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HERD HEALTH

A BLUEPRINT FOR DAIRY COWS

The right cow depends on your farming system

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Abstract

Pasture-based dairy farms need economically efficient herds. Herds of high-production capacity cows do not necessarily produce more milk than herds of modest-production capacity cows. Good grazing management can ameliorate differences in potential production capacity between cows at herd level. This ensures high pasture harvest and optimises land performance. One consequence is that some cow potential will remain unutilised. The cow genetic potential argument is open to misinterpretation without understanding the complete herd management explanation that follows.

Introduction

The traits used to identify individual 'superior' dairy cows—milk solids, fertility, survival etc.—do not necessarily identify superior pasture-based dairy herds. This is because of two limitations. First, total herd production is usually constrained by pasture feed supply, not cow capacity. How much of the limited feed is converted to milk solids is then a combined function of individual cow genetic potential and the number of cows (i.e. herd size and stocking rate). Second, cow production traits (e.g. protein production) identify animals capable of producing more or less, but they provide no information about the marginal efficiency of any extra production obtained. More milk may be produced from a fixed amount of feed by offering feed to cows who are not at or near their genetic maximum for milk production. These cows may be more efficient at converting pasture into milk solids than for cows at or near their physiological limit.

Effective pasture production and grazing management are core skills for managers of dairy farms based on pasture. Combine these with skill in supplementary feeding (fed primarily to optimise use of pasture and adjusted regularly on a case-by-case basis) then production potential differences between cows can be effectively managed out of play. It is skills in pasture and grazing management that the most successful dairy farmers of grazing herds possess that allows them place little weight on differences in productive capacity between cows and yet still achieve their goals.

The implication is that non-production cow traits will have greater impact on grazing farm profitability than cow production traits. In this regards, low cow fertility is the most pressing non-production trait of modern dairy cows on pasture. Cow fertility currently underperforms worldwide, and this poor fertility constrains management's ability to control calving with resultant change and spread to calving patterns and this exposes pasture-based dairy herds to increased seasonal risk.

An effective herd manager can use cows of modest production potential and obtain high pasture consumption, and achieve goals of profit, cash and wealth. In fact, it is easier to do this with a more modest producing cow. This cow typically comes with better fertility and has longer survival than her higher-producing counterpart. It is the cow that performs well over a long productive life that is the key to producing low-cost-of-production milk in pasture-based dairying. She is the cow to underpin pasture-based dairying worldwide.

Cow performance and herd performance

Cow-level differences in performance may not carry though to herd level. For example, before multi-trait selection become predominant, cow selection using solely production criteria provided cows with high milk production, but they were of lower fertility compared to the 'average' cow of the day. The mistake in reasoning is to then automatically assume that herds with higher cow milk production will also always have lower herd reproductive performance than an average herd. This was often found not to be the case. The main reason being these were mostly better fed herds and their cows produced more milk. These better fed cows responded with better fertility as well. The fallacy here exists because it did not consider the effect of good management—better managers get more things right than poorer managers. They tend to have both higher producing and more fertile herds.

This error is called the atomistic fallacy (*post hoc ergo proctor*). It is the making an incorrect inference about causality in groups based on observed differences between individuals. It is a well-recognised problem in epidemiology and economics. Atomistic fallacy reasoning is also confusing dairy farmers and advisers who routinely assume that any cow-level difference identified will automatically transfer to herd level. This problem is most common in pasture-based dairying *and especially with regard to cow production-related traits*.

Cow production

It is sensible to want more production from fewer resources; this is the basic economic challenge. Wanting more milk per cow seems logical as you require fewer cows to meet your milk production targets. However, in pasture-based dairying this can be the wrong way to look at the milk production challenge. It is not the number of cows that is the most limiting resource, it is the amount of pasture and (cheap) home-grown fodder that can be produced and consumed that is the most limiting constraint.

Land is the most valuable asset of a pasture-based dairy farm. In Australia, the selling price for dairy land is at least twice the value of the largest dairy herd that the land can carry, for both irrigated and dry-land farms. This has two implications: the most pressing economic driver must be to farm to optimise the performance of the fixed asset, land. And, as a consequence of this choice, the performance of individual cows may not be optimised (unmet cow potential). You need a bit of surplus cow capacity to remain unused to ensure you maximise income and profit from the land (producing up to the point where the cost of extra production equals extra income). The converse to this thinking is to farm to optimise cow performance. This implies high per-cow production (cows at or towards their genetic and physiological limit). In doing this, the land will not and cannot be optimised (there must be spare, uneaten feed at all times if cows are always to eat to maximum fill). Simply put, it is impossible to 'optimise' performance of land and cows together, and so you must choose your path. Choosing to optimise farm profitability requires a strong emphasis on land optimisation over cow optimisation. In reality, you are co-optimising your set of resources in order to maximise profit. For dairy farms based on pasture this inevitably means pushing land performance more than cow performance.

Farmers who choose to optimise land performance will inevitably increase stocking rate. This provides sufficient grazing pressure to ensure a high harvest of pasture and grazed crop (the other challenge is to grow sufficient pasture and forage from the land—something we will not address in this paper). As stocking rate increases, actual production differences between modern dairy cows (of different production potential) will decline. They eventually disappear as farm pasture consumption approaches the limits of land pasture production. This effect can be seen in Figure 1 which is a simplified model of two cow types over various stocking rates. One cow type can produce to the South African lactation average (427 Kg milk solids/year). The other cow type can produce 50 Kg of milk solids above this average. The farm can provide pasture for a maximum of pasture consumption of 14 tonnes dry matter per hectare per year. In this example, we allow all cows two tonnes dry matter of concentrate a year. The question is what happens as we increase stocking rate for each cow type?

Cow average production differences persists in this example until the stocking rate reaches 5.0 cows/Ha. However, total herd production equalises between the herd of low production capacity cows and high production capacity cows once the stocking rate was 4.5 cows/Ha or above in this example. The profitability of the two systems subsequently depends upon amounts of capital tied up in each herd alternative and any difference in herd annual maintenance (depreciation) costs.

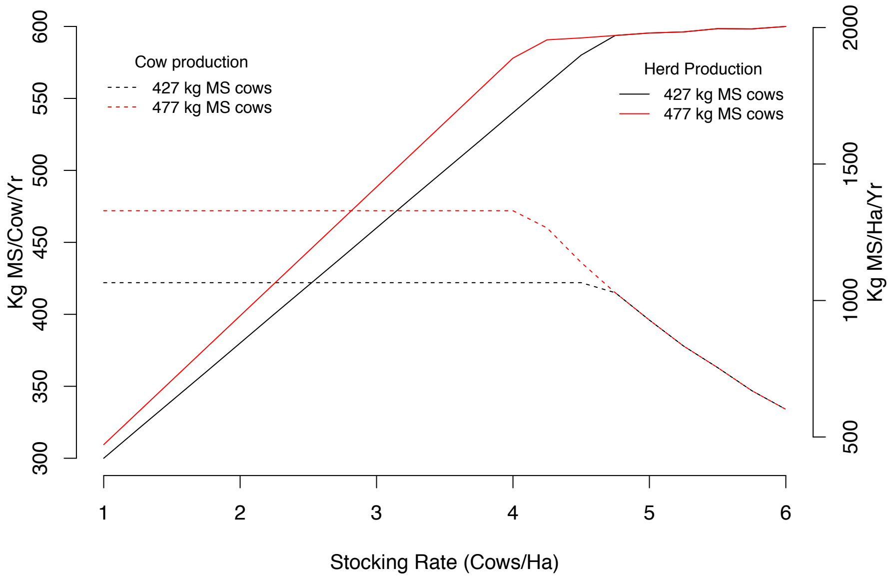

Figure 1: Individual cow and herd production performance for cows of two different productive capacity (but equal feed use efficiency) by stocking rate

Why? At low stocking rates, the cows are not constrained by feed supply and they are more able to meet their genetic potential, and this results in higher cow milk production occurring in the high-genetic merit herd. On the downside, pasture harvest efficiency (percentage of total potential pasture consumption that was achieved) is low at lower stocking rates. This effect is shown in Figure 2. At higher stocking rates, both low genetic merit and high genetic merit herds will maximise pasture harvest. Now the land is performing to an optimum. Note that a herd of high genetic merit cows for production will achieve maximal pasture harvest at a lower stocking rate than a herd with lower genetic merit for production (under the assumption both cow types graze equally efficiently—this may not be the case). This may be an advantage for some herds.

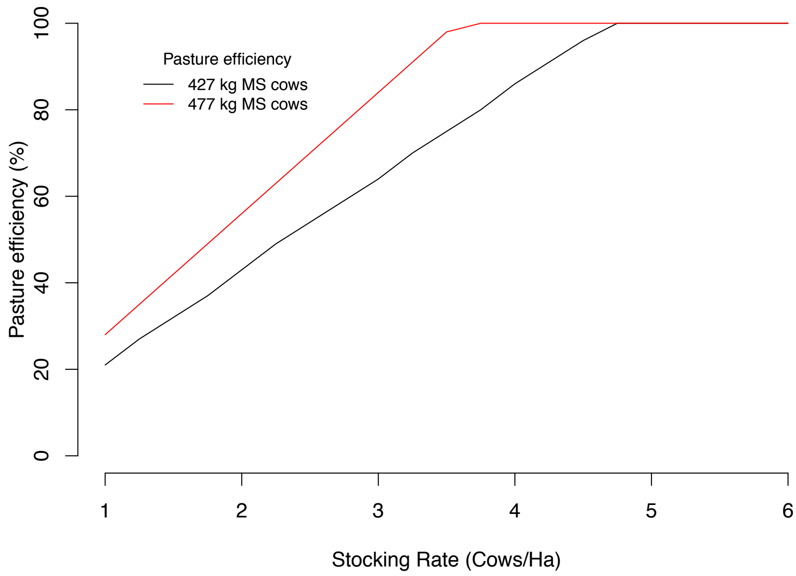

Figure 2: Pasture harvest efficiency (pasture consumed as a percentage of maximum production) by stocking rate for herds with cows of different productive capacity

This is not all the information required to best match cow to farming system (i.e. to stocking rate). Examples presented to date assume cows of different genetic merit to be equally efficient in their ability to convert feed to milk. It also assumes a constant feed efficiency to produce all milk—the same amount of feed is needed to make the first litre as for the last litre of the day, irrespective of how much milk the cow makes in a day. This violates the marginal response rule of economics which is presented in Figure 3.

Figure 3 shows the response of two theoretical machines (cows) to changing levels of one input (all other inputs held constant). For both machines, as inputs increase, we get more output, but that increasing inputs beyond a given level results in progressively less output from each extra unit of input. An example is a racing car that will consume more fuel to go from 199km/hr to 200 km/hr than it did to go from 99km/hr to 100 km/hr. This decline continues until the machines are overworked and more input result in a decline in output. Extending the racing car example, the fuel combustion becomes less efficient and less power is generated as more fuel is used and as a result the car goes slower. The plot also shows that two different machines may have inherent differences in efficiency (some machines provide more output than others for any given level of input).

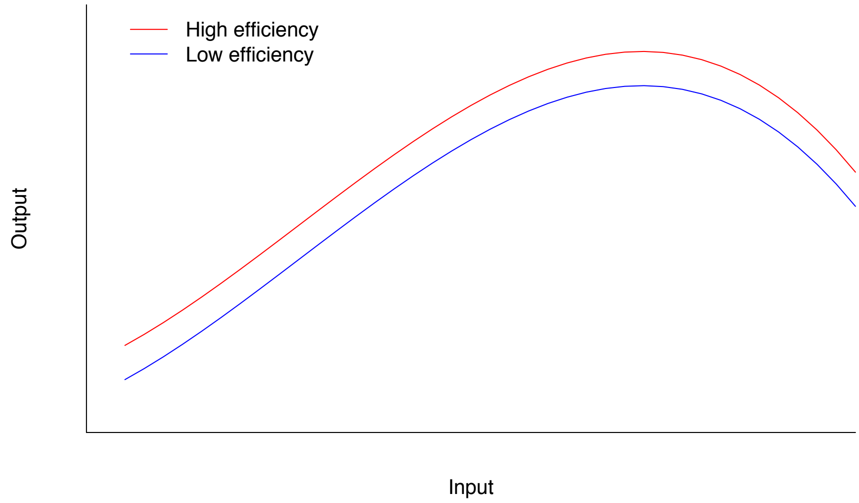

Figure 3: Marginal response curve for two systems across varying levels of one input (all other inputs held constant) and of differing basic efficiencies

The cow is like any other machine, she has a maximum performance limit (maximum feed intake). She will also have a tipping point. This is the level of feeding where she becomes increasingly inefficient at making extra milk. It is also the point where we need to ask ourselves where else could we have sent this extra feed and achieved greater return? This can be seen in **Figure 4** where instead of feeding more to a cow with already high milk production (left panel) the feed is diverted to a cow with lower production (right panel). This cow has greater marginal efficiency and we will see more of the extra feed converted to milk by feeding her instead of her high-producing counterpart.

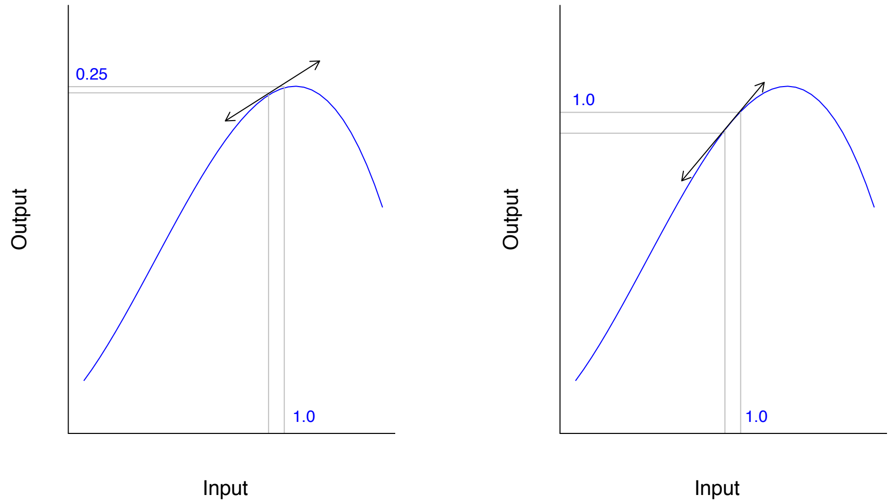

Figure 4: The effect of marginal response to feed in dairy cows. A farm may produce more milk by diverting feed from already high-producing cows (left panel) into more modest producing cows (right panel) who will use the marginal feed more efficiently (1.0 litre response versus 0.25 litre response to an extra 1.0 kg grain).

In the context of dairying, this all converts to asking *what combination of stocking rate, cow genetic capacity, supplementary feeding will give the most profit and percentage return to capital for the same inputs*? It is unlikely to always be simply choosing the option of more milk from fewer cows. Unfortunately, industry does not have information on marginal efficiency of genotypes across the feasible range of cow feed intakes. This lack of knowledge on marginal responses in agriculture is not confined to genetics. For example, can we expect the additional level and costs of inputs required to increase pasture production from 14 to 15 tonnes of dry matter per hectare to be the same as increasing from 19 to 20 tonnes? This is unlikely to be the case, and this is one of the key reasons why average benchmarks need to be interpreted carefully; they do not tell about the marginal response. Bigger or smaller may not always be better. Most financially successful farmers have most physical benchmarks in the middle of the range—they rarely, if ever, have a physical benchmark that leads the pack.

How can we practically assess cow marginal response to feeding? Fortunately, we have an (admittedly rough) way that we can estimate this at a herd level. We can sometimes get insight from estimating the milk production response to concentrates fed. There are many occasions where the necessary calculations cannot be done, but there are also times when we change supplement levels fed during reasonably steady state conditions (pasture allocations are constant, cows are at similar stages of lactation). When changes are modest to the amount of supplement fed (say, 1–3 kilograms per cow per day), we can estimate the marginal milk production response to these changed kilograms.

There is enough energy in most concentrate that if it were all consumed without wastage, all digested and all sent for immediate milk production to produce over 2 litres (150 grams milk solids). This never happens as there is wastage, inefficiency in digestion, some energy is diverted to other bodily functions and some goes into fat, etc. A long-standing (and wrong) rule of thumb in Australia is the average production response is 1.0 litre of milk (75 g MS) for each kilogram of concentrate fed. But perhaps this 'rule' guides us. If cow milk responses to a kilogram of concentrate added/removed is >1.0 litre (>75 g MS), then maybe the cows are on the profitable side of their marginal response curve. If <1.0 (<75 g MS) then cows may not be responding, or capable of responding profitably. If this is the case, we need to ask why not? What do we need to change to leverage that last kilogram of supplement? We also should probably ask the same question about profit response from kilogram of supplement fed preceding the one we have just estimated to be inefficient as well!

If the herd consistently responds to 1 Kg of 11–12 MJ ME/kg DM concentrate with more than 1.0 litre (75 g MS) of milk, then the herd is likely to be efficiently processing our marginal feed inputs. This herd should also still be able to graze efficiently (cows are hungry enough) and has desire to eat more. The cows should respond well to any extra supplement we may provide. When we have this situation, the feed conversion machine that is the herd is being marginally efficient. We can source extra feed (by growing more pasture or offering more supplement) with some confidence.

The effect of cow feed conversion inefficiency is shown in part in Figure 5. This is a variant of the herd model presented previously. In this case the high productive capacity cow requires 5% more feed than the low productive capacity cow to both exist and to produce milk. At low stocking rates sufficient pasture is still available for each cow type to produce to their genetic maximum. The high-producing, but less efficient cow still makes more milk than the low-producing cow. The interesting change happens when stocking rate increases beyond the point when each type of cow can obtain enough feed to produce to her potential. When feed is limiting on a per cow basis, the low-potential cow will paradoxically make more milk than the high-potential cow and (most importantly) the low-cow-potential herd will make more milk than the high-cow-potential herd. The problem with all this is that we usually don't know which genetic line is more efficient.

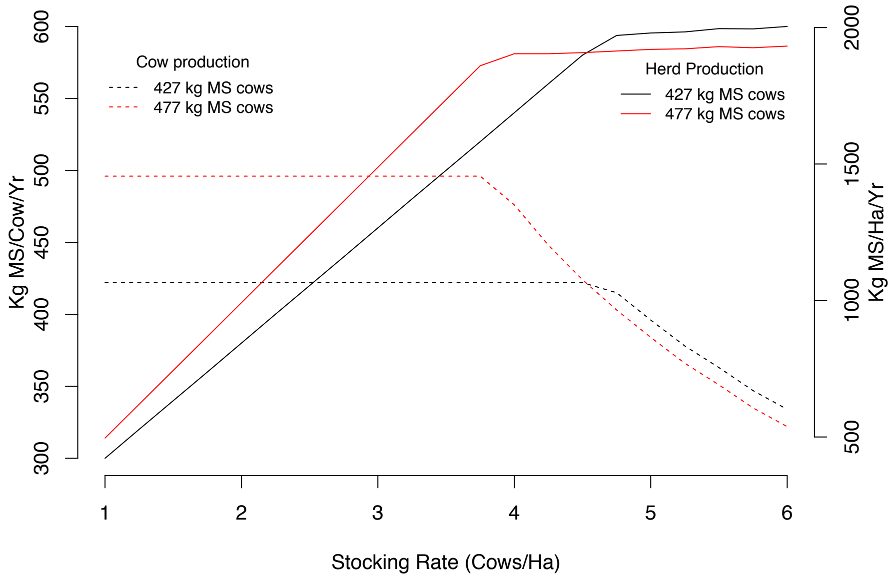

Figure 5: Individual cow and herd production performance for cows of two different productive capacity, with the high-productive capacity cow requiring 5% more feed for maintenance and production than the low-productive capacity cow, by stocking rate

We also cannot just keep adding cows to the system to make sure that they are all operating at an efficient point on their feed conversion curves. At some stocking rate or greater, the addition of another cow will result in only minor increase in the amount of pasture consumed. This means we end up purchasing almost all the feed required for this extra cow—typically at higher cost. The milk:supplement price ratio is rarely such that this is reliably profitable—especially when considering that 1.7–2.0 tonnes of dry matter are required for maintenance and pregnancy etc. So, we need to titrate the stocking rate to ensure that each additional cow has a sufficient mix of pasture and concentrate feed to provide for profitable production. Recognising this point for a farm is an ability that separates elite managers from others in the pasture-based dairy industry.

The key cow production messages for pasture-based dairying in summary are:

1. Production is primarily determined by how much pasture you grow and harvest. Profitability by how much it costs to grow pasture.
2. Cow production genetic merit is of lesser importance in pasture-based dairying. Herds of lower production merit cows can produce as much if not more milk than herds of higher production merit cows on pasture.
3. Stocking rate is the most important driver of pasture harvest. In general, a herd of modest production-merit cows at higher stocking rate will harvest more pasture more efficiently than a low-stocking rate herd of higher production-merit cows.

4. Aim to stock the farm to consume all the pasture you can feasibly grow. You will need to strategically feed supplement to achieve this. Make sure that each additional cow does not require you to buy most of her feed—this means there must be sufficient unharvested pasture available for her to contribute to the team. Target the right mix of cow type and stocking rate such that the herd consumes all pasture, cows respond to change in supplement fed (>1 litre/kg) yet meet body condition and fertility targets.
5. Focus on growing more pasture/forage. It is easier, more reliable and much more economical to increase farm milk production and profit this way than by selecting for higher-producing cows

Most modern dairy herds have unmet cow production potential already—so why select for more production if you already have unrealised potential in your cows? Pasture-based dairy herds provide the lowest cost-of-production milk to the global market. You compete to supply milk with milk from other production systems and you also compete against other pasture-based dairy farms, regions and nations. A sound business strategy is to target production of profitable but low-cost milk. This milk is always competitive in the market.

Cow reproduction

Poor cow fertility is the most important constraint in modern pasture-based dairy farming. The impacts of reduced cow fertility include the immediate and costly premature loss of non-pregnant cows from milking herds and the less obvious, but perhaps even more sinister impact this has on the farming system.

Every time a cow dies or is culled as not fit for purpose (e.g. not pregnant) we incur a loss. Whilst we may receive some income from the sale of the culled cow, this is less than the value of the animal if she was retained as a milking cow (i.e. she was pregnant). It is also usually less than the cost we incurred to breed and rear the animal or the cost of purchasing a point-of-calving pregnant heifer. This difference between the purchase/rearing cost and the cull-cow salvage cost is the loss we incur on the day of sale. In Australia, at the time of writing, a point-of-calving heifer has a market price of $2,500 and most cull dairy cows return $750. This means each cull crystallises a loss of around $1,750 to the business. Often, we only see the cull-cow cheque of $750 and we think of culls more as part of our ‘income’, but it is better business sense to view culls as an ‘expense’ of selling an asset that if it worked is worth $2,500 for $750. The sale of a once-prime asset is depreciation and this expense can be amortised across the life of the asset. If the cow provides only 1 lactation, then the annual depreciation is $1,750. If the cow provided 5 lactations, then the annual depreciation is $350. It is far easier to make profit if we can minimise the annual depreciation cost of the herd. This means cull the minimum number of cows possible and cull cows after they have had long productive lives.

The impact of cow fertility on cull-cow and herd annual depreciation is presented in Table 1. Many Australian dairy herds endure 25% replacement rates. A reduction to a 17% replacement rate would reduce herd annual depreciation cost by almost $150 per cow per year.

Table 1: Effect of fertility on cow survival and herd depreciation cost

Average number cow lactations	Herd annual replacement rate (%)	Herd annual depreciation cost per milking cow ($AUD)
1	100	1,750
2	50	875
3	33	583
4	25	438
5	20	350
6	17	292
7	14	250
8	13	219

A more fertile herd means a lower annual replacement rate. For dairy herds that breed their own replacements this brings time and cost savings because fewer cows need to be reared as replacements and become pregnant to artificial insemination to provide the required number of replacements. Also, in general, a more fertile herd has fewer cows requiring costly reproductive interventions (such as treatment for anoestrus) and they have less need for expensive whole-herd synchrony programs. Less land and fewer resources are needed to raise the smaller batch of replacements and these time, work and cost benefits add to the profitability and enjoyment of dairy farming. These sum of these savings is the reduction in depreciation obtained; it is real. A case study presented at the end of this paper will showcase these benefits.

The effect that low fertility has on driving change to the pasture-based farming system is more insidious. Done well, pasture-based farming is a low-input, low-cost, low-productivity, yet highly profitable dairy farming system. This system predominates in New Zealand where the cost of grain supplement is prohibitive (and because it just rains in New Zealand…). Pasture-based dairying also remains the predominant system in Australia. Most pasture-based dairy regions traditionally used a single, seasonal-calving system as this provided the best fit between regional pasture growth and herd feed demand. This system maximised the amount of milk produced from rain-fed pasture which in turn minimised the cost of production. Low cost milk from these systems and these regions is competitive on the international market.

As cow fertility has declined it has become increasingly harder for farmers to maintain tight seasonal calving systems. Too many cows remain empty at the end of mating and too few cows get in calf early in the mating season to calve down and hit peak lactation at or just before peak pasture production. This, combined with the Australian processors paying extra for out-of-season milk (in order to flatten milk intakes into factories), has encouraged farmers to move to split-calving, batch calving and even all-year-round calving systems[1]. This has resulted in an increase in the average milk price received (thanks to more out-of-season milk) but has also resulted in an increase to the cost of production. The effect on long term profitability of farms has been variable. The competitiveness of milk produced under this new system on the international market has reduced.

More tellingly, in Australia, where the seasons are markedly more capricious than in New Zealand (droughts are longer and more common), the change to the time when most cows calve is increasing the risk profile of dairy farms. An analysis of seasonal rainfall for an important non-irrigation pasture-based dairy region (West Gippsland, Victoria, Australia) is presented in Table 2. This region was traditionally a late-winter to spring calving dairy area. This was because of the high reliability of the spring rainfall and to avoid having to calve cows in (often) wet winters. With the decline in cow fertility, many farmers now have split calving herds. This means the addition of a late summer to early autumn calving group. In normal seasons this can work well as cows calve into good autumn pasture and have green feed through to the end of lactation. The problem is that normal or sufficient autumns occur only around half the time. This contrasts with spring which is normal or sufficient in four out of five years on average. A failed autumn is typically associated with drought. The absence of autumn rain and the typically preceding dry summer means farms remain bare well into winter; cows calve onto bare dirt and have no green feed in the critical first 100 days of lactation. This compromises performance, requires purchase of fodder as well as concentrates and results in lower milk production and higher cost of production. These insidious changes reduce the competitiveness of the Australian industry.

Table 2: Historical rainfall for Warragul, Victoria, Australia (109 years of data)

Season	Season average rainfall (mm)	% of years with > 225 mm per season (75 mm/month)
Autumn	244	53
Winter	268	74
Spring	289	80
Summer	194	31

A case study of the consistently most profitable Australian dairy farms (*InCalf Farm case studies (2017)*: see https://www.dairyaustralia.com.au/incalfbooks) identified that the seasonally-calving pasture-based study herds did not change their farming system as an adjustment to cater for the effects of a generalised reduction in cow fertility. Many of these herds had less than satisfactory herd reproductive performance, but management chose to

[1] The higher price paid for out-of-season milk is not a premium, it merely reflects the higher cost of producing out-of-season milk. For most, this is less profitable milk

maintain seasonal calving and they had to increase their supply of replacements in order to service their high empty rates. They chose to do this rather than change to split calving. This policy increased herd depreciation and mating costs, but these farms remained consistently more profitable than their peers that chose to go to split calving to avoid heavy annual culling. These extra costs were more than outweighed by the increased profitability of their seasonal milk production when compared to herds that swapped to split calving systems.

Cost savings come with improved fertility. There is lower depreciation, less time, effort and expense required for herd mating and it becomes easier to maintain calving patterns. These factors allow for more pasture to be consumed by early-mid lactation cows. Combined, these factors reduce the cost of production and this helps to maintain the competitive advantage of the low-cost pasture-based dairying system. Contrast this to selection for extra cow production. For this to be realised, extra feed must be provided to the herd. In general, the marginal feed (extra supplement, more nitrogen-boosted pasture) has moderate to high marginal cost. Selecting for extra cow production without also increasing farm pasture production capacity will result in an increase to cost of production. Improved fertility can only decrease cost of production. For these reasons, fertility is the most important cow trait to chase for most farms.

The ideal cow for pasture-based dairying

In some way the question of defining the ideal cow for pasture-based dairy farming has the wrong focus, because pasture-based dairying is all about herd performance. You require a herd of cows to graze pasture effectively and it is herd performance that determines efficiency and profitability of converting feed (home-grown and purchased) to milk. The costs of maintaining (or growing) a herd are significant and this influences cost of production and profitability. We start by defining what we ideally want our herd to do.

The most important feature required in a herd of grazing cows is ability to graze effectively. This means cows get stuck in when they first enter the (lush) paddock and all continue to graze hard as pasture residuals reduce. If herds regularly graze the pasture down to the desired post-grazing residual, farms can optimise pasture harvest and over time this also encourages maximum pasture regrowth.

No-one gets paid directly for the tonnes of pasture (or any other feed) consumed, so the cows need to produce milk solids from this feed, and this makes feed conversion efficiency important. It is better to have 520 cows averaging 25 litres of milk per cow per day from the feed resource than 480 cows averaging 26.5 litres of milk per cow per day. We almost never know marginal feed efficiency but at times we can estimate response to change in supplement fed. If we have herds that regularly produce >1 litre milk per Kg of 12 MJ ME supplement fed, we have efficient converters and our supplement feeding is supporting pasture management.

If we can combine this feature in cows that maintain body condition score within desired range and are fertile (i.e. they can cope with the challenge of grazing in early lactation) then we have cows that can be long-term contributors to the farm. Fertility is a critical feature of pasture-based dairying. Any farm whose plan is to best match herd feed demand to seasonal pasture production requires a fertile herd to enact that plan.

The fertility effect is twofold: a fertile herd requires less expense in herd mating programs and less expenditure on producing and rearing replacements (need fewer of them) and a fertile herd allows calving patterns to be maintained allowing best use of pasture.

Converting these herd-level features to cow level we want:

1. Efficient grazing cows
2. Good feed converters
3. Fertile cows

These cows tend to be of moderate body size and moderate producers. The crossbred is the leading example.

Case studies

Two case studies are presented. One showcases how effective herd management will offset most cow-level production differences. This is by following the cow-level and herd-level performance of a herd that transitioned from pure-bred Holstein-Friesian to cross-bred cows. The second case study shows the importance of fertility in seasonal-calving, pasture-based dairying. The capacity of a fertile herd to ensure herd feed demand best matches pasture growth and the minimisation of annual herd depreciation costs are presented.

Malmo & van Wees

Dairy farms owned by veterinarian Dr Jakob Malmo in the Macalister Irrigation District of Victoria, Australia have detailed farm physical and financial data extending back for more than 20 years. One farm, managed by Hans van Wees, converted from Holstein-Friesian cows to cross-breed cows around 10 years ago whilst maintaining stable management, single (spring) calving and the same pasture-based feeding system across the transition. The two-breed cross-breeding program began in 1998 with the introduction of Jersey with the first cross-breeds entered the milking herd in 2000. A three-breed program began in 2005 with the introduction of red-breed genetics and the herd composition has not yet fully stabilised to a three-breed cross at the time of analysis; a few pure-bred Friesian cows remain. The breed makeup of the herd is presented in Figure 6.

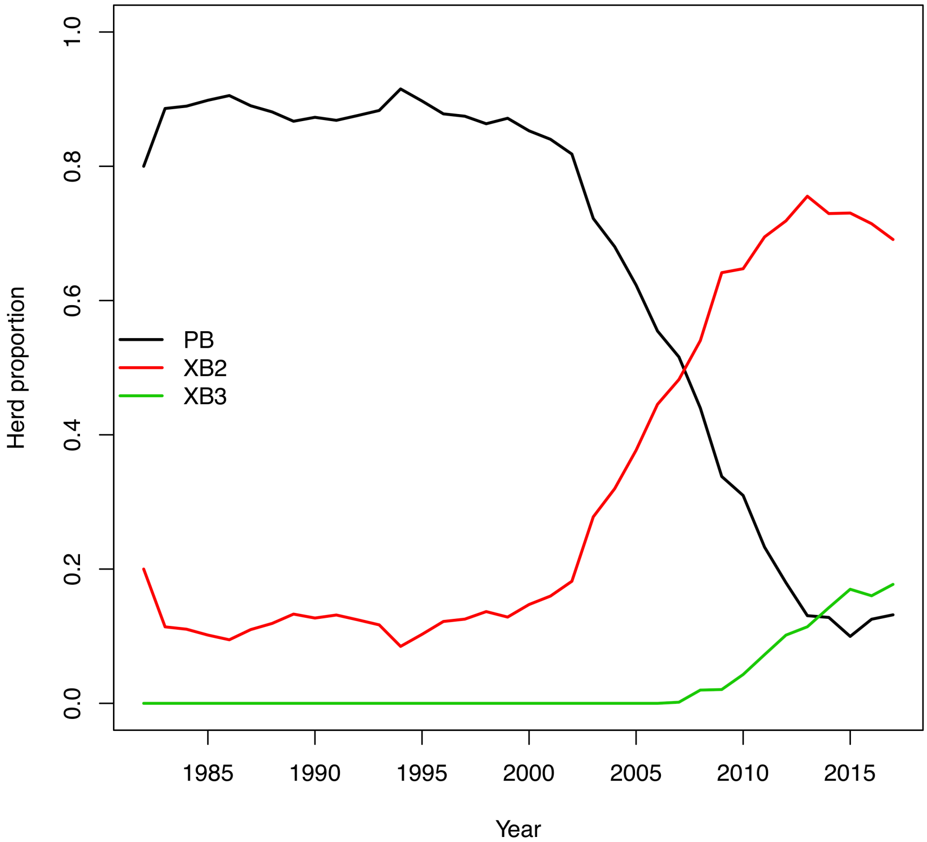

Figure 6: Herd breed composition by year for Malmo & van Wees

The farm has always been pasture-based with single seasonal-calving (spring). Grain feeding is used to supplement pasture with average annual grain intakes of 1.7 tonnes per cow per year (a minimum of 1 tonne is fed per cow per year). Average pasture/forage consumption is 3.5 tonnes per cow per year. The constancy in the calving pattern and production system presents ideal data for examining impact of breed change on per-cow and per-hectare physical and financial benchmarks and on overall farm financial performance.

The stocking rate history is presented in Figure 7. There was an increase in stocking rate of around 1.0 cow/Ha between 2000 until 2007. This was the period when much of the herd became crossbreeds. Note the gradual increase in stocking rate as the farm moved towards a smaller and less productive cow.

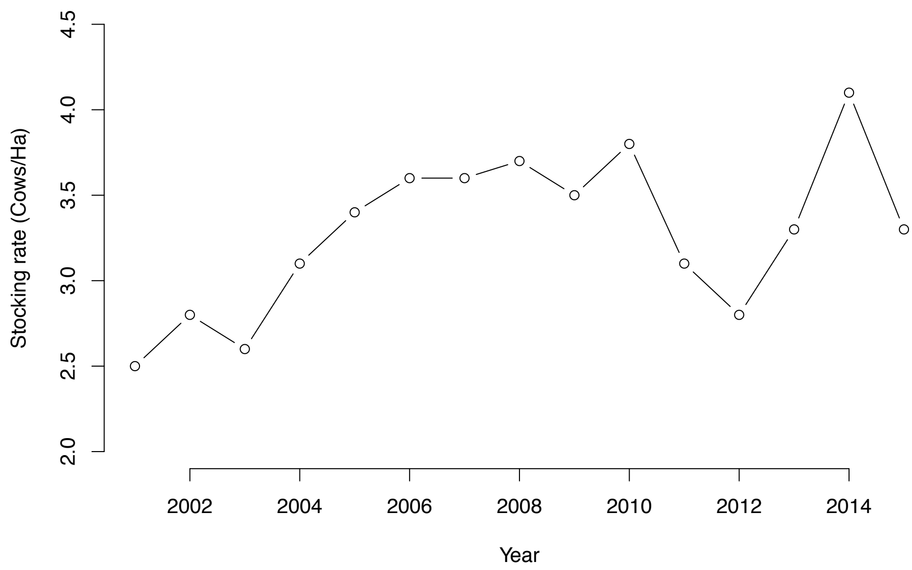

Figure 7: Stocking rate (cows/Ha) changes across time for Malmo & van Wees

Average cow production continued to increase across the transition to cross-breed cows. This is a reflection both of the high quality management and the continued use of good genetics within each breed. Perhaps the rate of increase in average cow milk production was slowed by changing to crossbreeds; we don't know.

The average amount of milk harvested per hectare has also risen across the period. In fact, it has increased at a faster rate than the increase in cow average production. See Figure 8. Management adapted to the smaller cow by slightly increasing cow numbers. The cross-bred herd was more efficient at grazing and at least as efficient at converting feed to milk as the original pure-bred herd.

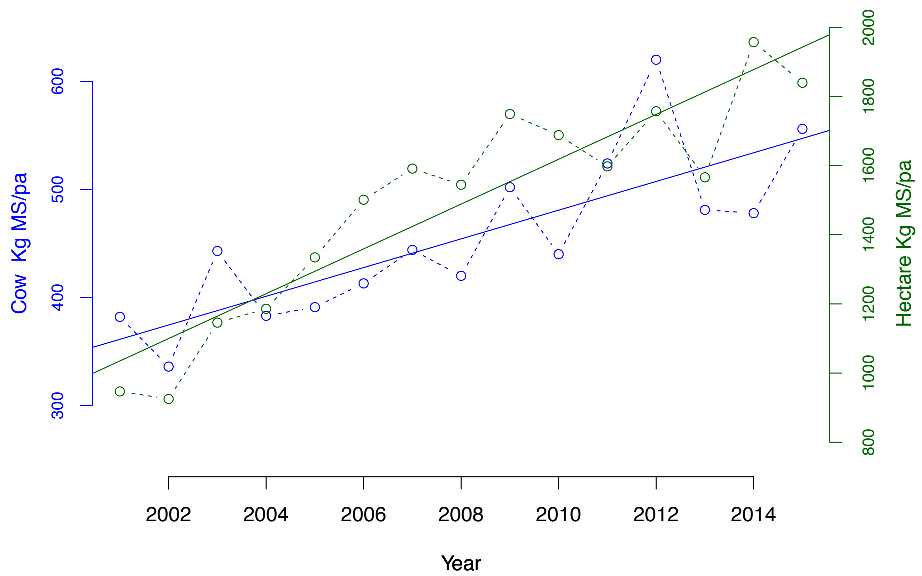

Figure 8: Average cow and hectare annual production (Kg milk solids) with trend lines by year for Malmo & van Wees

Annual average production comparison between the original pure-bred cow and the new cross-bred cow tells only part of the story. The lifetime average cow production comparison provides insight into depreciation. This is presented in Figure 9. Here we can see the average lactation production per year and the total average lifetime production for a cow that first enters the herd in the year (note we have limited data because many cows who first entered the herd after 2006 still remain in the herd—their lifetime production is not complete). We can see that both average annual production and average lifetime production trends are upwards but that the trend in average lifetime production trend is greater than for annual production. Simply put, the farm is getting more lactations and more milk out of the new cross-bred cow than the old pure-bred cow.

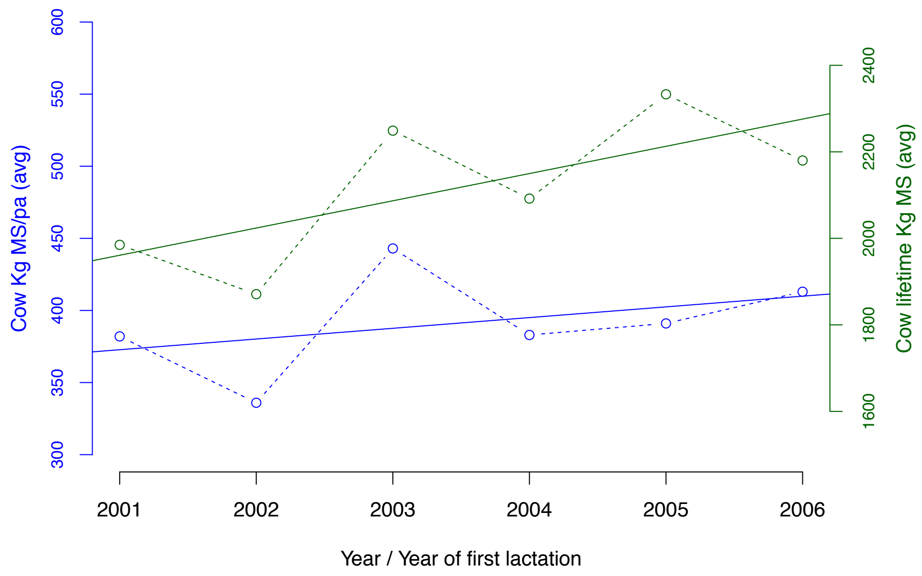

Figure 9: Cow average annual production (Kg milk solids) by year and average cow lifetime production by year of first lactation with trend lines for Malmo & van Wees

The increasing average lifetime production trend has a large fertility component. This is shown in Figure 10. Whilst the farm still experiences the frustrating industry-level decline in six-week in-calf rates, the decline in this herd is slow. Importantly, the decline in empty cow rate has been more rapid and this is contributing to longer cow survival and greater lifetime production. Fertility remains an area of focus and the farm has chosen to continue to over-produce replacements. Extra replacements allow selective culling of pregnant dairy cows. These are sold at a premium to other farmers in the district (there is a waiting list). Note that I did advise the farm to only produce enough replacements and to follow a short artificial insemination period with (natural) beef bull mating as is needed and to stop unrequired premature culling when I completed this analysis. I'm not sure if they will be changing their current approach (maybe they will change their consultant).

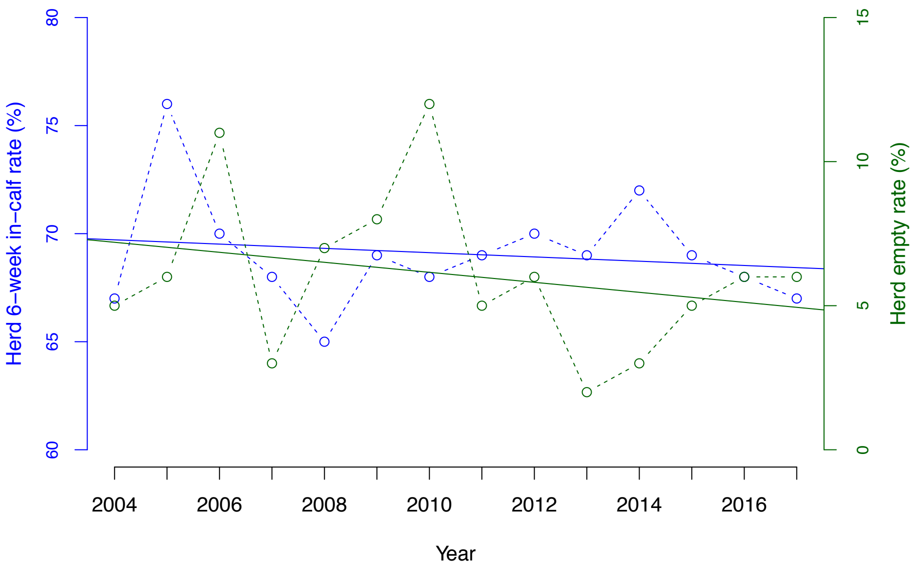

Figure 10: Herd six-week pregnancy and end-of-mating non-pregnancy rates by year and trend lines for Malmo & van Wees

The economic performance trends of the farm are presented in Figure 11. Here, the average annual gross margin per cow and per hectare are presented. The trend line differences tell the story. Whilst per cow gross margin trends were constant (perhaps even reduced) in the early years of the transition, they soon began increasing. During this time the trend in per hectare gross margin performance was continuously upwards! Farm profit tended to increase each year. If total herd capital was unchanged, increased herd gross margin and reduced farm overheads provides increased profit and increased return on capital. Some herd capital loss may have occurred by changing from (higher value) pure-bred cows to lower value cross-bred cows, but both Jakob and Hans have no plans to exit dairying in the foreseeable future, so any loss of herd book capital value was not a consideration in their decision to change. Management effectively offset any perceived disadvantages of going to a smaller, less-productive cow by increasing herd size. Management also manoeuvred itself to a position where they were able reap the benefits from converting to a herd of efficient, fertile and effective grazing cows. This farm is one of few farms that remain in the traditionally single-calving (spring) dairy farming district that shuts down the dairy in winter. This is when the farm owner and farm manager take their annual overseas holidays.

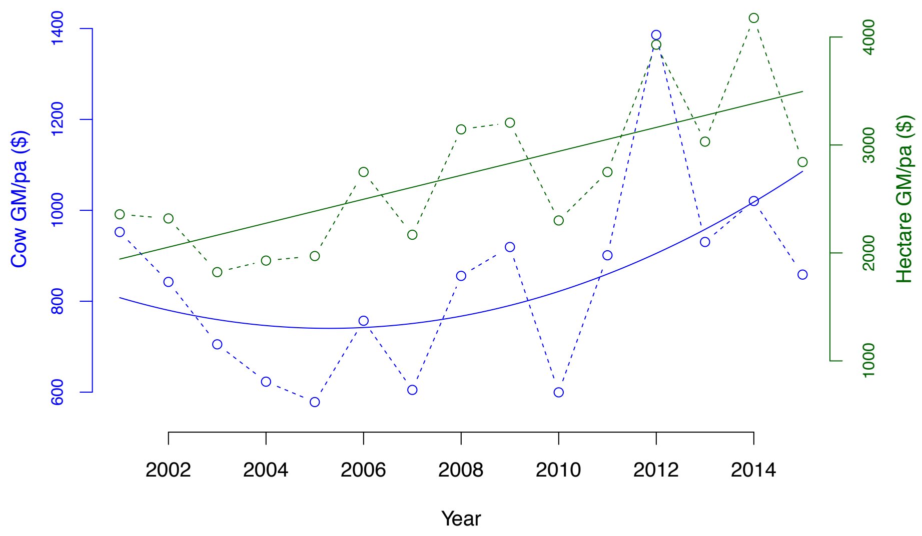

Figure 11: Cow versus hectare annual gross margin by year and trend for Malmo & van Wees

AgCap - Tasmania

This case study is of a farm once held by an investment fund with a suite of dairy farms. This analysis relates to one farm in the portfolio that is based in northern Tasmania. The farm milks 810 spring-calving crossbreed cows on 240 hectares (which includes 190 hectares of irrigation). Pasture growth rates are highest in spring but remain high in summer on irrigation.

The farm objective was to have a simple and profitable pasture-based system. This was achieved through a single spring calving. Management has observed workers to be more efficient and work flows are simpler when people focus on a single primary task e.g. calving or mating. The farm is stocked at 3.5 cows/Ha (4.2 cows irrigated Ha). The production target is >480 Kg milk solids per cow per year. This is >1,600 Kg MS/Ha. The farm performance in the 2014–15 season is presented in Table 3.

Table 3: AgCap 2014–15 farm physical and financial performance

Item	Performance
Herd size	810
Milk production (kg MS/Year)	480 Kg cow; 1,620 Kg Ha
Pasture consumption (T DM/year)	3.2 T cow; 10.8 T Ha
Breed	3-way cross (Genomic)

Calving	Single (Sept)
Pasture profile and growth pattern	Irrigated (Spr/Sum/Aut/Low Wint)
Duration AI	3 weels
Duration bull mating	5–7 weeks
Duration mating	8–10 weeks
6-week in-calf rate	80.9%
End-of-mating not-in- calf rate	12.5%
3-week submission rate	100%
First service conception rate	62.8%
% of herd bred as replacements	22%
Reproductive culling	All not-in-calf cows
Heifers mated to AI	Yes
Heifers calve before the cows	1–2 days before cows
Profit as ROA %	6.00%
Profit as $/kg MS	$1.24
Cost of production	$5.28

The key to meeting farm objectives is effective reproduction. Management says *good reproductive performance is a key to a simple and profitable farming system. It assists us in maintaining our simple system*. The targets of the dairy system are:

1. **An average of 6 lactations per cow**. This supports a low replacement rate (<20%) and costs associated with replacements are reduced e.g. AI, agistment, heifer rearing etc.
2. **Maintain a compact calving pattern.** The herd calve within nine weeks. This best matches herd feed demand to pasture supply and allows long recovery time from calving to mating .
3. **Maximises cow lactation length.** A tight and early calving allows the herd to be dried off (the dairy shuts down over the winter). Cows that calve early produce more milk and are more profitable than late calvers. The farm aims to have 50% of the herd calved by the 16th day of calving.
4. **Simplified herd management**. A tight and short calving pattern means that calving of cows, transition cow feeding, and calf rearing is managed more consistently, if more intensely, than spread calving. The replacement calves are of a similar age and can be reared together as a single group. This also makes mating short and

focused. It is also separated from calving. Workers can focus on one main task at a time.

The reproductive program was managed precisely. An intensive three-week AI period was followed by a short bull mating. This brought a few weeks of respite for the cows and the workers between the end of calving and the start of joining. The target is for at least 90% of the herd to be calved more than 60 days before the start of mating (and at least 80% of the herd calved more than 80 days). Management chooses to do no routine reproductive examinations and only minimal post calving health checks and there is no pre-mating heat detection. These are deliberate decisions aimed at minimising work load for staff before the intense activity of mating starts. A synchrony program using prostaglandin is used to maximise the number of insemination in the first week of mating. During mating the whole farm team focus is on heat detection. Any cow that fails to get pregnant during mating is culled at the end of lactation.

Heifer replacements are synchronised using a fixed time AI program. This single day of AI is followed by bulls running with the heifers. The replacement target is to provide 22% replacements available as pregnant heifers to ensure that 20% replacements can enter the herd each year. This is sufficient to meet requirements and maintain herd size and calving pattern. This is only possible because the herd empty rate is low!

The three way crossbreeding program capitalises on hybrid vigour. Cows have longevity, a mature body weight of 480 Kgs, they are capable of producing 480 Kgs of milk solids, are highly fertile and need minimal assistance at calving. In economic terms these cow-level features ensure:

1. **Cow depreciation is minimised.** The annual depreciation cost per cow is calculated from the following: point-of-calving heifer replacement value of $2,500, cull-cow value of $750 and an average of six lactations per cow. This equates to around $290 per cow per year. The value of extending the number of lactations from 5 to 6 equates to a reduction in herd depreciation of $60 a cow a year.
2. **Herd replacement costs are minimised**. Reducing replacement rate from 20% (an average of 5 lactations per year) to 17% reduces cow annual replacement cost. Using $2,500 as the cost to buy or to rear a pregnant replacement heifer at point of calving, a herd requiring 20% replacements a year accrues an annual cost per cow of $500. Reducing the required replacement rate to 17% will reduce the annual replacement cost per cow to $425 (a saving of $75 a cow per year).

Combined, the effect of reduced cow depreciation and reduced herd rearing costs from extending the average number of lactations per cow from 5 to 6 is $135 a cow a year; a real saving. Importantly, it is all profit. A herd of 5-lactation average cows would need to produce 525 Kg milk solids per cow per year in order to match the annual profit performance of a herd of 6-lactation average cows producing 480 Kg milk solids per year at a milk price of $6.00 Kg milk solids and marginal cost of production $3.00 Kg milk solids.

Case study summary

The driver of performance on both farms was high reproductive efficiency. It was the desire for improved herd reproductive performance that underpinned Jakob and Hans' move to crossbreeding. The investment fund management understood that single spring calving was the key to low cost milk production in Tasmania and this demanded a fertile herd. Both farms had the necessary managerial skill to operate lower-producing cross-breed cows and maintain—even improve—farm production and profit performance. Both farms are profitable, resilient and stable. If only we had more like them.