure 13. There is a trend towards increasing lifetime survival and increasing lifetime milk solids production with increasing birth year—as the herd converts from pure-bred Friesian to cross-breed.

Hectare-level physical benchmarks

The average pasture and fodder consumption per milking platform hectare per year is presented in Figure 10. There has been a trend towards increased pasture/fodder consumption across the study period.

Financial benchmarks

The inflation (consumer price index; CPI) adjustments used are presented in the appendix in Table 1.

[4]Metrics obtained from birth cohorts with animals still in the herd will underestimate performance

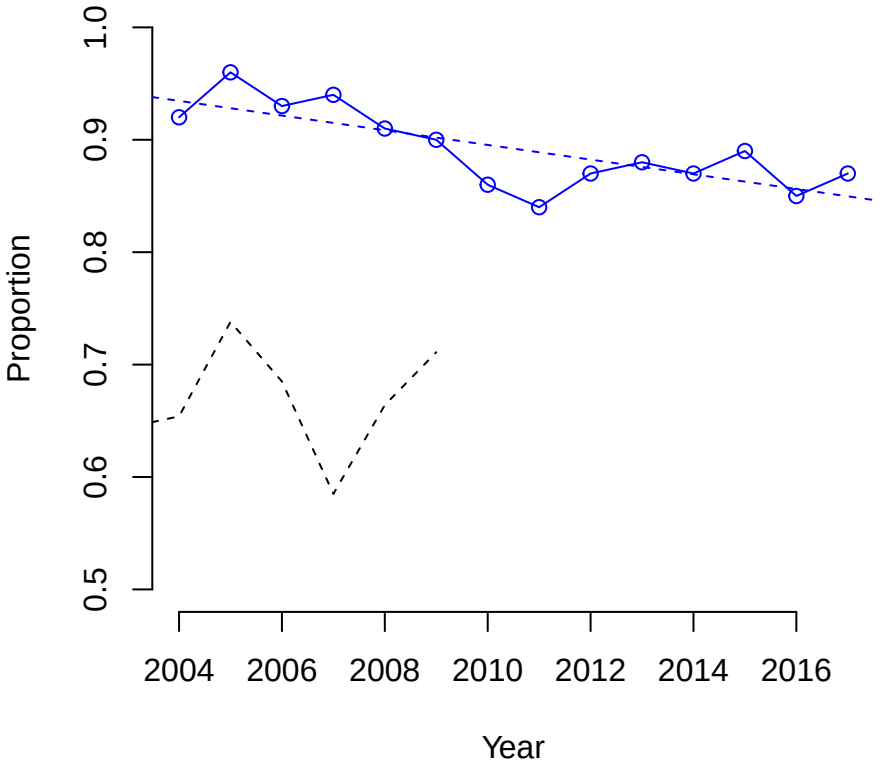

Figure 5: Three-week submission rate (SR) by year

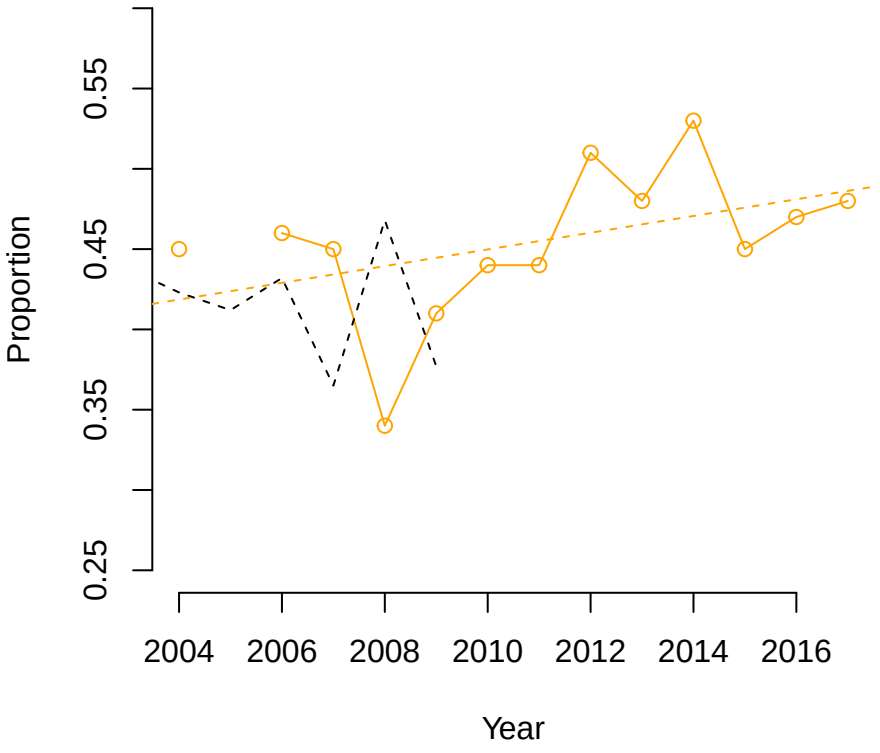

Figure 6: First service conception rate (CR) by year

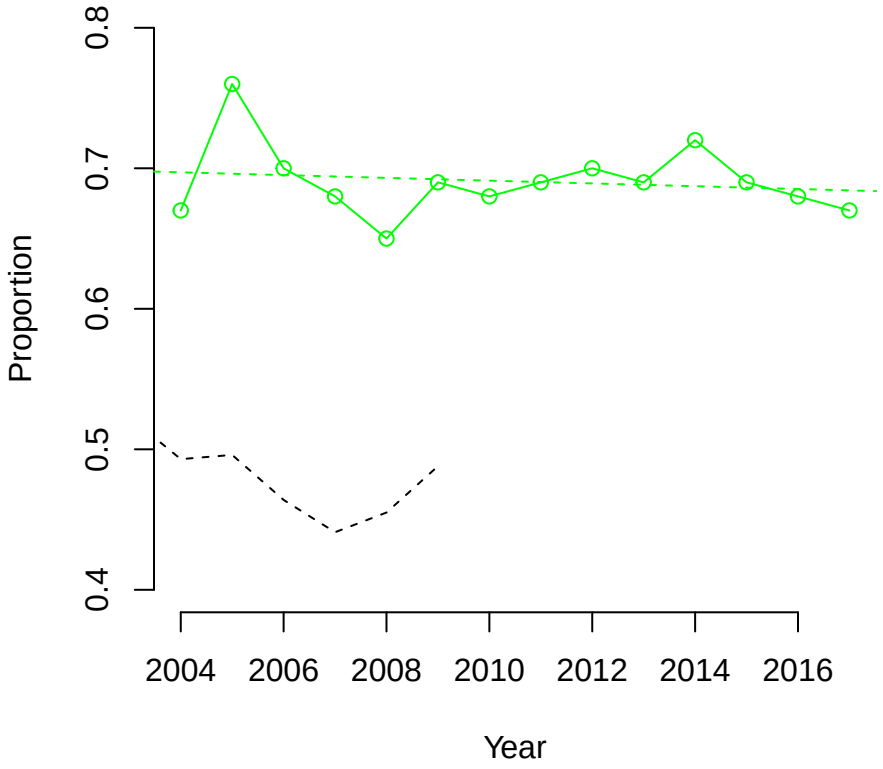

Figure 7: Six-week in-calf rate by year

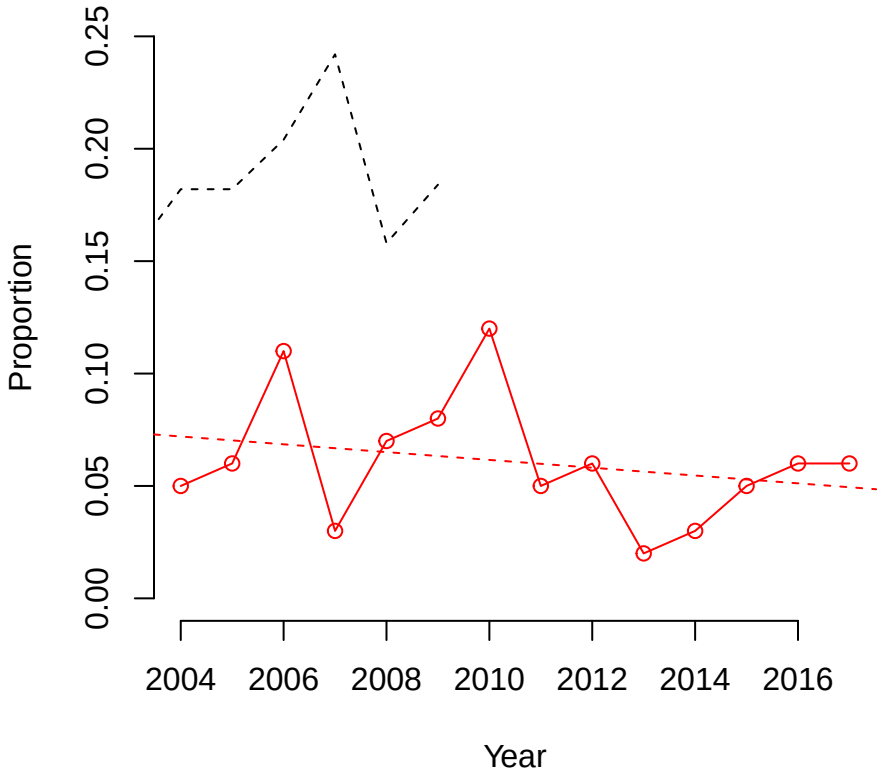

Figure 8: Not-in-calf rate by year

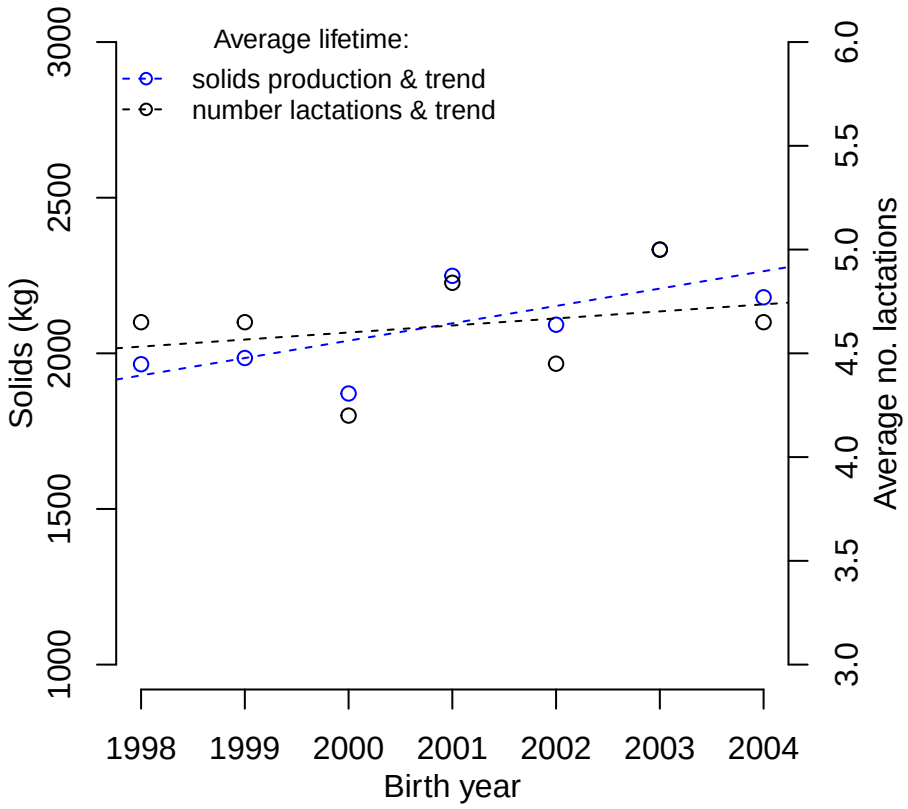

Figure 9: Average cow lifetime survival and production for cow birth cohorts that have no surviving members

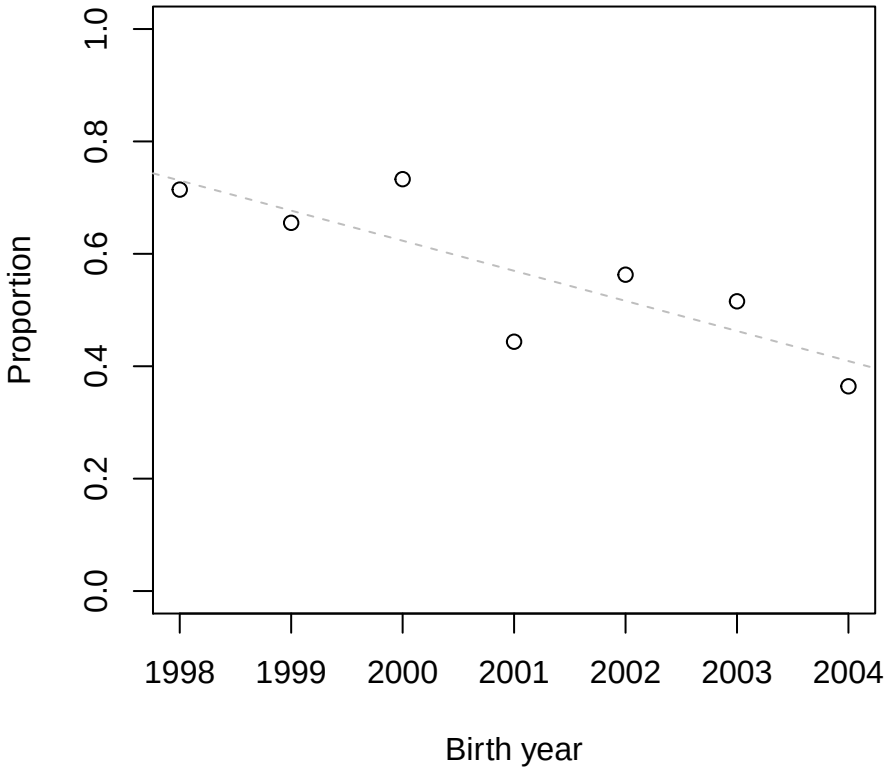

Figure 10: Average purebreed proportion of cow birth cohort by birth year

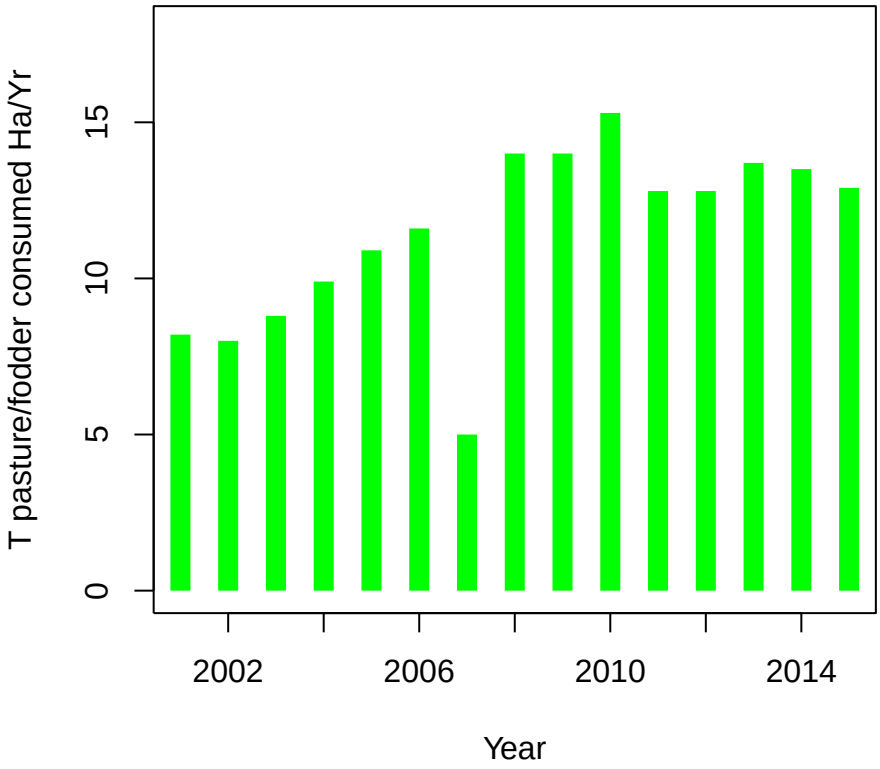

Figure 11: Tonnes of pasture dry matter consumed per hectare per cow per year

Cow-level financial benchmarks

Cow-level gross income, variable costs, gross margin and annual rate of change in gross margin for the years 2000 to 2015 (CPI adjusted) are presented in Figure 11. Cows decreased in average gross margin returned in the period 2000 to 2007 but have increased since 2007. This temporary reduction in average cow performance was predicted by simulation modelling and is primarily the result of having a mixed herd of cross-bred and pure-bred cows together. However, across the whole of the study period, the cows returned on average an extra $20 of gross margin every year after adjusting for inflation (2015 prices).

Hectare-level financial benchmarks

Hectare-level gross income, variable costs, gross margin and annual rate of change in gross margin for the years 2000 to 2015 (CPI adjusted) are presented in Figure 12. Each hectare of the milking platforms has returned an extra $110 in gross margin per year after adjusting for inflation (2015 prices). It is important to note that the hectare-level trend remained upwards during the period of declining per cow gross margin performance.

A focus on the change in gross margin trends is presented in Figure 13. The trend in hectare gross margin performance has been linear whilst the trend in cow performance has been curvilinear. The cow-level change in gross margin performance was characterised by a decrease in the early years of the cross-breeding program which plateaued as cross-breeds became the dominant cow in the herd and then increased as the genetic merit of the cross-breed herd improved through effective within-breed sire selection.

The different shapes of the hectare and cow gross margin trends is critical to understanding. The smaller cross-breed cow produces less than a large Friesian so they are expected to generate a smaller gross margin on a lactation basis. However, management predicted these changes and adapted to the reduced production by milking more cows and this maintained the upwards trend in per hectare gross margin performance.

The other critical aspect of understanding these different benchmark trends is that examining and

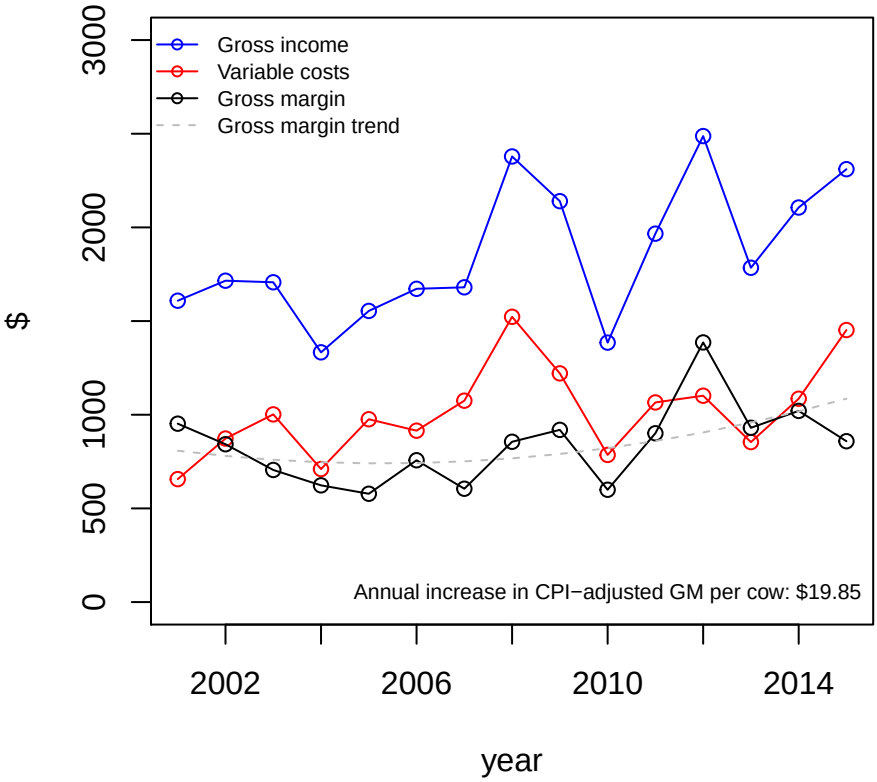

Figure 12: Cow-level gross income, variable cost and gross margin from 2000 to 2015 (CPI adjusted)

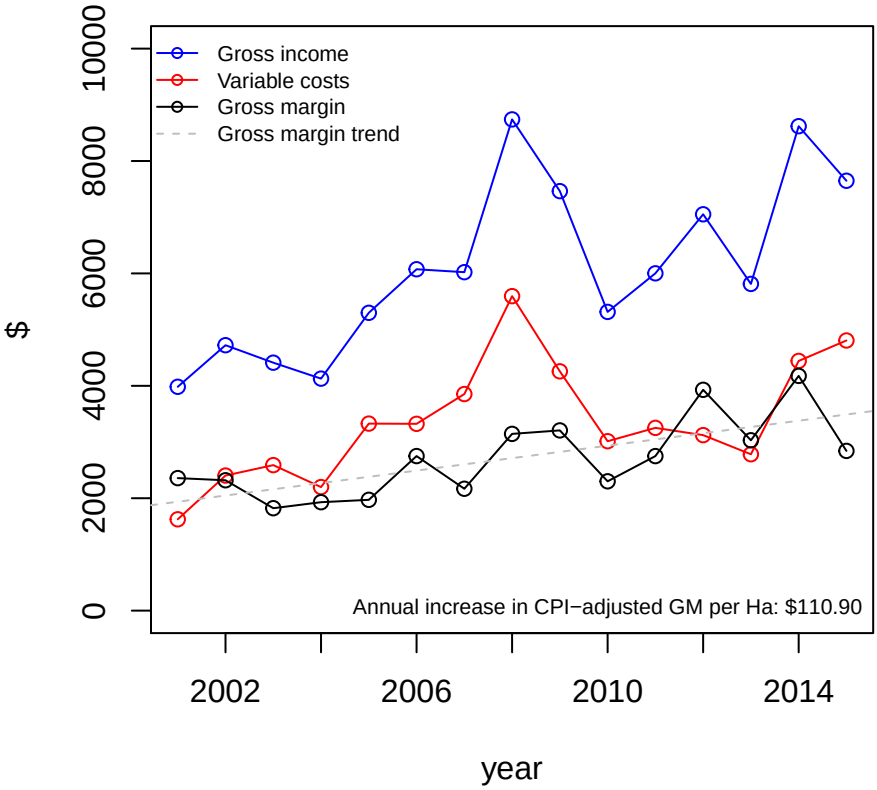

Figure 13: Hectare-level gross income, variable cost and gross margin from 2000 to 2015 (CPI adjusted)

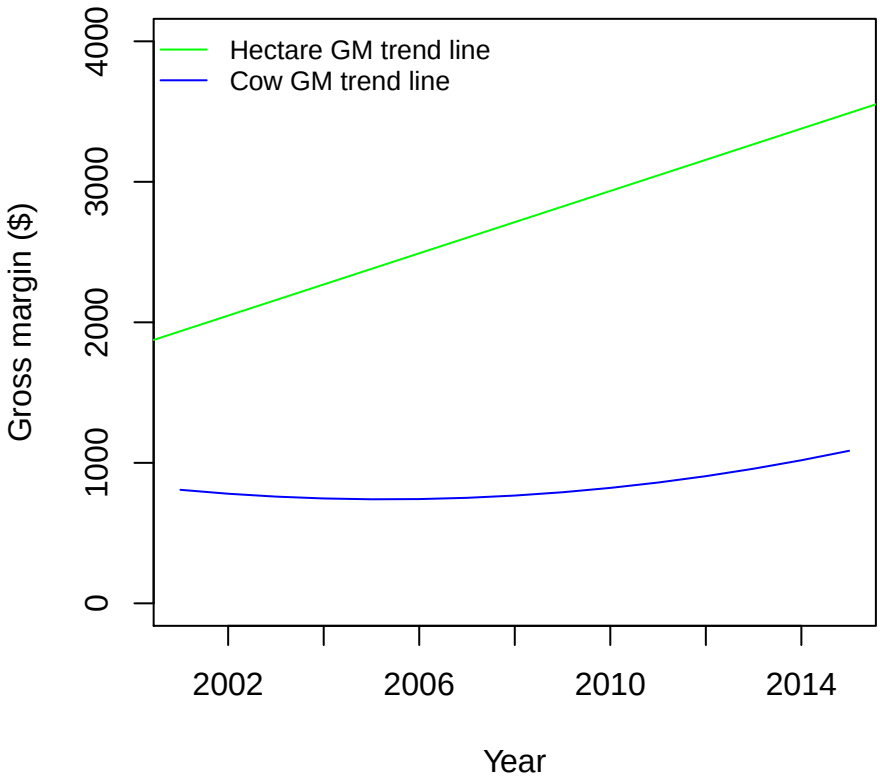

Figure 14: Cow and hectare trends in annual gross margin performance between 2000 and 2001

comparing cow performance on a lactation basis provides incomplete economic performance information. One way this farm harvested extra profit from the cross-breed herd is through the improvement in fertility. Whilst the cross-breed cows produce less than their Friesian herd mates on a lactation basis, they provided more lactation than the Friesians on average and therefore their lifetime milk production was similar to or exceeded that of the Friesian herd mate. This means the cross-breed cow, when viewed as an item of capital, had lower depreciation than the comparatively short-lived Friesian.

Discussion

The results from this analysis demonstrate that the farm has been and continues to be successful. It is productive and profitable and importantly, it increases profit each year. This study shows that the transition from a pure-bred herd to a cross-breed herd has been successful in this case. This analysis also highlights the problem of viewing any individual (intermediary) benchmark in isolation (except return on assets—the whole-farm benchmark).

A (solitary) focus on per-cow performance would have led to the conclusion that the farm had gone backwards in the first half of the 2000s and had only just managed to restore performance to historical levels of last century. The reason why the declining cow-level benchmarks did not mirror a decline in overall farm performance and profitability was because management adapted to the change—they adapted the farming system to maintain farm productivity and profitability gains. The primary managerial adaptation was to cater for the change from a large, high-producing cow to a smaller, lower-producing cow. This was achieved by increasing herd size and farm stocking rate to compensate for the decrease in cow size and individual cow production. This ensured there were enough mouths and herd demand to eat the pasture.

The improvement in fertility from converting the herd to cross-breeds subsequently resulted in an increase in cow lifetime production. Genetic-driven production gains in the cross-breed cow as a result of effective sire selection[5] subsequently drove an increase in cow lactation production that became apparent after

[5]These are true genetic gains and not simply heterosis—selecting good sires within breed is as important in a cross-bred

the herd conversion to cross-bred cows had stabilised around 2017. The longer productive life of the cross-breed cow results in reduced annual herd depreciation. The herd depreciates less each year because fewer need to be culled; they milk for more years. However, this benefit is not fully realised in this herd as management continues to produce surplus heifers. These heifers are bought into the herd and pregnant, lower-producing cows are sold into dairying (there is a long waiting list for these 'surplus' cows).

There is no evidence of significant net differences in feed conversion efficiency between the pure-bred herd and the cross-bred herd. Cows with higher productive capacity convert a higher proportion of their feed intake into milk during a lactation (if fed sufficient)—so called 'maintenance dilution'. The marginal efficiency of milk production curve is unknown—does it take as much feed and nutrients to increase milk production in a cow from 20L to 21L per day as it does to increase from 40L to 41L? No change in efficiency effects were apparent in the production or financial data suggesting that any impact in marginal efficiency or maintenance dilution at herd level is relatively minor.

The farmers commented that they like their seasonal system. This allows for single calving period, mating period, calf-rearing and allows for a period of dairy shutdown (this is essential because it lets people take overseas holidays). The lower milk price is offset by a lower cost of production but for management it was all the non-financial benefits of a seasonal calving system that were the driving force behind the decision to switch from pure-bred Friesian to a cross-bred herd. Converting to cross-breeds provided the cow fertility that they sought to allow them to maintain the single seasonally-calving farming system they prefer. Effective management meant this conversion to cross-bred cows did not come at an overall farm production or profitability penalty—if anything, it boosted both. All that changed were the cow-level benchmarks... and they don't appear to tell us much when viewed in isolation.

Conclusion

Benchmarking of farm performance to identify areas of under performance can be difficult. This is because a benchmark is essentially an average, and change in average performance provides minimal information about marginal change. Good management decisions are based around understanding if the last unit of input generated more income than cost. The marginal response can still be profitable in circumstances when the benchmark is increasing and then decreasing just as it can be unprofitable in circumstances when the benchmark increases and then decreases. Understanding this is important for benchmarks to be used to best effect.

Bbenchmarks are also mostly unsuitable for comparisons between farms because, almost certainly, there are system differences between farms that prevent direct comparison of measures. Benchmarks are best suited to comparison within farm over time.

Users of benchmarks need to understand how benchmarks are derived, how they relate to marginal profit and how the farm and farming system impact on individual benchmarks in order to use them effectively to contextualise performance.

herd as it is in a pure-bred herd

Appendix

Table 1: Consumer price index inflation adjustment estimates

Year	CPI
2001	1.44
2002	1.40
2003	1.36
2004	1.33
2005	1.29
2006	1.25
2007	1.22
2008	1.17
2009	1.15
2010	1.12
2011	1.09
2012	1.06
2013	1.03
2014	1.02
2015	1.00