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PROGRAMME

Genetic Gain Opportunities

A Trans-Tasman Comparison

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Contents:

1. Executive Summary

The story of the herd improvement industry in New Zealand is the story of a long history of great innovation, on a scale not replicated anywhere else. A complex industry of science, human resources and innovation, dairy farmers wherever you go are a resourceful bunch. They are plying their trade across many facets such as animal science, animal welfare, human resources, soil science, engineering, finance just to name a few. Priorities over different areas of the farming business shift over time depicted by financial pressures, available resources, environmental pressures and in more recent times animal and environmental practices which are being called into question. The purpose of this project is to try and dig deeper into some of the conversations I come across every day during the course of my work on Tasmanian dairy farms. What is the difference between New Zealand and Tasmania? With increased reliance on grain inputs in Australia, how does New Zealand produce what they do on just grass? "They have better grass" "It just grows better over there", "Its just different" "it's a more even growing season". I wanted to find out more about these off the cuff comments, and see just how different the two industries are, from a climatic and environmental point of view, and at the core of the dairy business, the dairy herd.

Comparing Tasmania to the West Coast, Tasman, Marlborough region, on the same latitude line, my research suggested the two areas are very similar in climate, annual rainfall volumes and temperatures, and should have reasonably similar opportunities to grow good quality grass. Both have similar numbers of herds, and herd sizes. Tasmania features slightly higher in per cow production, but has narrower margins. Both regions have access to good cow genetics from around the world.

Singling out herd improvement – one of the biggest drivers of New Zealand dairy production gains over time, I carried out a survey of 37 dairy farmers in Tasmania to find out what is influencing the breeding, and how they are reacting to the operating environment in Tasmania. The survey population was a mixture of farm sizes and breed of cow. I looked at the answers and attempted to seek out any correlations.

The stand out opportunity is the way dairy genetics are managed. The lack of herd testing uptake is evident in Tasmanian herds when compared to their New Zealand counterparts, not only that, those that do herd test don't have easy access to software that makes cow selection on performance simple and accurate. As a direct result of the small numbers of farmers herd testing, Datagene, Australia's dairy genetics evaluation body has placed an increased reliance on predicting genetic merit through DNA testing, as opposed to herd test data which would be the case in New Zealand. Yes, accelerating the opportunity of genetic gain by not having to wait considerable time for bulls daughters to hit the dairy herd for proving, but placing large weighting on a system which is less reliable than that of daughter proving data.

My findings suggest there needs to be better education and more information from industry bodies around the financial benefits of herd testing, more so the implications of not herd testing. Tight margins and cost cutting at the farm level are partly to blame, but the immediate monetary savings of not testing are well outweighed by the production losses bought about by losing genetic gain and efficiency. A 70% uptake in the New Zealand region versus 30% in the Tasmanian region is a stark contrast. From my experience, the benefits of herd testing in New Zealand have never been called into question, and in tight times become even more important. Tools such as MINDA, New Zealand's herd management system, and herd testing have been an integral part of the dairy farmers arsenal since herd testing was rolled out 110 years ago in 1909.

Recommendations:

- As an industry – look at ways to increase herd testing uptake to enable targeted selection pressure on low performing animals
- Further educate farmers and software providers the basics of sire selection indexes and daughter proven vs genomic proofs, heritability of traits vs environmental, and make visible the financial benefits of good genetics and selection pressure.
- Streamline data on farm to record ancestry and increase outcrossing at an individual cow level

2. Acknowledgements:

I would like to thank the following who have given their time to make this report, and my Kellogg journey possible:

- LIC Australia
- LIC International
- Joyce Voogt – LIC Technical manager
- LIC New Zealand
- David Beca (Red Sky Agricultural)
- The Tasmanian dairy farmers I surveyed
- Aliastair Hainsworth – Meterologist
- DataGene
- Dairy Tas

3. Introduction

As a Kiwi working in an international market - Tasmania, it becomes evident how one is shaped by culture and attitudes which have been instilled by being raised in a country and industry at the forefront of innovation and efficiency. New Zealand as a producer of dairy proteins has poised itself as a leader on a global scale; it is the greatest and most efficient producer of dairy and agricultural food products on the planet. Or is it? Have New Zealander's been brainwashed by immersion in culture and industry. New Zealand punches above its weight, but how far? How easy is it to ply your trade overseas? Is there a blueprint for success that works in any country? Many New Zealand individuals and companies have gone abroad looking for the golden opportunities of yesterday's dairy industry, places such as Missouri and Chile, Australia and China. Some have been successful, some haven't. Some may have underestimated the cultural and political differences when dairying outside of New Zealand, where references to our success in sports and business falls on deaf ears.

Polar shifting in the way we think about our dairy industry is upon us. Generation Z and Y are the consumer. Globally, about 26 percent of the world's population is under 15 years of age, (https://www.statista.com/statistics/265759/world-population-by-age-and-region), generations who no longer know life without a mobile device. The Information Age has born a consumer who is holding its forefathers to account, a historic lack of research and understanding about the impacts of farming and consumption is to blame and a fast paced game of catch-up is coming at the primary sector at an unprecedented speed. If only we could wind the clock back 20 years to a New Zealand with 2Million cows less, and a Canterbury Plains still proud to be called the 'Granary" of New Zealand – but what would our economy look like?

The Tasmanian Dairy Industry shares many similarities to that of New Zealand, with the opportunities of water resource, and room for development. Gen Y is tech savvy, and open to new ideas and ways of doing things. With the Gen Y approach, and the agility of a small island, Tasmania is poised in a position to become a leader in innovation and environmental practice without having force of hand by a regulator. One element of such innovation and environmental practice and at the core of dairy production and sustainable farming is the dairy cow. Genetic gain is one key driver of production gains and productivity on farm. With NZ$25 Million being spent on "the resilient cow", genetic gain will be the core focus once again to show the world New Zealand dairy cows are not only world class performers, but they are well looked after and environmentally sustainable. Annual dairy semen straw use throughout the world stands at 232 Million doses of frozen semen and 11.6 million doses of fresh semen. (Journal of dairy science, 2007) The sheer volume and wide uptake of artificial insemination in the dairy industry creates the opportunity to select desired traits from sires and applying those to one's own herd. This study seeks to look into this sire selection process, benchmark similarities between New Zealand and Tasmanian from a climatic and industry perspective, and to communicate what is influencing the breeding decisions on farm, leading to illustrating some of the opportunities that lie awaiting for the Tasmanian Dairy Industry.

4. Background:

Throughout my daily travels around Tasmanian dairy farms, I see polarized patterns in relation to the best type of cow to breed, and differing attitudes towards farming systems. The volatility of processor farm gate payments, grain prices, and farm working expenses has created insecurity around profit margins, and an increased reliability on other income streams such as livestock sales. This polarity in thinking has created vastly varying dairy farm systems within the State of Tasmania. Farms next door to each other can be seen to have different breeds of cows, large live weight variances, and huge differences in grain and supplement inputs. They might be intensively monitoring pasture and costs, or very relaxed in this area. Some are huge adopters of technology; others don't own a cell phone. It seems quite remarkable given they are farming in exactly the same climate, soil type, economic environment, and being paid very similar farm gate milk prices.

5. Aims and Objectives

The aim of this report is to compare and contrast two dairy industries on different sides of the Tasman Sea, and investigate whether there are the same opportunities to grow similar quantity and quality of grass in Tasmania as there is in New Zealand. Discovering what is driving the selection of genetic traits in Tasmania will create an understanding of whether there are the same opportunities for Tasmanian farmers to produce milk efficiently as there is in a comparable region in New Zealand. Animal genetics influences the ability of an animal to turn grass into milk, so a key element of my research is to analyze the findings of survey information and look for any correlations between farm type, and genetic choices.

6. Methodology

Firstly I sought out to compare Tasmania with New Zealand from a climatic perspective.

Alistair Hainsworth is an experienced meteorologist working with BOM (Bureau Of Meteorology) and the world Meteorological Organization, in Tasmania, Australia, and around the planet. I met with Alastair to look at some of the best ways to compare two climates, and learned some of the methods used to record data and climate types. I selected four towns, two each region (Tasmania, and top of the South Island) on similar latitudes, collated data from meteorological organizations in the two countries, NIWA and BOM (Bureau Of Meteorology) and put them into graphs for comparison.

A survey was then carried out on a group of Tasmanian dairy farmers, to see what is driving and influencing breeding decisions on farm. I phoned 37 dairy farmers from different parts of Tasmania, and asked them questions around farm type, production, and reproductive performance (see appendix). I recorded their answers, and sought to find any relationships using spreadsheets to record and calculate any correlations. Once I was in possession of these results I used my own industry knowledge, networks, reviewed science literature and professional peer resources on genetic gain to look for opportunities and recommendations.

7. Comparisons:
    7.1. Physical Industry Comparisons:

I have chosen the West Coast/Tasman and Marlborough regions to compare industry statistics, for reasons outlined later in (7).

Tasmania

The following is information gathered from Dairy Tas – the Tasmania levy body, responsible for driving production, education, welfare and research in Tasmania– as a subsidiary of Dairy Australia.

There are 412 dairy farms in Tasmania (Dairy Tas 2019) Production from the State of Tasmania is 913 Million litres in 2017/18 (confirmed) and likely to be 913 Million in 2018/19 (estimated)

The average per cow production is 445kg milk solids per cow - based on 2017/18 dairy base information. The average herd size is 392 cows.

NZ Dairy Stats – Tasman/Westcoast/Marlborough

The following stats are sources from Dairy NZ – Stats 17-18 – West Coast, Tasman and Marlborough. 5% of New Zealand's cows, 5% of herds and 6% of dairy land are situated in this region.

There are 595 herds in this area, the average herd size is 399. The average farm size is 166 Ha, cows totaling 237215.

Total cow numbers across the 3 regions:

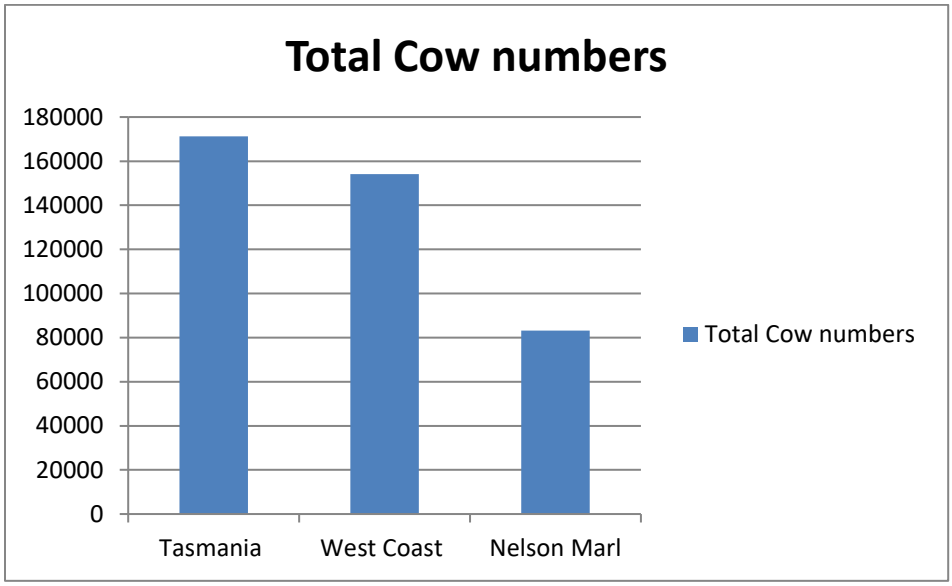


Fig. 1 Total cow numbers by region

Figure 1 gives a perspective of the total cows in Tasmania, vs the regions I have chosen to compare with from a climatic perspective in New Zealand.

Total number of herds across the 3 regions:

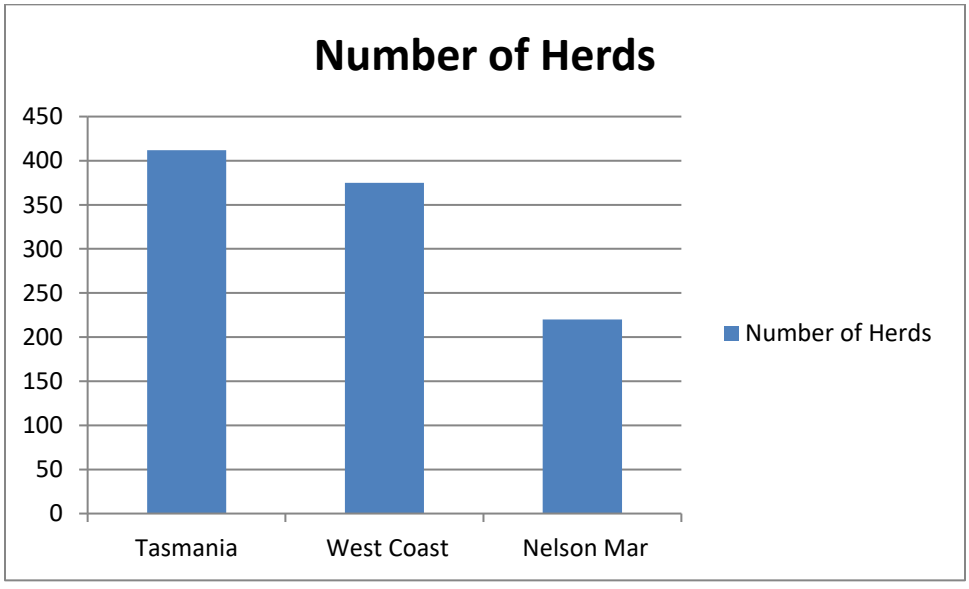


Fig 2. Number of herds by region

Figure 2 is looking at the number of herds in the regions being compared. This should give you an idea of the number of farms we are discussing. Again, the areas are reasonably comparable from a statistical point of view.

Per cow production comparison across the 3 regions:

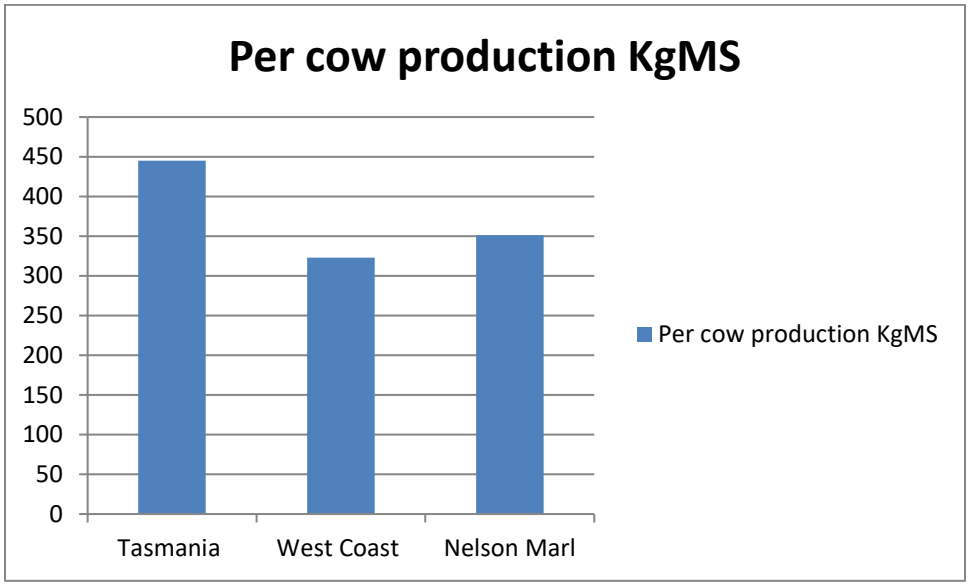


Fig 3. Per cow production by region

Per cow production in Tasmania is more than that of the same regions in New Zealand. This possibly due to the accessibility of grain to the Australian market, many farmers in the Tasmanian region feed grain as a seasonal management tool. If you drive through the two areas, one stark contrast is the lack of large grain silo's adjacent to dairy sheds in New Zealand.

7.2. Geographical comparisons

Where are the dairy areas in Tasmania, and what is a fair comparison when looking across to New Zealand?

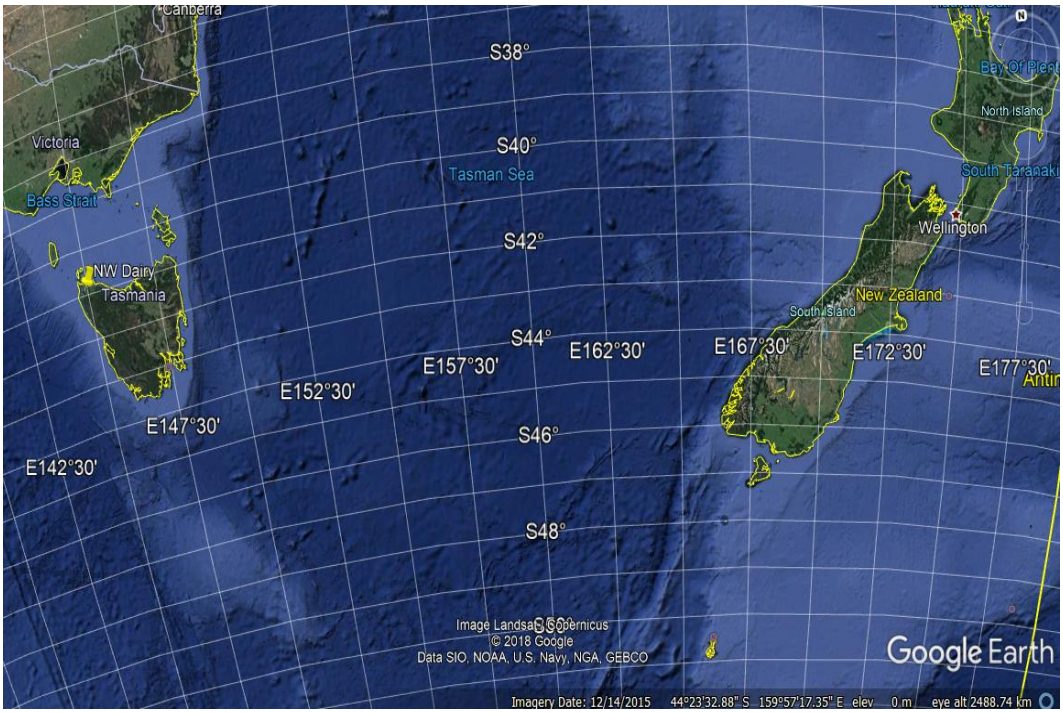


Fig. 4: map showing latitude line 41 degrees: Source: Google Maps

The biggest concentration of Tasmanian dairy farms lie near Smithton, at the North Western tip of Tasmania, with dairy farms scattered throughout the North coast, and Northern area of the state, and a pocket of irrigated farms in the Derwent Valley to the South at around 43 degrees.

The latitudinal line of 41' South sits very slightly south of this dairy region, and intersects with Westport, and the Marlborough Sounds at the Top of the South Island. So it would be fair to say if a comparison was to be made with a region in New Zealand the closest in latitude is that of the West Coast/Tasman/Marlborough areas. It is for this reason I used these regions as my industry comparisons above.

Scope and scale – physical land mass:

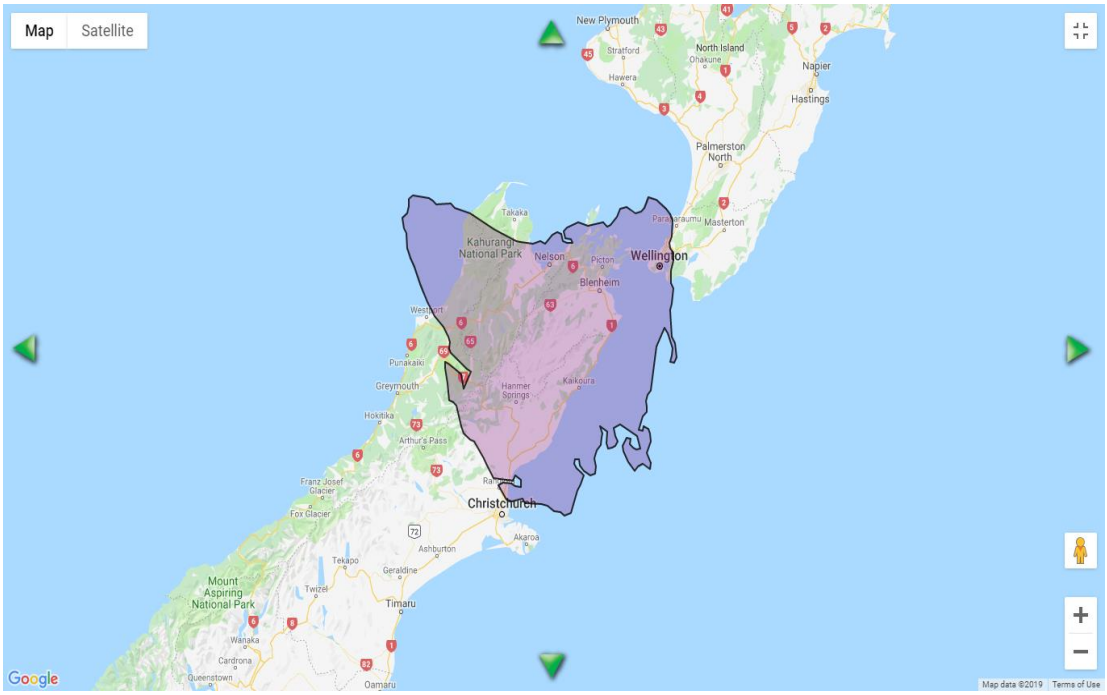


Fig. 5: Overlay of Tasmania – Upper South Island (http://overlapmaps.com/index.php)

Fig.2 demonstrates the physical size and similarities of the two regions on the same latitude line. As comparisons are being drawn in a latitudinal sense, it is interesting to see the two regions from a land mass point of view. The Island of Tasmania covers 64 519 square KM (www.ga.gov.au) – 42% of which is protected in National Parks and reserves (https://en.wikipedia.org/wiki/Tasmania)

You can see it covers an area from slightly North of Christchurch in the South Island to somewhere approximate to Levin in the North Island. This is relatively close in latitude, but not an exact reflection of latitude.

Another comparison – the land area of Canterbury is 45346 Sq KM, a majority of which is productive farm land, around 2/3 the size of Tasmania – nearly half of which is national parks.

Climatic conditions, geography and geology would suggest Tasmania is not too dissimilar to the South Island of New Zealand. But just how similar are they?

7.3. Climatic comparisons

Climate, in the sense of moisture and temperature influences a regions suitability to be inhabited by dairy farms. Optimal soil moisture levels and a temperate climate is the catalyst for New Zealand's position in being the world's most efficient producer of milk products. Ryegrass is crucial for efficiency in

a pasture grazing system, and will not grow at optimal levels in prolonged periods of excessive heat, or conversely cold

When being compared to one another, conditions share many similarities across the two regions, both are described by the koppen climate classification as oceanic. The koppen climate classification system is the most widely used climatic classification, classifying the world into 5 climate types. (Hainsworth personal communication Sept 2019). I have chosen some strategic points near the latitude line of 41 degrees on the upper coasts of Tasmania, and the South Island. Smithton and Westport both being located near the West Coast area, Nelson and Scottsdale both being more Central Northern Coast – tending towards the East.

The Graphs below are drawn from data extracted from the Bureau Of Meteorology (BOM) (http://www.bom.gov.au/jsp/ncc/cdio/weatherData) and NIWA (https://niwa.co.nz/education-and-training/schools/resources/climate)

The data used from both BOM and NIWA is for the period 1981 – 2010. This time period is set by the World Meteorological Organization (WMO) and is produced using this date range to create a 'normal' for climate comparisons around the planet. This benchmark is necessary to make comparisons across a period of time. Now more than ever there is a huge focus on this data set as climate change has become the catalyst for social change and driving influence in all countries across the globe.

Rainfall:

Mean Rainfall across 4 sample towns on similar latitudes in Tasmania and New Zealand, January to December, millimeters per month on the left axis

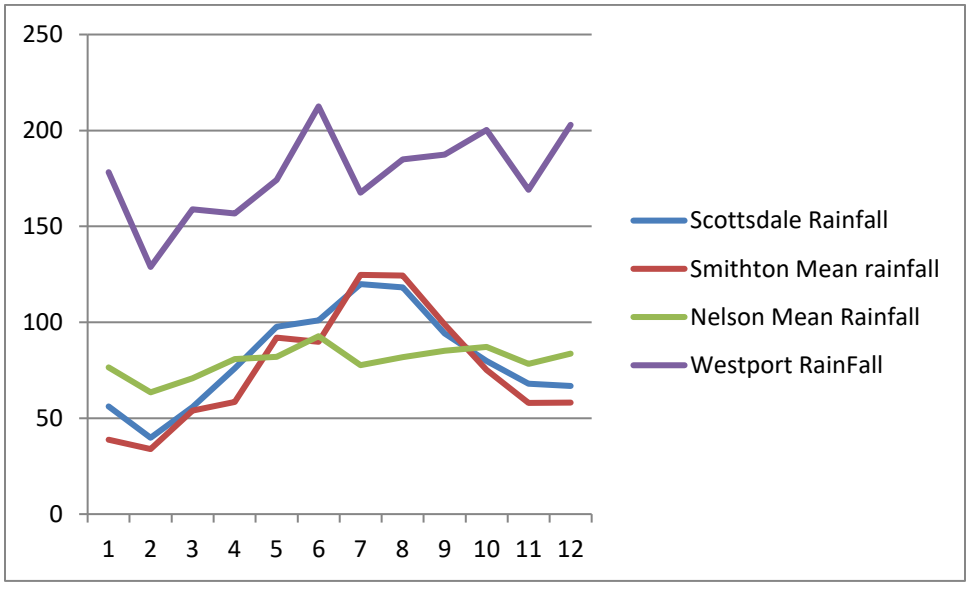


Fig 6: rainfall data comparisons across 4 sample towns.

In general terms – you can see there are relative similarities in monthly rainfall patterns in the summer months across both regions, with the Tasmanian towns experiencing more seasonal consistency in the winter rainfall months. Moisture, namely excessive amounts of which at this time of year being the biggest limiting factor to allow Ryegrass species to grow, along with temperature. The Tasmanian data shows more consistent rainfall from July until September, also coinciding with the coldest months. The absence of a mountain range as significant as the Southern Alps in the west of Tasmania accounting for the differences between Westport and Smithton, New Zealand equivalent data in Nelson and Westport showing reasonably inconsistent rainfall on a monthly basis, in comparison to the Tasmanian data.

Temperature:

Mean temperatures across 4 towns in New Zealand and Tasmania

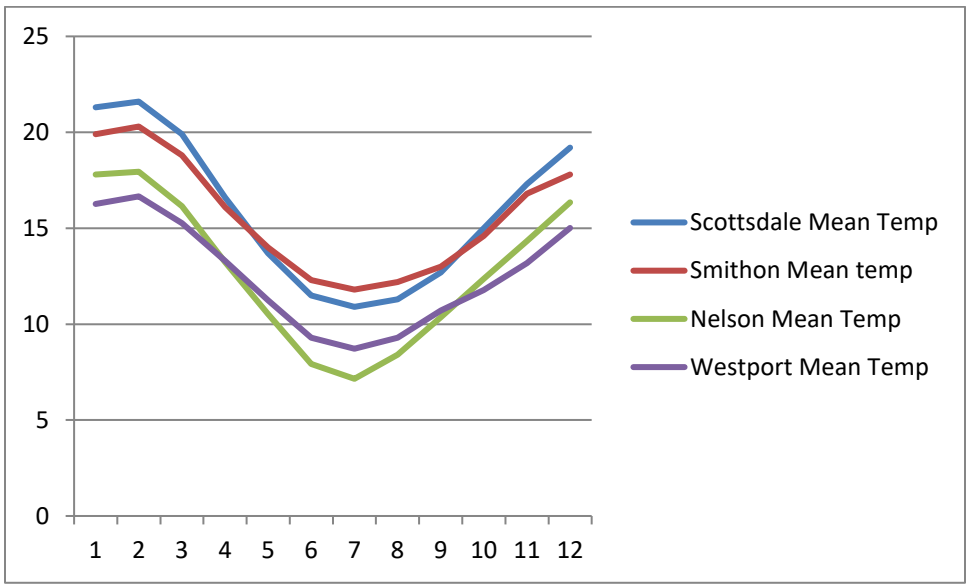


Fig 7: Temp Comparisons

Seasonal variation in temperature is responsible for slower grass growth in the winter months, and higher growth in spring and autumn months. Although at slightly different temperatures, the regions are seasonally consistent in this regard. The Tasmanian data is showing slightly higher temperatures overall. It is showing slightly warmer winter months in Tasmania, which in theory could result in higher yields from June through to August. On the flip side - potentially lower yields in the summer months if daily temperatures spike too high. High temperatures, soil moisture deficiency, and high evapotranspiration from the plant will result in plant stress and reduced or even negative daily growth during the hottest months.

Access to reliable irrigation sources at this time will have significant influence over dairying businesses in all regions based on the rainfall and temperature charts above.

Sunshine:

Sunshine hours relative to 3 sample towns on similar latitudes in New Zealand and Tasmania

Data from Niwa and Bureau Of Meteorology

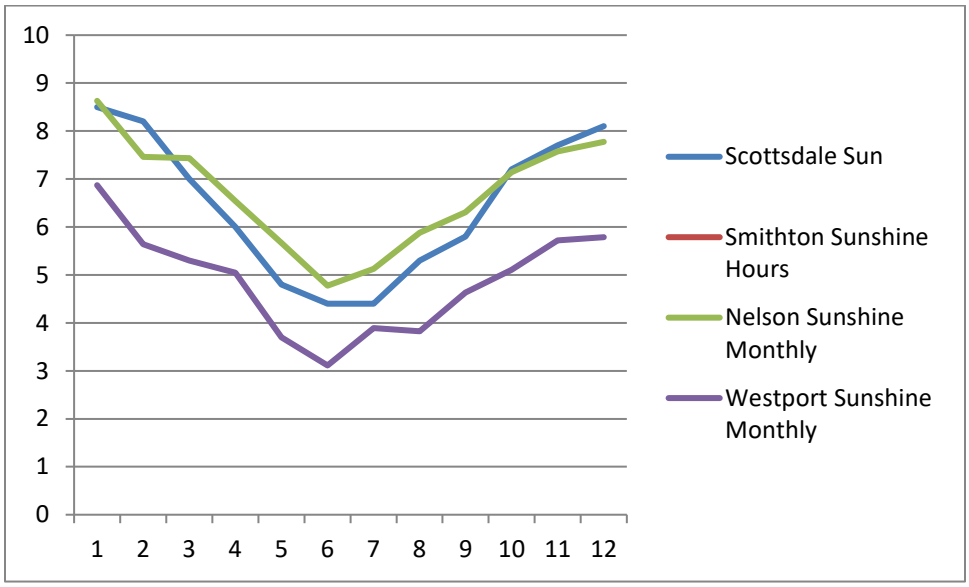


Fig 8: Sunshine Hours (Smithton Unavailable)

Smithton sunshine data was not available, but data for 3 of the 4 towns in question again shows similar trends across the space of 12 months, but at varying levels. Not surprisingly Westport has the lowest sunshine hours, due to its high rainfall and cloud cover.

So with the sun, rainfall and temperature at reasonably comparable levels we can make the assumption there are reasonable opportunities to grow ryegrasses at similar levels from across all the regions in question. So that leads us to the next component of milk production and business efficiency – the dairy cow.

8. Survey overview

It was interesting trying to paint a picture of the average Tasmanian dairy farm, and dig a bit deeper into what was influencing the breeding decisions on farm, there were a few surprises.

Farmers overwhelmingly said they talked in kilograms of milk solids rather than litres, which differs to the everyday conversations I have on farms. Conversation around individual cow performance is more often than not, liters focused. This certainly has implications when selecting sires on production because the trait you are selecting on is volume, instead of milk solids. Payment by processors is generally based on fat and protein, not litres, so it makes sense milk solids is the focus of production measures.

Responses were also very strong when talking about semen selection vs reproductive performance. Empty rates and 6 week in calf rates have a strong influence over the semen they select. This means farmers are using the fertility trait of sires to try and drive their own fertility on farm. A risk of this is sacrificing other traits such as production to achieve good fertility.

When talking about mating, I was also surprised that only half the farmers spoken to were using synchrony in their mating program. Synchrony is using naturally occurring hormones to stimulate a cow to ovulate, creating the ability to mate many cows at once, rather than waiting 21 days for them to cycle. Perception around the Industry is the use of synchrony would have been much higher than this.

Current market rates for China export heifers are very strong, and I had expected this to be a big influencer on semen selection. The criteria for an export heifer to China are generally four white feet, and a Friesian type. Currently around $1400 for a 200kg animal, it is very tempting to inseminate as much of the herd as possible with a black and white bull to capture the china market the following season. Only 8 of the 37 respondents named china export calves as a priority for livestock sales. But out of these 8, only 4 carried out herd testing. This mean these 4 farmers could potentially be exporting animals from their top producing cows, and very much slowing the progress of the genetic merit of the herd.

Of respondents, 12 of the 37 are currently carrying out herd testing. This is 32%. In the 2017/18 season, 128 farms carried out herd testing in Tasmania (Datagene 2019) There are 412 Herds In Tasmania (Dairy Tas 2019) which is 31%, so the response from the sample I have surveyed is proportionate to the general population.

Some of the reasoning's given for not carrying out herd testing:

Fig 9: (Wordart.com)

Out of those 25 who did not herd test the reason/s for not herd testing were varied, but the most common reason being 'building numbers'. Therefore as farms grow in physical size, and require more stock, farmers are growing by attrition of numbers, rather than stock purchases, and they feel selection pressure on the bottom performers will impede growth. I will go into the implications of this later. A number of farms already have milk meters, which is measuring the litres of each milking. These devices only measure volume, and not fat and protein, so is still not an accurate indication of efficiency or production. The components of milk solids as a percentage can vary from cow to cow.

The survey results gave an interesting insight into what is influencing farmer semen selection, and has created the opportunity to discuss some of these points. Herd testing and identifying top and bottom performers is important. Once identified, mating of these animals has to be carefully managed, and I will now discuss why the semen farmers select, and how it is managed is so vitally important.

9. Inbreeding and Outcrossing:

My observations as to one of the biggest voids existing in the Tasmanian dairy industry when compared to that of New Zealand is that of on farm data, especially in the herd recording space. Is the lack of quality data available to Tasmanian dairy farmers hampering their breeding decisions? Looking East across the ditch, a database called MINDA is the tool a majority of New Zealand farmers are utilizing for their herd improvement decisions. It has been born of a co-op which has been in existence for a long time, and has been a part of New Zealand's herd improvement story for generations. It drives genetic gain in New Zealand herds through its ability to quickly identify low producing animals. Long term selection pressure has improved traits such as fertility, fat and protein production, and longevity. Datamate is another tool used in parallel with MINDA to record mating's by the inseminator, but probably most important of all reducing the instance of inbreeding at the cow level. Why is this important?

Inbreeding has adverse effects on a cow's performance. Closely related mating's increase the risk of negative genetic traits emerging, such as small calf syndrome and BLAD (Bovine leukocyte adhesion deficiency). Reduction in fertility is directly negatively correlated with inbreeding. Gonzalez (2007) studied 49497 cows from the Spanish population and sought to measure any correlation between fertility and inbreeding:

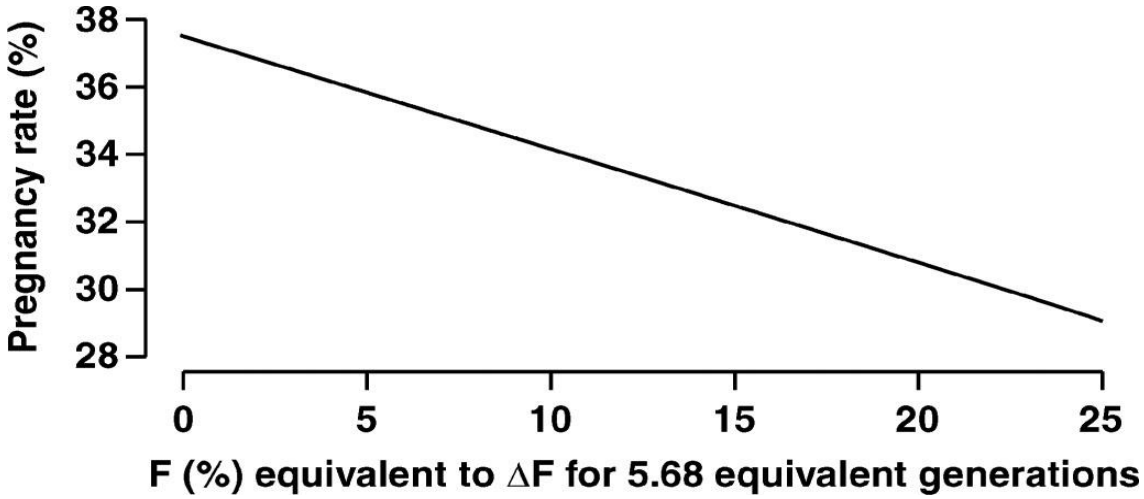


Fig. 10: Regression line for inbreeding rate (ΔF) on pregnancy rate as a fertility trait [González-Recio O., 2007].

Pregnancy rate decreases as relatedness increases.

Fertility and calving interval are vitally important for a commercial dairy herd. Increased days in milk are driven through tight calving patterns, and a cow's ability to get pregnant 42 days after calving. The ability to use data to walk the inbreeding tightrope with confidence gives the New Zealand dairy farmer the ability to chase desired genetic traits as hard as possible whilst staying on the right side of the inbreeding ledger.

"Starting with the first national herd database, one of the strengths of our co-op has always been our ability to use our data to drive genetic gain, produce better milk and help farmers save time and increase their profits". Wayne McNee LIC CEO.

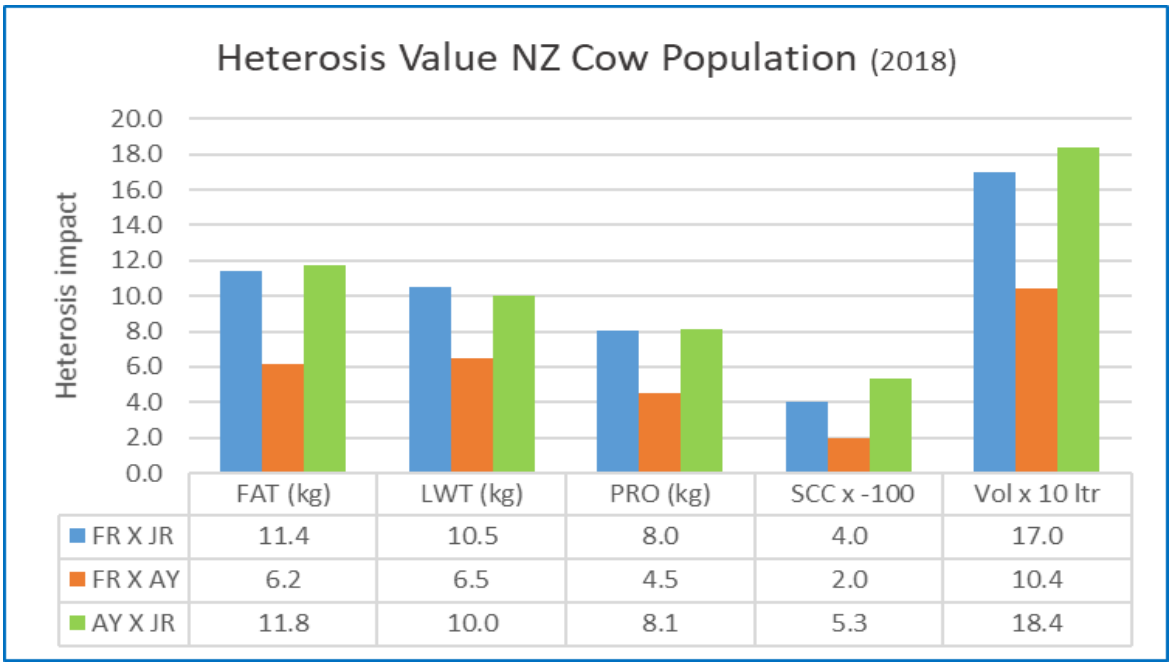
Looking back to Tasmania, without tools such as Datamate, or the cost structures to be able to afford herd DNA testing, Tasmanian dairy farmers tend to take a 'whole of herd' approach to outcrossing genetics, rather than be able to manage individual mating's.

Without the ability to look at a cow's performance, and potential, cows are traded based purely on looks and type. Herds and cows are purchased, and move around the state, most often than not, no ancestry or production information follows the animal, therefore making it impossible for the new owner to truly manage the inbreeding of that cow. In contrast New Zealand's breeding worth system places different values on an individual animal, mostly around what potential that cow has to contribute to the business, and with ancestry, the ability to outcross mating's based on the records that arrive with the cow.

The opposite of inbreeding is crossbreeding. Cows cannot be inbred if they mated across different breeds. Crossbreeding drives heterosis, or hybrid vigor. Hybrid vigor is proven to increase production and performance traits, as per figure 11 below. Without the ability to manage the relatedness of the dairy herd, and manage outcrossing, and crossbreeding at the individual cow level, the farmer loses the ability to increase cow performance (fertility and production) through crossbreeding.

Cross breeding and the effects on production – the first cross.

FR = Friesian JR = Jersey AY = Ayrshire



	FAT (kg)	LWT (kg)	PRO (kg)	SCC x -100	Vol x 10 ltr
FR X JR	11.4	10.5	8.0	4.0	17.0
FR X AY	6.2	6.5	4.5	2.0	10.4
AY X JR	11.8	10.0	8.1	5.3	18.4

Fig. 11: LIC NZ

Aside from the genetic gain of pasture species, genetic gain in dairy cows has been at the forefront of productivity on farm, as a drive for efficiency has seen a push towards a more productive animal that consumes less. You can see from figure 11 that crossbreeding produces production gains. The more unrelated the breed, the larger the effect of heterosis. '*Systematic crossbreeding contributes to a substantial increase in the economic performance of dairy production systems*' (Aarhus University 2008). The inability to record and manage outcrossing and crossbreeding through lack of individual cow information is potentially hampering genetic gain within the Tasmanian herd.

The creation of a national herd database very early in New Zealand's dairy farming history has allowed the New Zealand farmer to maximise genetic gain and chase particular genetic and phenotypic traits whilst managing inbreeding. It has also created the ability to manipulate the national herd to meet global demand. Changes in the Breeding Worth Index over the course of time has enabled a reaction to increased demand for protein, and more recently, fat.

10. Herd selection pressure

"But we are using all the best and latest genetics from New Zealand" is a statement I commonly hear. When looking at administrators of herd improvement, we are dealing with similar structures as far as bodies overseeing the data.

New Zealand has the Animal Evaluation unit (AE), an independent subsidiary of Dairy NZ, which collects and collates data from the national dairy herd. It also governs and adjusts the Indexes which make up the Breeding Worth (BW). Cows are ranked by their BW, their performance, and the performance of their ancestors. A Bull is ranked by the performance of his daughters in the herd, and in more recent times, a prediction of performance based on DNA testing, generally referred to as genomic testing. The two main herd testing and bull breeding companies in New Zealand are LIC, and CRV Ambreed.

Data from these herd tests is fed into the Animal Evaluation database, the sires of these cows are ranked according to the performance of their daughters, and what they will contribute to the New Zealand economy. It is estimated that genetic gain in dairy cows contributes over $300 million dollars to the New Zealand economy each year (Dairy NZ)

Australia – similarly has an evaluation unit – Datagene , which is a subsidiary of Dairy Australia – the Levy body for Australian Dairy Farmers. One of the key differences between the two regions, is the amount of data available to Datagene through herd testing. The low uptake of herd testing, especially in Tasmania, around 30% (Datagene 2017-18), limits the amount of datasets available for sire proving. This, coupled with a large selection of international genetics in the Australian market, makes it difficult for Datagene to get large Australian datasets of herd testing to measure daughter perfomance. As a result of this the Australian industry has placed a larger emphasis on Genomically tested sires than what New Zealand has, which, up until has been proven to have less reliability to breed top performing bulls.

So how does this all relate to "selection pressure". True selection pressure can only be applied successfully if the farmer knows which cows to select and match to their sire of choice. Herd testing is one thing, but using that herd test data over time to identify the top and bottom producing cows is taking the data to the level required to truly benefit from the sires the farmer is selecting.

The general manager of AE Dr Jeremy Bryant talks about the importance of genetic gain, but it also identifies the importance of identifying the top and bottom producers in the herd: '*NZAEL has analysed 800 2005-born cows across 30 herds nationally, comparing the performance of cows ranked highest and lowest within each herd . Each animal was ranked according to its Breeding Worth (BW), and the performance of animals in the top 20 percent was compared to the bottom 20 percent. In the 2009/10 season, cows in the top 20 percent for BW generated an additional 17kg of protein, 18kg of milk fat and calved 4.5 days earlier than those in the bottom 20 percent for BW*.' He goes on to say: *'The liveweight and conformation scores of the cows were consistent across both the top and bottom groups'*

Tasmania has access to these high BW genetics, whether it be from New Zealand, or a different index from bulls bred elsewhere in the world, and many farmers have been breeding from the best BW bulls available for some time, but where the opportunity lies is selection pressure, and lacking the tools to identify that "'*top and bottom 20 percent'* is impeding that pressure. As important as culling the lowest performing animals, is breeding correctly from the top performing ones. This is the area of concern when talking of breeding calves to export to China.

Given BW is a proven tool to increase production and efficiency in the herd – Dairy NZ has identified 6 steps in order to build a high BW herd:

1: Use high BW sires
2: Keep accurate and detailed records
3: Use DNA sire verification
4: Measure cow performance
5: Use AI over your best heifers
6: Target replacements from your top cows

Likewise, the Australian industry has the BPI (Balanced Performance Index), on which farmers can base their breeding decisions. Farmers can select sires on BPI and performance of certain traits in order to make breeding decisions. Datagene have even gone as far as developing a handy tool – The Good Bulls Guide – so all the available bulls are on an app in the palm of your hand. Farmers can set limits on certain traits such as production, or fertility, and filter out sires that don't meet their threshold. They also have the opportunity to use BPI in the same manner as the 6 steps above. From my own observations, farmers in Tasmania have the opportunity to follow all these steps, but a majority doesn't. Many use high BW or BPI sires, however due to low margins the budget for semen is often sensitive to processor payment. Accurate and detailed records are kept by a minority and very few DNA or Sire verify. Some mate heifers, and many mate from their 'top cows' or 'likeable cows' but don't herd test, so it is just a subjective test based on likeability or perceived performance as she 'looks like a good cow'.

Table 1 – Table of comparisons between BPI (Australian) and BW (New Zealand) indexes

Breeding value	Aus BPI	NZ BW
Production	55	51
Fertility	13	13
Cell Count	10	7
Type/Cond Score	12	7
Workability	7	0
Residual Survival	0	11
Feed Saved/LW	3	11

Source: DataGene (2019) Pers Com

Comparing the two indexes New Zealand and Australian farmers are making their breeding decisions on, there are quite a few similarities. It would be debatable how comparable type, and condition score are, type being more the structure of the animal, Condition score is the cows ability to conserve body fat, whilst still producing. Workability sits outside of BW in New Zealand so does not feature in this index. Looking at feed saved, more emphasis is placed on efficiency in New Zealand, along with residual survival. But the question is also raised – how many farmers are using the BPI. In New Zealand BW is basically a currency. Cows are valued on it, banks lend on it, it is a measure of your cows and herds worth. BPI conversely is a great selection tool; however livestock values are not depicted by a cow's potential to contribute to the Australian economy.

Data such as the following is a more accurate way of measuring cow performance rather than how a cow looks or perceivably performs.

Table 2 : Herd Ranking by quartiles in a New Zealand Dairy Herd:

Ranked by BW	# Animals	Avg KgMS	Avg Birth Year	Avg BW
Q1	67	575	2013	140
Q2	66	566	2013	108
Q3	66	530	2012	78
Q4	66	502	2011	43

Source: LIC 2019 Pers Com

This is a data extract from a dairy herd in New Zealand. The difference in KgMS between the top quartile and the bottom being 73KgMS per lactation. If the bottom quartile of cows could perform as well as the top it would equate to an extra 4818 KgMS for this farm. At $6.85 KgMS (current Tasmania payout) this would be an extra $33000 in additional income, a pretty simple argument to spend around ten percent of that on herd testing one would have thought. This data can be compared to live weight as well for further efficiency gains, ie are you large cows that require more feed producing as well as your smaller cows when compared to live weight.

On the subject of 'building numbers' a common reason for respondents not herd testing, the efficient use of land needs to be bought into the equation. Agistment (grazing off farm) costs are a significant contributor to reduced margins in Tasmanian dairy. Many farmers are paying significant portions of income in order to graze young stock away from the dairy platform.

Here is a basic example of how selection pressure and genetic gain can lead to more efficient land use.

Table 3 - An example of efficiency:

Number of Cows	Produce each	Consume each	Tot Consumption	Tot Production
9	500kgMS	5 Tonne	45 Tonne	4500kgMS
10	450kgMS	5 Tonne	50 Tonne	4500kgMS

LIC NZ (pers com)

Fewer cows, eating less, produce the same. When building numbers, would you not want to make the most efficient use of land? By identifying the high and low producing cows in the herd, you can carry less animals for the same amount of production, again making the argument for herd testing more important.

11. Margins

Margins and costs are touted as being a reason many don't herd test. Some rough comparisons based on my experience in Tasmania, and information available online (LIC) an estimate of cost for herd testing a 400 cow herd in New Zealand is approximately $1266, whereas the same test in Tasmania would be approximately $1722, a difference of $456 per test, for those respondents testing 9 times, an extra cost of $4104 which is quite considerable. Of note, processors in Tasmania offer a herd test incentive, allowing the farmer to recover a certain amount of this cost at season's end, so cost should not really be a significant barrier. The amount spent on breeding and good genetics is heavily influenced by the dairy business's ability to carry that cost until the benefits of gains are seen in the medium term. The latest Dairy Australia Situation and Outlook report found just 43 per cent of farmers expected to make an operating profit, in 2018-19. Dairy Australia chair, Jeff Odgers, has urged the sector to address the issue of profit margins, stating too many farms are still struggling.

Are margins to blame for a poor uptake in herd testing and herd recording in Tasmanian farms?

This chart kindly shared by David Beca demonstrates the cost pressures the Australian dairy industry has been under since 2003. New Zealand and Tasmania initially having similar cost of production, you can see the increases in cost of production, and volatility around milk price

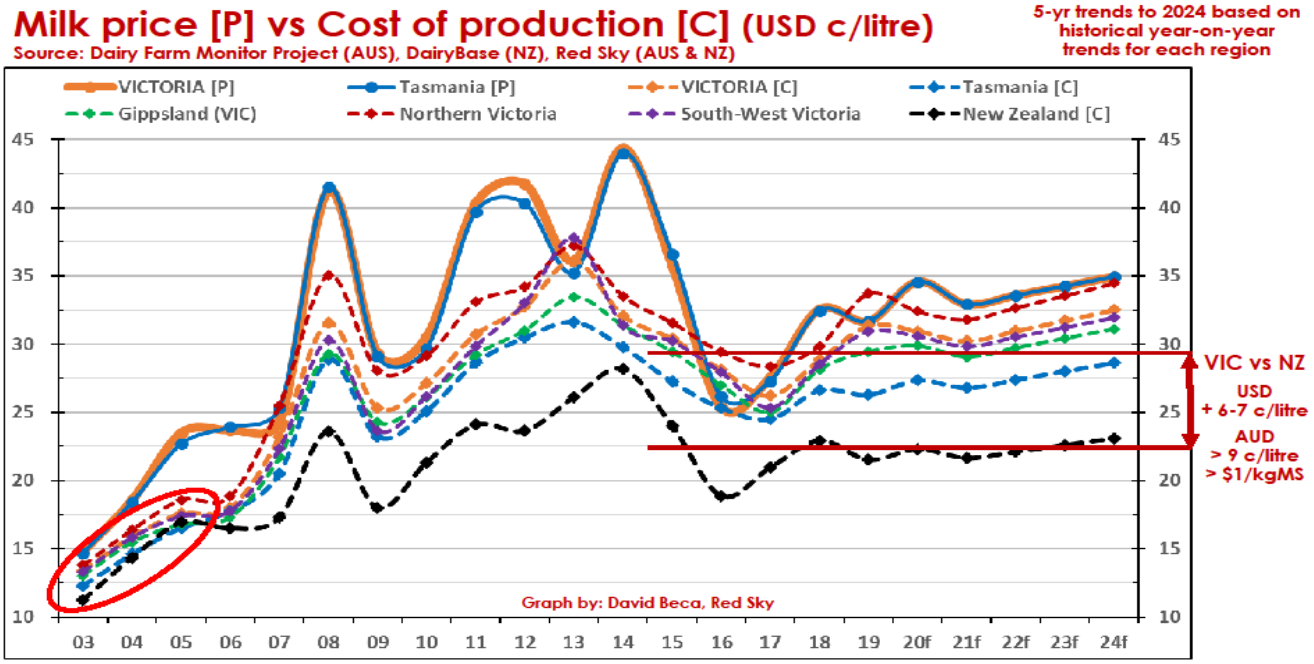


Fig. 12: Milk Price Vs Production. Source Red Sky. (David Beca)

Variances in costs over time have created volatility and insecurity in income streams. At times in the example of Tasmania – costs and milk price have met, and come close to meeting.

Of note – New Zealand's cost of production is lower than Australia – similarly input costs tend to trend with milk price as farmers adjust to lower milk years and 'loosen the belts' over higher payout years. New Zealand's milk price is not mentioned above.

A major influence in narrowing margins in recent times in Tasmania was the 'claw back'. In the 2015-16 season, the two major processors in Australia, Murray Goulburn and Fonterra, had overpaid for milk supply, and in 2016-17 announced they would have to 'claw back' these over payments. This caused significant financial pressures for those farmers, especially those with high levels of debt. Farmers took drastic measures as costs of production exceeded income. Many culled large numbers of cows, potentially their best cows. A lot of good genetics was lost to the freezing works. Some farms ceased production and dried off cows. All farmers looked at areas they could cut back. It was around this period when herd testing participation in Tasmania dropped, even though as a percentage, uptake was already relatively low. In the 2014-15 season 165 herds in Tasmania were tested, reducing to 128 during the period of low payouts.(Datagene 2019)

Potentially we see a false economy in play here, as cutting back on costs such as herd testing and genetics can have medium to long term implications for the dairy farm business. If Tasmanian farms

were to match their New Zealand counterparts in herd testing uptake, science would suggest they will see production and efficiency gains through improved genetic performance. "*Genetic gain is set to deliver $11 profit per cow per year, which equates to $4600 per herd per year, based on the average herd size of 419 cows, the value of genetic gain compounds over time, accumulated over ten years equates to $250,000 per herd*" (Dairy NZ, 2014).

12. Conclusion:

The ability to be able to make culling and breeding decisions based on good quality data gives New Zealand dairy farmers an advantage over their Australian counterparts. Data such as this is one of the reasons cost of production is lower on New Zealand Dairy Farms.

Although there are some subtle differences in climate and soils types, this report has revealed two regions on opposing sides of the Tasman Sea, which are similar in their capacity to grow good quality grass in the right quantities at the right time of year. A conclusion can be drawn that the capacity for efficient milk production is present in both regions. Based on findings, Tasmanian cows are producing as well, if not better than their New Zealand counterparts, on a per cow basis, but at a higher cost of production. Whereas genetics, herd testing and data are driving efficiencies in New Zealand production, grain inputs, nutrition and genomics are at the forefront of driving production in Tasmania. Tight margins and cost cutting is responsible for driving farmers away from herd testing, therein lies the greatest opportunity.

The herd improvement blueprint so successful in New Zealand is not replicated in Tasmania, or Australia, and probably never will be. There are individual herd improvement companies in parts of Australia, but the Co-op structure of LIC in New Zealand, and dominating the majority of the New Zealand market for a considerable length of time means herd testing and genetic improvement has been at the forefront since the turn of last century. A systemic flow of data throughout the country has been enabled this to occur. Tasmanian wide herd testing and easily digestible data has the potential to drive production and efficiency, not only through genetic gain, but the ability to manage inbreeding at the individual cow level. Selection pressure momentum needs to increase and become more widespread to grow efficiency in the Tasmanian herd. Attitudes toward herd testing as a luxury rather than a necessity need to be changed and the financial cost of not herd testing needs to be somehow bought to the fore. Applying the $250,000 per herd in genetic gain theory to the Tasmanian herd suggests great financial gains are to be had. Even if one was conservative, at $200,000, this would equate to $82M for the Tasmanian Dairy industry. How much of that figure will truly be achieved? An early adoption of genomic technology has led to a drive for sales of semen based on genomic proofs, giving some farmers the impression there is no longer need for testing. This needs to be addressed by Dairy Australia, as the processors are already doing their part by subsidising partial costs of herd testing. As Jeff Odgers said, 'we need to talk about margins'. How do we improve them? Improve the data.

13. Recommendations:

- As an industry – look at ways to increase herd testing uptake, enabling targeted selection pressure on low performing animals
- Corroboration between herd improvement organizations in Australia, ie research bodies, the levy organizations, on farm software providers, and genetic companies.
- At the farmer level, identify higher performing animals to breed from the best genetics, and managing the low performers.
- Look for specific education for farmers around the indexes, and daughter proven vs genomic, and increase awareness of tools such as The Genetic Progress Report, and Good Bulls Guide. Make visible the financial benefits of good genetics.
- Streamline data on farm to record ancestry and increase outcrossing at an individual cow level.
- Develop tools to enable Artificial Insemination Technicians to manage individual mating's.

14. Next Steps:

    Creating resources that explain the financial benefits of genetic gain acceleration, and pitching them in a medium term time frame, so the dairy business operators can see why they would pay for herd testing and good genetics in the short term. I would like to corroborate with Tas Herd, the local herd testing company, and talk about the reasons farmers not carrying out herd testing. Working with farmers and LIC, I will look to add value by talking to industry participants to develop tools to help identify poor performing animals. Also asking questions of herd software providers around the capability of their systems to interact with add on's, and the accurate recording and sharing of ancestry data. Also their ability to digest herd test data and help farmers identify performance in their dairy herds.

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- https://niwa.co.nz/education-and-training/schools/resources/climate

Appendices:

Survey Questions:

- What is you average per cow production?
- Breed mix of herd:
- Country Of Origin of genetics?
- Do you use Synchrony?
- How long does mating go for?
- Does your mating program influence the semen you select?(Ie heifer mating = calving ease, FTAI Limits gest length, gestation length = Days in milk)
- What is your 6 week in calf rate
- What is your usual Empty Rate
- Do you think your empty rate or 6 week in calf rate influences your semen choice when selecting semen?
- Do you herd test?
- If No - Reason for not herd testing:
- If Yes - How many per season?
- What is the main reason for herd testing?
- Which herd test results do you use for most for culling decisions?
- Livestock sales: When making breeding decisions what is your first priority for livestock sales: