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RESILIENT FARMING SYSTEMS **COMMODITY AND RURAL LAND PRICE CYCLES**
DAIRYING – THE COST OF PRODUCTION PLANTAIN PASTURE RESILIENCE

NZ Institute of Primary Industry Management

Building the capability and capacity of Rural Professionals

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STEPHEN MACAULAY CEO

CEO's comment

Understanding and responding to volatility in the global dairy market

This year many dairy farmers will face financial losses. It is estimated that New Zealand dairy farms and their supporting rural firms collectively could face up to a $3.5 billion capital shortfall under worst case conditions for 2015/16, which will need to be funded by new debt or equity into the system, or in some cases involve exit. Will it get this bad? We will need to wait until the season is over to find out.

To help understand what has been occurring in the international marketplace, the implications for the New Zealand dairy sector, and to enable the farming community and their advisors to make informed on-farm decisions, a workshop was held at Massey University in Palmerston North during September. The workshop brought together a range of representatives from across the primary industry and government to evaluate and to share collective insights into responding to volatility in the marketplace.

Video conference calls were held with market analysts based out of the US, Europe and China, who provided updates on the current state of international dairy markets and their views on global milk supply and demand drivers. Key points arising from their presentations included:

- 20% of US milk comes from California, which dropped production by 3% due to drought. Expectations are that El Nino may bring rainfall to rebuild snow cap on Sierra Nevada next year, thereby increasing the scope to produce more milk.
- Whilst California has struggled this year, Eastern US has experienced excellent rain with good corn and hay crops being harvested. Wisconsin, the number two milk-producing state, has been up nearly 4.5%. 2014's record profit has rebuilt working capital on farms in Eastern US.
- A steady increase in export sales out of the US accounting for 15-16% of milk production, up from around 4% in 2004.
- More recently, reduced demand for milk products from China. There is an increasing emphasis by central government on boosting domestic production and becoming less reliant on dairy imports.
- In Europe, the removal of milk production quotas has presented opportunities for dairy expansion. Ireland, The Netherlands, North Germany, Denmark and Poland are gearing up their milk production – most likely destined for the global dairy market.
- The supply response out of Europe has not occurred with production up on last year.
- Trade sanctions against Russia have affected the demand for dairy products from Europe, who in turn have focused on alternative markets.

The question is whether there has been a fundamental structural shift in the market, or is this just part of a market cycle? The general view is that this is part of a market cycle rather than a fundamental structural shift, as there has always been some level of regulatory intervention in global markets. However there do appear to be higher than 'normal' factors at play in the global market geared at increasing milk production. So the jury is probably still hung on whether we are facing a structural change or not.

There is no doubt that we are experiencing greater volatility in global dairy markets than ever before, which has implications for profitability and decision-making processes on-farm.

The time between market cycles is decreasing significantly, while the intensity of market cycles is increasing, which are beyond the control of farmers, rural professionals and government under the current market structure. The focus is therefore on the areas within the farm system that farmers and their advisors can control and manage in response to signals from the marketplace.

To this end, gaining more information from the global market and understanding the impact of shifts in supply and demand for dairy products have on the farming business have a critical part to play in enabling farmers and their advisors to make informed decisions. The challenge for rural professionals is keeping up to speed and staying informed on global market shifts for our dairy products and potential implications back on-farm.

The question for me is how do we build platforms that allow the primary industry, government and the rural profession to respond more quickly and in a meaningful way when significant issues occur within the primary industry and the marketplace to enable the right conversations to occur at the right time.

JOHN ROCHE AND BRENDAN HORAN

Resilient farming systems – surviving volatility

In the future, the only constant will be change.

Introduction

In the future, milk price and input prices will be more variable than they have been historically. Farming businesses will need to be resilient; this requires a solid farm system foundation (strategic plan) with the technical expertise to make appropriate tactical decisions (tactical implementation).

Farm businesses must be business focused: they must be designed with land production capacity, soil class and rainfall in mind; they must be based on elite high performance animals; they must be highly efficient per unit of land, labour and capital; and they must limit their exposure to external forces. Such businesses should:

- Provide a reasonable rate of return on equity
- Be environmentally sustainable and animal welfare compliant
- Allow for an enjoyable and rewarding lifestyle
- Allow opportunities for training and personal development.

The business environment for dairy farming is changing. While it has always been difficult to predict international commodity prices or foresee production risks (climate and feed availability and price), the reduction in dairy product stores in Europe and the US and increasing wealth in previously developing countries has led to a price volatility, arguably, not witnessed before. Future milk production will be set against a backdrop of increased farm business uncertainty. As a consequence, modern dairy farming systems must be sufficiently resilient to respond positively and rapidly to change.

> *"If you don't like change, you'll like irrelevance even less"*
>
> *General George Shinseki*

> *"Markets love volatility"*
>
> *Christine Lagarde, Managing Director of IMF*

The need for system resilience is even more important in expanding businesses. Dairy farm expansion has risks, as the additional infrastructural investment must be financed by the existing dairy enterprise(s). Such investment increases expenses and, yet, is almost always accompanied by sub-optimal biological performance initially. This places significant additional pressure on the original farming business. While prudent use of debt is an effective part of a growing business, heavily geared farms are significantly exposed to downturns in product prices, increases in input prices, 'changes' in banking priorities, and the vagaries of climate, particularly during the developmental phase of the new business.

Fundamentally, resilient systems must:

- Have a low production-cost base to insulate the dairy farm business from price shocks
- Allow farms to generate sufficient funds in better times to meet requirements in lean years.

This article discusses the design of our production system against a backdrop of a more uncertain production and economic environment.

What is a resilient farm system?

Resilience denotes the capacity of a system to absorb and thrive in a changing and uncertain production environment. Resilient farm businesses must, therefore, have a plan (strategy) for how the farm will run in an 'average' year.

Resilient farm businesses are those that are designed to utilise their competitive advantages. This requires a 'fit for purpose' system that will provide a consistent level

Resilience denotes the capacity of a system to absorb and thrive in a changing and uncertain production environment.

of production at a consistent price, within the general averages of climate, input price and milk price uncertainty. A resilient farm system will also have sufficient tactical flexibility to overcome unanticipated events that can lower short-term profitability (e.g. cold wet spring, low milk price, etc), but the system principles remain the same.

Although there are many components to a successful farm system, we believe that there are four 'pillars' that define resilient farm systems (**Figure 1**), irrespective of region, rainfall or farming philosophy.

Figure 1: The four 'pillars' of a resilient farm system

Efficient utilisation of available resources

Land-base

Although dairy farms differ in their capacity to produce and utilise pasture at different times of the year, one of the most important drivers of operating profit and, therefore, return on capital, is maximising the amount of pasture that is grown and utilised. This requires consistent monitoring and effective record keeping of pasture grown in each paddock, so that strategic decisions around drainage, fertiliser and pasture reseeding can be made to maximise pasture grown in all paddocks. Although farmers instinctively know their best and worst paddocks, without measuring weekly pasture covers you will not accurately rank paddocks in the middle or the magnitude of the difference between the worst and best – 'You cannot manage what you do not measure'.

The development of management practices to improve pasture production and quality should take precedence over practices informed by individual animal performance. Grazing management is concerned with achieving adequate soil fertility, the reseeding of underperforming swards, and achieving the correct balance between grazing severity and individual animal intake. Grazing to

The decision on how much supplement should be incorporated into the system on an annual basis is a strategic decision.

a consistent post-grazing residual height of 3.5-4.0 cm maximises pasture growth and results in consistently higher quality pasture.

Supplementary feed

The decision to feed supplements and how much supplement should be fed each day is part of tactical management. However, the decision on how much supplement should be incorporated into the system on an annual basis is a strategic decision (i.e. an annual feed budget). This decision is based on the amount of pasture grown, the stock carrying capacity of the land, and the level of financial exposure that the importation of feed creates in the business. Resilient businesses limit exposure to outside influences where possible. The greatest operating expense in dairy farming businesses is purchased feed, leaving dairy businesses that are heavily reliant on bought-in supplements very exposed to the vagaries of international commodity prices. For example, we have recently seen both milk price and supplement prices rise and fall by 30-50% and the requirement for supplementary feed increase by more than 20% in some regions because of drought and poor pasture growth.

In the United Kingdom, Ireland and New Zealand, datasets analysed to determine associations between feeding and cost of production indicate that for every 1c spent on feed, operating expenses increase by 1.3 to 1.6c. This means that a kg of supplement must be purchased for considerably less than the value of the milk it produces. Under ideal circumstances, supplementary feed results in 7.5 g MS/MJ ME consumed (i.e. 80 g milksolids/kg DM for a 10.5-11.0 MJ feed). However, recent farm systems analyses indicate that on-farm responses are only two-thirds of those achieved in research experiments (~55 g MS/kg DM).

DairyNZ proposed a '5% rule' to aid farmers in decision-making around supplementary feeding: to be profitable, feed needs to be purchased for less than 5% of the milk price. This rule accounts for the increase in non-feed costs, but assumes a response of 80 g milksolids/kg DM, 50% greater than the estimated response on the average dairy farm. If, instead, we assume the average milksolids response achieved on-farm, then the *breakeven cost* of feed is actually 3.5% of milk price. This means:

- At a $6 milk price, supplements must be purchased for less than 21 c/kg DM
- At a $5 milk price, supplements must be purchased for less than 17.5 c/kg DM.

The calculated breakeven price for supplements (as a % of milk price), at different milk responses and after accounting for all costs, is presented in **Table 1**.

In addition to considering the price of supplements strategically placed into the dairy system, it is also important to consider the amount of supplement that the farm system depends upon. In analysing the requirement for supplements and the risk of exposure to economic forces external to the farm gate, we propose limiting the use of supplements to less than 500 kg DM/cow. This limits the exposure of the business to an increase in feed prices. These supplements must be purchased for less than 3.5% of milk price (**Table 1**).

Table 1. The breakeven price of supplements (as % of milk price) at different milk prices and responses to supplements – the average milk response to supplementary feed on-farm is highlighted

Response to supplements, g MS/kg DM	Breakeven price for supplements, % milk price
80	5.0%
60	4.0%
55	3.5%
40	2.5%
20	1.5%

Supplements used tactically to fill unexpected feed deficits can be priced according to need, and the value proposition can be evaluated using the DairyNZ supplement price calculator (www.dairynz.co.nz/feed/feed-management-tools/supplement-price-calculator/), but most supplements must be sourced at less than 3.5% of milk price.

In future, on-farm management practices must be tailored to achieve excellent nutrient management.

Environment

The efficiency of nitrogen (N) and phosphorus (P) use within pasture-based systems is variable and can potentially result in nutrient loss to water resources. In future, on-farm management practices must be tailored to achieve excellent nutrient management. Intensive production systems require grazing and nutrient management practices that increase the efficiency of effluent use, optimise fertiliser N use, and minimise the cultivation of grasslands and nutrient overloading associated with external feed supplementation. Recent evidence from both New Zealand and Ireland suggests that where intensification (i.e. more milk/ha) is fuelled by increased grazed pasture utilisation (i.e. increased stocking rate), nitrate leaching can be reduced, but when intensification is fuelled by purchased feed, nitrate leaching increases.

The appropriate animal for the system

If we accept that the comparative advantage of dairy production in New Zealand involves the efficient utilisation of grazed pasture, then the appropriate cow must be able to harvest pasture efficiently. To do this in a farm system context, she must re-calve every 365 days to ensure peak intake demand coincides with peak pasture supply, she must be an aggressive grazer, and her live weight must be no more than is required to maximise intake (i.e. big cows do not eat proportionally more than medium-sized cows in grazing systems). Excellent research over the last two decades has led to the production of a multi-factor, profit-focused, breeding index – Breeding Worth (BW) – that takes the guess work out of choosing the appropriate cow for New Zealand dairy systems. In addition to BW, crossbreeding may offer significant financial reward, improving production and fertility beyond the value of the improvement in BW.

Developing people

Dairy production systems must be simple and labour efficient, providing adequate time off and training opportunities for those working in the business. The requirement for greater labour efficiency increases the need for an easy care dairy cow and simplicity in operational protocols to minimise the requirement for additional labour. It is also essential to enable sufficient time for farm staff and owners to develop new skills that will increase the efficiency of the production system, and to make farming a viable and attractive career choice relative to a 40 hour working week in town.

The need for continuous improvement cannot be overstated. It will be vital that farmers are adaptable, flexible and able to make appropriate decisions quickly. In the past, farm management was dominated by production economics, and farmer learning has traditionally focused on plant and animal husbandry rather than the acquisition of broad management skills. With modern dairy farming increasing in complexity, farmers of the future need a broader range of management skills (e.g. human resources, contract negotiation, forward contracting of milk and feed). The rapid pace of change in technologies necessitates lifelong learning and continuous education and training to ensure the viability and sustainability of farming businesses.

Developing a business discipline

Dairy farmers will need an increased level of understanding of business principles if they are to prosper in a tumultuous 'price-taker' environment. Every dairy farm business needs to develop their farming operations in a manner consistent with the requirements of a vibrant business for the future: upgrading skills in financial management (e.g. accounting, business structures, strategic planning, succession planning), people management, communication and negotiation. In addition, skills in technically efficient sustainable farm management will be essential. Recent studies have highlighted the important role of financial management skills in underpinning successful dairy farm businesses, as people with these achieve a higher level of business growth in the long term.

Resilient farm systems and comparative stocking rate

In the last section we defined a resilient farm system as any system that efficiently utilises natural resources in an environmentally sustainable manner using appropriate dairy cattle genetics, thereby generating sufficient financial reward and free time to achieve lifestyle and wealth creation goals. This definition was predicated on continuous professional improvement and a strong business acumen. In this section, we combine these parameters to produce a 'strawman' system as an example of what we believe a resilient farm system will look like.

A resilient system needs to account for land class and usability, supplement purchases and the type of cow being used. These factors are encapsulated in the concept of comparative stocking rate (CSR):

- When most people hear the term *stocking rate*, they automatically equate this with cows/ha. But this metric does not allow people to compare different land classes or regions capable of growing different amounts of pasture, differences in the size of cows (e.g. 2.5 Jersey cows require less feed than 2.5 Friesian cows), or in the amount of supplement purchased.
- The use of the metric *live weight per/ha* was an improvement over cows/ha, as it accounted for the different demands of different-sized cows, but it does not account for purchased supplements. Considering the contribution of purchased supplement to variable expenses, failure to plan usage of supplements undermines the resilience of the system.
- *CSR* is an attempt to include all of these variables in the one metric, whereby the carrying capacity of the farm is defined by the live weight of the cows, the potential of the land to produce pasture and the amount of supplement purchased. Simply put, CSR is defined as the amount of live weight that can be fed per tonne of feed DM available (kg of live weight per tonne of feed DM available: kg Lwt/t DM).

What is the optimum stocking rate?

We already proposed that to limit exposure to international commodity prices, resilient farm systems should maximise the use of grazed pasture and limit planned supplement purchases to no more than 0.5 t DM/cow. We also

'The difference between a good farmer and a bad farmer is a week'.

established that a crossbred cow of high BW was the most efficient cow for a grazing system. In addition to BW and crossbreeding, however, we believe that cows should average no more than 500 kg live weight, with, arguably, no advantage to cows greater than 550 kg live weight in the herd. The relationship between cow live weight and DM intake in a grazing system is not linear. Intake increases with cow live weight up to about 500 kg, but the factors regulating grazing behaviour limit further increases in DM intake with increasing cow size in a largely pasture-based diet. Although bigger cows can eat more total DM intake and, therefore, may have some value in systems feeding higher amounts of supplement, justifying these cows in this way *leads* to the greater use of supplements, which, we believe, undermines the resilience of the system.

With these variables in mind, the results of extensive New Zealand farm systems research indicate that the optimum CSR for grazing systems is between 75 and 85 kg live weight/t DM. This is equivalent to *offering* a 400 kg cow between 5.0 and 5.5 t DM total feed DM/year or a 500 kg cow between 6.0 and 6.5 t. This means that the optimum stocking rate will be different for different farms and different farm systems. In **Table 2**, the optimum stocking rate for farms that produce different amounts of pasture and feed different amounts of supplement are defined. For example:

- A farm capable of growing 12 t DM pasture/ha while feeding 0.5 t supplement DM/cow to 500 kg cows should be stocked at 2.2 cows/ha
- A farm capable of growing 18 t DM pasture/ha while feeding 0.5 t supplement DM/cow to 400 kg cows should be stocked at 4.0 cows/ha.

If the actual stocking rate is less than optimum, the farm should be feeding less supplement/cow, while more supplements at the optimum stocking rate indicates that either pasture growth is overestimated or that pasture grown is being wasted.

Although not foolproof, the concept of CSR allows farmers to set a stake in the ground regarding the optimum stocking rate for their farm. This does not suggest 500 kg DM supplement/cow should be a target in years where pasture growth exceeds the average used in strategic planning or where milk price drops and supplement price does not follow suit; nor does it preclude the use of more supplements in poor pasture growth years or for winter milk. Such decisions are tactical and must be made with all of the available immediate information. Nevertheless, it allows you to plan what the number of cows on the available land should be and makes mistakes around use of supplementary feed less likely.

Table 2: Stocking rate* (in shaded boxes: cows/ha) that optimises profit on farms growing different amounts of pasture and feeding different amounts of supplement/cow – the proposed stocking rates for a resilient system are highlighted

	400 kg cow					500 kg cow				
	Pasture grown, t DM/ha					Pasture grown, t DM/ha				
Supplement fed/cow, t DM	12	14	16	18	20	12	14	16	18	20
0.00	2.4	2.8	3.2	3.6	4.0	1.9	2.2	2.6	2.9	3.2
0.25	2.5	2.9	3.4	3.8	4.2	2.0	2.3	2.7	3.0	3.3
0.50	2.7	3.1	3.5	4.0	4.4	2.1	2.4	2.8	3.1	3.5
1.00	3.0	3.4	3.9	4.4	4.9	2.3	2.6	3.0	3.4	3.8
1.50	3.3	3.8	4.3	4.9	5.4	2.5	2.9	3.3	3.7	4.1
2.00	3.7	4.2	4.8	5.4	5.9	2.7	3.2	3.6	4.0	4.4

*All of these stocking rates equate to 80 kg live weight/t feed DM available.

Tactical management

Tactical management involves making short-term decisions to ensure the viability of the business (i.e. tactical management is about reacting to an immediate or upcoming situation). For example, during bad weather, the need for supplements will be greater because of poor pasture growth or an inability to utilise the pasture grown, whereas when pasture growth exceeds demands, supplement use should be less than budgeted and/or the amount of silage harvested greater.

> *“Change before you have to”*
>
> *Jack Welch*

The importance of tactical management cannot be overstated; this is where the farmer's ability and experience of their own farm come into play – 'the difference between a good farmer and a bad farmer is a week'. In other words, they will both do virtually the same thing; the big difference is the timing of action. The effect this has on farm profit, however, can be extraordinary.

Tactical management decisions must be made in conjunction with a cash flow budget. As an example, in years where milk price is low and supplement price high, it would be unwise to feed all of the supplements budgeted for in the strategic plan. As a consequence, cows will be fed a little less and will produce less milk. But the overall viability of the business will be more secure, as the expense would not have returned value. This is not a recommendation to grossly underfeed cows; it is merely a recognition that the total response to the last 1-2 kg of supplements will not pay for the supplement. Nor will this undermine the cow's welfare, as she will reduce her milk production commensurate with the drop in energy intake and so negative energy balance is not greatly affected. A slight restriction will not impact reproduction. Management issues such as this cannot be planned for. However, the strategic plan facilitates a non-emotive more objective decision, ensuring business viability.

The forecast for food production is bright, but there will be periods of heavy rain.

Conclusions

The forecast for food production is bright, but there will be periods of heavy rain. Demand for dairy products and, therefore, average milk prices will, we expect, be higher than historical values, but there will also be periods when commodity prices soften and milk price drops. Successful dairy farm businesses will need to be resilient. Resilience in any business requires a solid system foundation (a strategic plan) with the technical expertise to make appropriate tactical management decisions.

Resilient dairy farm systems must be designed with land production capacity, soil class and rainfall in mind, they must be based on elite high performance animals suited to the system, and they must be highly efficient per unit of land, labour and capital. Such businesses must give a reasonable return on equity, be environmentally and animal welfare compliant, and provide an enjoyable and rewarding lifestyle for those working on the business. The key pillars of a resilient farm business are the efficient utilisation of natural resources, a 'fit for purpose' animal, a strong business acumen in management, and a policy of continuous improvement for staff at all levels of the business.

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PHIL JOURNEAUX

Dairying – the cost of production

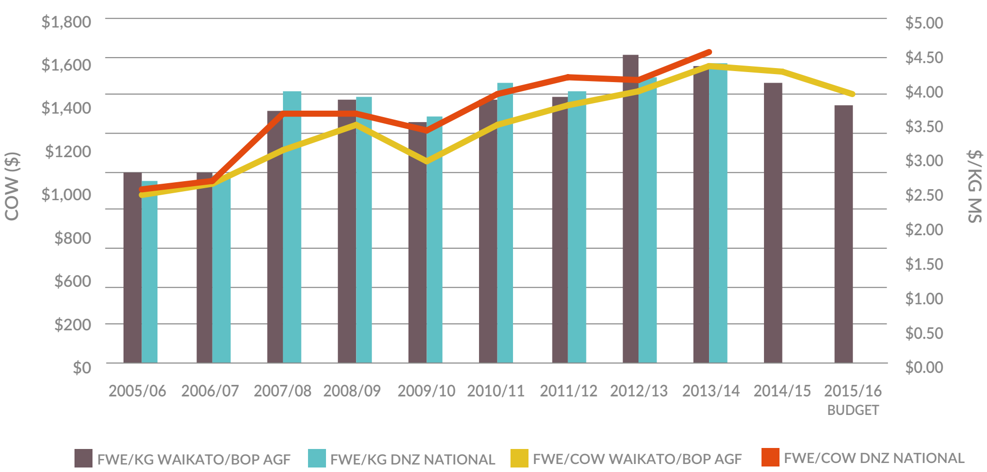
With the drop in payout over the last two years, there is a renewed concentration on farm expenditure, as farmers endeavour to reduce costs in line with the payout in order to remain profitable.

The recent financial survey carried out by AgFirst in the Waikato/Bay of Plenty indicated that farmers were seriously looking to reduce costs, with debt reduction, capital and development spending early casualties, followed by reductions in farm working expenses, particularly supplementary feed, fertiliser, and repairs and maintenance. The overall profitability of the average Waikato/Bay of Plenty (BoP) farm over the last decade is shown below.

Figure 1: Waikato/BoP profitability trends. Source: MPI, AgFirst

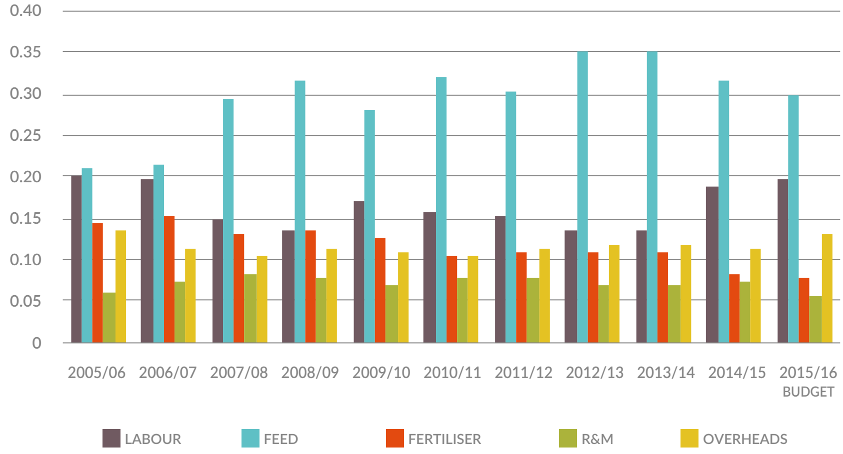
As can be seen from this figure, farm working expenses in 2015/16 are currently budgeted higher than net cash income. The trends in farm working expenses, from both the Waikato/BoP survey and the national figures from DairyNZ, in both $/kg milksolids and $/cow, are shown below.

Figure 2: Trends in farm working expenses (FWE)



As can be seen from **Figure 2**, there has been a general upwards trend through to 2013/14, and a switch downwards in 2014/15 and 2015/16. Within farm working expenses, there are definite trends as to which items make up the bulk of expenditure. This is illustrated in **Figure 3**.

Figure 3: Waikato/BoP FWE items as a proportion of total FWE



Supplementary feed, which includes off-farm grazing, is the single biggest expenditure item, averaging 30% of total annual expenditure.

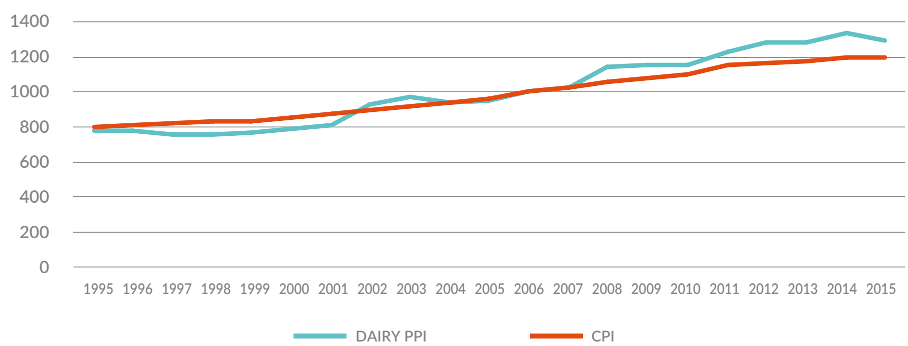
This shows that supplementary feed, which includes off-farm grazing, is the single biggest expenditure item, averaging 30% of total annual expenditure over the period. As the figure illustrates, expenditure on supplementary feed took a significant jump in 2007/08 as a result of the drought that year, and then generally never looked backwards. With the drop in payout over the last two years, expenditure on supplementary feed is an obvious target, although many farmers are finding it now tends to be more of a fixed cost rather than a discretionary one. Aspects that need to be considered here include whether supplement is being substituted for pasture, the response to the supplement and, above all, whether marginal profit from extra feed is greater than marginal cost.

The next largest cost is labour. While its proportion of total farm working expenses has varied, this is mostly related to fluctuations in production rather than changes in payments; these tend to be (a) fixed, and (b) have generally followed an upward curve, especially in recent years.

Fertiliser and repairs and maintenance are traditional targets for reduced spending as a result of lower payouts. At least in the Waikato, with a history of good fertiliser applications, a short-term reduction should have minimal impacts. Overheads include a range of expenditure items – phone and mail, accountancy, legal, consultancy, rates, insurance and ACC. Most of these are fixed costs, and most have had a steady upward trajectory over many years.

Part of the issue in controlling cost on-farm is that on-farm inflation over the last decade has been increasing at a steady rate, above that of general inflation as measured by the consumer price index (CPI). This is due to (relatively) high inflation within the domestic economy, which is offset by deflation/low inflation imported from the international economy. Unfortunately, most on-farm costs are generated via the domestic economy. The difference in general inflation as measured by the CPI, and on-farm inflation as measured by the dairy producer price index (PPI), is illustrated below.

Figure 4: Dairy PPI versus CPI. Source: Statistics NZ, June years, 2006 =1000

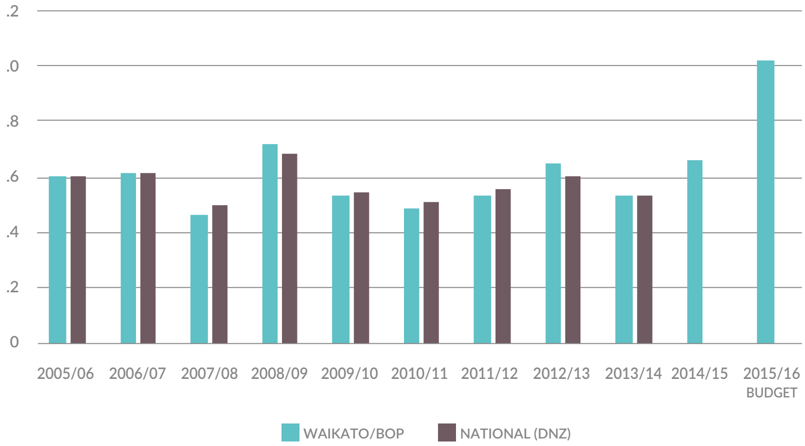


Over the last two decades the PPI compound rate is 2.4%, compared to 2.0% for the CPI. Over the last decade the compound rate for the PPI is 2.8%, compared to 2.0% for the CPI. While these differences may look small, the magic of compound interest means the absolute differences grow rapidly. Interestingly, there is an 85% correlation in movement between the payout and the dairy PPI. The dairy PPI has also shown wide fluctuations, and even decreases, compared to the CPI.

Figure 5: Percentage variation in the dairy PPI versus the CPI

While there is some variation in the proportion of net cash income that farm working expenses takes up, this variation tends to be reasonably narrow, as illustrated below.

Figure 6: Farm working expenses as a proportion of net cash income



Interestingly, the mean across both datasets, ignoring 2015/16 (as it is currently only a budget figure), is 58%. There is also a wide variation in farm working expenses at the farm level as illustrated below.

Table 1: Variation in FWEs from the 2014/15 financial survey

WAIKATO/BAY OF PLENTY

	2014/15			2015/16 budget		
	Lowest	Highest	Average	Lowest	Highest	Average
$/kg MS	2.65	5.06	3.93	1.64	4.26	3.47
$/cow	919	2,282	1,473	762	1,734	1,304

SOUTHLAND

	2014/15			2015/16 budget		
	Lowest	Highest	Average	Lowest	Highest	Average
$/kg MS	3.04	5.39	4.36	2.39	5.06	3.94
$/cow	1,232	2,518	1,787	1,103	2,397	1,722

Within this of course there are wide variations in individual expenditure items between farms, depending on a large range of factors such as soil type and topography, farm system, stage of development and managerial skill of the farmer. An example of this variation is illustrated in **Table 2**.

There are wide variations in individual expenditure items between farms, depending on a large range of factors such as soil type and topography, farm system, stage of development and managerial skill of the farmer.

Table 2: Variation in selected 2014/15 FWE costs from the monitored farms ($/kg MS)

	WAIKATO/BOP			SOUTHLAND		
	Lowest	Highest	Average	Lowest	Highest	Average
Total feed costs	0.10	1.77	0.72	1.15	2.25	1.72
Fertiliser	0.05	0.61	0.32	0.24	0.77	0.45
Repairs and maintenance	0.11	0.66	0.30	0.02	0.46	0.18

While it is inevitable that expenditure will rise when payouts increase, the difficulty lies with reining it back when payouts fall. At a payout of $8.40/kg MS it is difficult (but not impossible) to spend too much. At a $3.85/kg MS payout it becomes imperative to trim everything possible. A characteristic of the consistently more profitable farms is their iron control on costs. And, having made a major effort to control costs in 2015/16, it would be a pity to let things slip.

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JEREMY SAVAGE

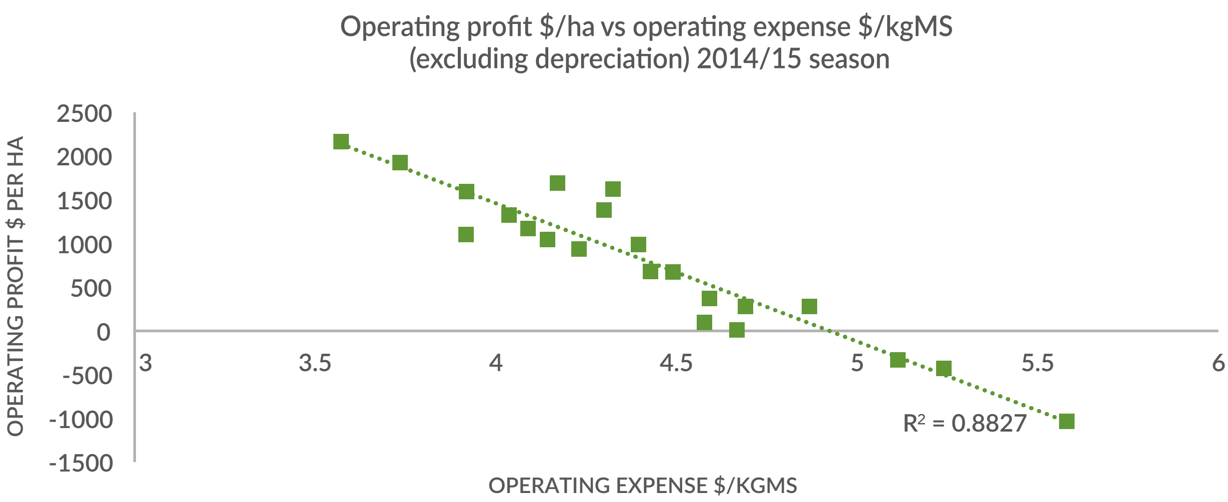
Focus on farm programs for profitable low cost farm systems

The ceiling has been the limit for Canterbury dairy farm programs. On high-performing, well-irrigated farms the ceiling has been 2,000 to 2,200 kgMS/ha. But at what cost? Both to the environment, and of greatest urgency in the past 15 months, to the bank account.

Farm business performance

This article explores some of our findings from our client base across the South Island. At Macfarlane Rural Business we have been analysing farm programs with Dairy Systems Monitoring (DSM), a database that benchmarks client's performance relative to each other. Farmax Dairy is used to model farm performance. We use cashflow forecasts, and actuals (Cashmanager) to compare financial performance. As much as possible we use the same procedures as DairyBase.

Figure 1: The relationship between MRB's client base 2014/15 actual operating expenditure $/kgMS (excl. depreciation) and operating profit $/ha



Key performance indicators

Operating expenditure continues to be the key driver of profitable farm systems. Analysis of the main key performance indicators (KPIs) from the client base is given in **Table 1**. Consistent with DairyBase results, farm operating expenditure is one of the key drivers of operating expenditure. High feed harvested per cow and high production per cow also have a good relationship with operating profit. Production per hectare does not drive profitability; it takes high payouts before a poor relationship exists.

Production per hectare does not drive profitability; it takes high payouts before a poor relationship exists.

Table 1: Key relationships from 2014/15 DSM data using Farmax Dairy

Relationship			R-squared
Operating expenditure ($/kgMS)	vs	Operating profit ($/ha)	0.88
Feed harvested (kgDM/cow)	vs	Operating profit ($/ha)	0.62
Production per cow (kgMS/cow)	vs	Operating profit ($/ha)	0.72
Production per ha (kgMS/ha)	vs	Operating profit ($/ha) $6.00/kgMS	0.28
Production per ha (kgMS/ha)	vs	Operating profit ($/ha) $4.40/kgMS	0.09
Production per ha (kgMS/ha)	vs	Operating profit ($/ha) $8.00/kgMS	0.51

Observations of client base farm systems

Farm working expenditure $3.60-$4.00/kgMS

- Per cow production 470-520 kgMS/cow
- Using 500-700 kgDM of supplement
- Feed harvested per cow 3,800-4,200 kgDM/cow
- Stocking rate driven off achieving feed harvested per cow – typically 3.2-3.6 cows/ha
- Cheaper irrigation sources, e.g. shallow water, surface water

Farm working expenditure $4.00-$4.40/kgMS

- Wider range of feed harvested per cow 3,600-4,000 kgDM/cow
- Stocking rate driven off achieving feed harvested per cow – typically 3.2-3.6 cows/ha
- Per cow production 440-470 kgMS/cow
- Using 600-800 kgDM of supplement
- Dearer water

Farm working expenditure $4.40+/kgMS

- Higher stocking rate which does not support a higher feed harvested per cow – per cow production 440-470 kgMS/cow
- Using 900-1,200 kgDM of supplement
- Lower feed harvested per cow 3,400-3,800 kgDM/cow
- Sometimes leasing land for support, which is not being well utilised
- Expensive water

Exceptions to these rules:

- High input farms (supplement 1,200 kgDM/cow) achieving very high per cow production (550-600 kgMS/cow)
- Farms with one-off expenditures, e.g. storm damage impacting supplements
- Farms run in conjunction with arable farm programs. When grass can be brought across the boundary, costs can sometimes be very low. These farms also have a shared cost structure associated with overheads and vehicles.

Focus on feed harvested

We have noted a number of farms able to achieve a low cost structure by focusing on very high feed harvested per cow/high per cow production while minimising supplement use, which has been a deliberate strategy. This is also a key focus of the Lincoln University Dairy Farm (LUDF).

Table 2: Changes in feed use over time

	2003/04	2007/08	2009/10	2013/14	2014/15
Feed harvested (TDM/ha)	12.1	11.5	12.3	11.6	12.1
Stocking rate	3.3	3.32	3.42	3.47	3.46
Per cow production (kgMS)	382	383	416	438	450
Pasture harvested kgDM/cow	3,667	3456	3600	3,346	3445
Forage harvested kgDM/cow	-	-	-	43	90
Supplements kgDM/cow	623	680	637	967	855
Feed intake per cow (kgDM)	4,290	4,136	4,237	4,355	4390
Supplement as % of diet	15%	16%	15%	22%	19%
kgDM per KgMS	11.2	10.8	10.2	9.9	9.8

Many farms are operating with the stocking rate too high. The cows are not being fed enough to express their genetic potential for milk production.

Important trends

We now have over 10 years of calibrated model data for DSM. There are a number of key points to note from the data and trends, starting with 36 farms, peaking at 92 for 2013/14:

- Feed harvested is not lifting
- We have increased our stocking rate over time
- Supplement use and forages have increased over the last two seasons in particular. As previously noted, this is due to an increased standard of management around feeding cows, especially feed quality and maintaining feed intakes and consistency of feeding.

Most farms expect to grow and harvest more feed every year. For our established, well-managed farms this is not viable. To increase feed harvested, structural changes are needed, such as irrigation upgrade or improvement in reliability of irrigation water. Southland farms we model also have a reasonably stable feed harvested which is not lifting over time.

Many farms are operating with the stocking rate too high. The cows are not being fed enough to express their genetic potential for milk production. The breeding that is carried out allows cows to increase production by 1% to 1.5 % per year. For the cows to achieve this production, they need to either be fed more supplements or offered more grass. If a farm is not improving in feed grown for the year, consideration needs to be given to dropping the stocking rate to feed the cows on pasture – the most profitable option. Taking this theory to a conclusion, you need to drop your stocking rate by 1% per year to make a return on your breeding. A stocking rate which is 3.5 cows/ha today, at 400 kgMS/cow (1,400 kgMS/ha), equates to 3.32 cows/ha in five years at 432 kgMS/cow (1,430 kgMS/ha).

We noted that the average stocking rate in DSM is not dropping. Farmers are responding to increase per cow production potential by increasing supplement use rather than dropping their stocking rate. Similar trends are noted in the LIC New Zealand Dairy Statistics.

'Stocking rate is the most important driver to your farm's profitability' – a line often driven by key farm system researchers. We have noted that stocking rate can be manipulated to drive the feed harvested per cow. We have defined the appropriate stocking rate as:

$$\text{Stocking rate} = \frac{\text{Feed harvested per hectare (kgDM/ha)}}{\text{Feed harvested per cow target (kgDM/cow)}}$$

We used feed harvested as defined by FarmMax Dairy or UDDER. Both models are similar.
Observations from our client base, and from consultants using DSM nationwide, are shown in **Table 3**.

Table 3: Pasture harvested per cow (kgDM/cow) targets

Target pasture harvested per cow	Typical dynamics of farm and cows
3,800-4,200 kgDM/cow	High quality pastures, reliable growth and good shoulder season growth, e.g. LUDF
3,600-3,800 kgDM/cow	High quality pastures; often high altitude farms with limited growth in the shoulders
3,400-3,600 kgDM/cow	Poorer quality pastures; drought-prone farms
3,400 or less kg DM/cow	Drought-prone farms; once-a-day milking

Conclusion

For many of our clients we have lowered farm working expenditure ($/kgMS) by focusing on their farm program. With Farmax farm modelling and benchmarking, we have confirmed their feed harvested and the client has accepted that this is stable and not moving. This is a key outcome when working with dairy farmers. Once this is achieved, we set the farm program and stocking rate at what we assess as the farm's 'sweet spot'. Key components of the farms 'sweet spot' farm programs are: a high pasture harvested per cow; high per cow production; management and staff capable of delivering the targets and support is given to fill in any gaps; and the lowest cost farm program ($/kgMS) to deliver the highest profits on a sustainable basis.

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KEVIN WILSON

Commodity and rural land price cycles

Commodity price cycles have been around for centuries. Finding sustainable solutions to avoid the consequences of a commodity bust has occupied many minds for the same length of time without real success. This article sets out the characteristics of commodities and commodity price cycles and details some macro policies that attempt to soften the cycles.

The repetitive behaviour of business in booms is identified, as is the unaltered recipe for dealing with a bust. Rural land price cycles are also not new. The question of whether the price of land fairly reflects the value of all farm land is discussed. It is concluded that rural land and commodity price cycles come and go as do the associated business behaviours. The lessons from the history of price cycles are quickly forgotten by many.

Commodities

A commodity is a basic unrefined or partially refined, tradeable, homogeneous product or resource that is often the basis of a more complex product. Suppliers can usually only differentiate from another supplier by price. The price of a commodity is driven by the simple concept of the balance between supply and demand. However the interactions between the two are complex.

Supply can be influenced by one or more of: the weather, shelf-life, lead time to production, cost of production, tariffs, taxes, trade barriers, government regulation, the presence or absence of marketing organisations, wars and terrorist activity. Demand drivers include several of the above plus the number of buyers, consumer income, cultural festivals, confidence, perceptions about food safety and service levels. Price and supply are also influenced by the price, quality and availability of substitutes. The list goes on to include the level of economic activity, relative exchange rates, the levels of inventories and the presence or absence of speculators in the market. The above lists are not all inclusive.

Commodity price cycles

Much has been written on the origin and behaviour of commodity price cycles, often with conflicting views between academic papers. Two ways of describing a boom or bust are described. One focuses on the extent of a deviation from a price trend. The trend is quite sensitive to the start and end points of the time periods used in the analysis. The booms and busts tend to be more frequent in this methodology. The second method took a longer-term view by considering the period of absolute increase or absolute decline. Several trend booms and busts can occur within a period of absolute price rise or decline.

The main characteristics of price cycles are their frequency, amplitude and duration. The three characteristics vary between commodities and are influenced by the underlying circumstances applicable at the time. Several observations can be made and contested. Commodity prices have and always will be volatile. The only debate is the matter of degree, i.e. the magnitude of the amplitude in the cycle. A 20% change in the annual average price of a commodity between years is common.

Volatility

Are commodity prices more volatile now than in the past? The answer depends on the periods chosen and the analyst's definition of a boom and bust. One paper suggested that commodity prices between the end of World War Two and the early 1970s were less volatile than the later period (to 1999). The increased volatility was attributed to the abandonment of fixed exchange rates

Table 1: Volatility of selected commodities

Period	Coal	Oil	Coffee	Tea	Soya meal	Wheat	Aluminium	Copper	Gold
1963-1996	16	41	38	23	29	35	47	53	44
1997-2014	44	67	67	28	39	56	39	50	50
1963-2014	28	50	48	25	33	42	44	52	46

Source: Derived from World Bank commodity data

Booms and busts are often rapid and unexpected. Slumps tend to last longer than booms.

linked to a gold standard (the Bretton Woods Agreement) in 1973. Selected data supports increased volatility over the past 18 years (1997 to 2014 inclusive) compared to the previous 34 years (1963 to 1996 inclusive). The measure used in this instance is the percentage of annual average price changes that were greater than plus/minus 20% in the reference periods.

But as usual there are exceptions. The price volatility for tea, aluminium, copper and gold is similar in both periods. Before you ask, the comparable figures for Oceania sourced whole milk powder (WMP) for the period 1997 to 2014 are 58% for the price in USD terms and 47% when the USD price is converted to NZD at the spot rate. Another international USD price series for WMP from 1979 to 1996 had slightly less volatility at 46% and that was in a period of minimum prices and inventory controls in the European Union. And, as noted earlier, the analysis is sensitive to the periods used.

The reasons attributed to each boom and bust vary, but the result is the same. A period of abnormal or super-high prices is usually followed by a period of below normal or super-low prices. There are several techniques used for deciding what an abnormal price is, which are often based on the extent of the deviation from a rolling period average or simple annual period average. Pet techniques abound, as do more complicated mathematical models.

There are no consistent patterns in the frequency, amplitude and duration of commodity cycles, either within a category of commodities, e.g. food, or between categories such as food and energy. That said, the price of commodity products within a family of commodities may be linked quite closely, e.g. dairy commodities, or conversely not linked, such as fruit. Bananas and oranges are an example where all round supply is priced quite differently from seasonal supply fruit such as cherries, apricots and kiwifruit. Prices for the later fruit can attract a significant premium at the beginning of the season compared to prices for the same fruit at the end of the season.

Booms and busts are often rapid and unexpected. Slumps tend to last longer than booms. The length of time in a period of boom or bust is independent of the time in that state, i.e. the length of time a boom is being experienced is no indicator of how long the boom will continue for.

A consequence of a boom and bust can be a major change in the fundamentals of supply and demand or, in other words, a structural shift. Technological advances in the oil industry which developed fracking and boosted the supply of oil from previously inaccessible/uneconomic sources would be an example. The structural shift may be short-lived, but may become permanent, e.g. transition from coal-fired boilers in ships to oil-fired and then to diesel electric power units.

Uncertainty

There has also always been uncertainty about commodity prices in the future. Again, it is a matter of degree. The level of price volatility itself is an indication of the degree of uncertainty about the future. There always appears to be extenuating existing circumstance(s) highlighted by commentators or economists. But extenuating circumstances come and go to be replaced by another set. The world doesn't end and the uncertainty always remains.

Macro policies and commodity price cycles

The economic cost of interfering in commodity markets can be high, unsustainable, have unintended consequences, or be a combination of all three. The use of monopoly powers, large cartels or agreements between producers and users are now mostly banned in democratic countries by anti-trust or competition laws and/or regulation. Such laws and regulations are not always enforced in countries with combinations of weak governments, administrations or judiciary.

Extenuating circumstances come and go to be replaced by another set. The world doesn't end and the uncertainty always remains.

Government intervention with the use of stabilisation funds is another macro mechanism, e.g. the New Zealand Dairy Board up to 1988. Managing inventory is another mechanism that has been tried (New Zealand and Australian Wool Boards) and still exists in some lesser forms, e.g. European Union intervention stocks of butter and skim milk powder. The product still has to be sold and biological production is not easy to turn off, so the next season's production can add to the amount of product to be sold with a double whammy effect on price.

Governments can attempt to control supply thorough quotas, taxes, tariffs, phytosanitary requirements and marketing boards. Compensation for low prices can be offered via support prices (think Supplementary Minimum Prices in New Zealand in the early 1970s) or below cost finance. Crop insurance in the US is a form of price support.

All the above can have their sustainability tested in a prolonged downturn. The costs to governments or producer bodies quickly escalate to some large dollar sums, which cannot be financed or only at a high direct or indirect cost. They also have unintended consequences by reducing innovation, insulating asset prices from the real economic return, and lead to a misallocation of resources.

They become politically difficult to remove and their removal can create another price shock to the commodity and/or an economic shock to the industry and associated businesses.

The costs of mismanaged macro policies can well exceed any benefits and may be bigger than letting market forces apply, albeit that can be a very painful process for the individuals involved.

Inherent business behaviour

The increases in a commodity price always boost confidence in the industry producing the commodity and in associated industries. Asset values respond positively and arguably get in front of the economic ball. Credit is easier to obtain and there is often talk of a new higher long-term price. The rate of innovation accelerates, systems change, may intensify and may also add more fixed cost. Businesses expand and risks are taken. That is business. A boom exacerbates all the above and shortens memories even more quickly, but history shows that the commodity price cycle will reappear. The known unknown is when.

Business strategies

There is nothing new to offer here. Being prepared and good management are key and are old messages from the past. Getting bigger and extending the global reach of commodity manufacturing companies, adding value, or combinations of all three are often touted as a way of reducing commodity price volatility. There is ample international evidence that this strategy does not always work. The benefits of scale, global reach and adding more value than cost require above average management to plan, implement, manage and monitor progress.

The good management message is the same at an individual business level and that has been said many times by well-qualified people. At the risk of repetition, a few pointers are offered. All businesses of every type (and first homeowners) are always most vulnerable to an economic shock in the first three or so years of commencing. Take the time to consolidate the ingoing position before making another move. Get the operation and systems in order, including the cash flow and liquidity as quickly as possible. Before the next move is made, consider the risks and some actions that could be undertaken should a crisis arrive in the next vulnerable period before committing. Consolidation before expansion and planning for risk have not been fashionable strategies in the past 25 years.

Read the signs. Nobody talks down a boom. Be prepared. When the crisis arrives re-look at everything. Be aware of marginal costs and marginal returns. Work on what you can control. Plan, implement, monitor and control with even more vigour. Finally, look after yourself and your family. Advice is easy for me to write and hard for people in crisis to remember to do.

Rural land prices and commodity cycles

New Zealand agriculture and rural land prices have never been exempt from agricultural and other commodity price cycles (land is taken to mean the underlying land plus improvements to the land). Commodity prices are only one influence on the value of rural land, and rarely in isolation, but low prices for agricultural produce has featured in all the instances where the price of rural land declined. One or more of global economic depression, politics, economic reform and financial crises have also featured. An attempt to separate the impact of commodity prices from other influences would involve major econometric modelling well beyond the skill of the author. It is suspected that the statistical reliability of the answer would be low due to the large number of variables involved.

The price of land in New Zealand has had at least six booms followed by a fall, as opposed to a big slow-down in a continuing rate of increase. Periods in the 1870s, early 1920s, the early 1930s, late 1980s, mid-1990s and 2009/10 come to mind. The last three mentioned have similar behaviours. The number of sales is falling before price starts declining. Sales recover before the price starts increasing but never regain the previous peak. The period from peak price to the bottom has been two to four years followed by another three or four years to regain the previous price level.

Table 2: Comparative data for three periods of falling rural land prices

Period around	1987	1996	2009
Sales			
Reduction in numbers from peak price (%)	-50	-30	-65
Years of decline from peak price	5	3	3
Price			
Fall in price (%)	-30	-30	-25
Years of decline	4	2	2
Years from low point back to previous high	4	3	3

Source: Derived from date sourced from Valuation NZ and the Real Estate Institute of NZ

It is of interest to note that the number of sales for the year-end December 2014 is still 26% less than the number of sales at the peak price at year-end December 2008. The comparable measure for the year ending June 2015 is a reduction of 35% in the number of sales from the peak price.

Land prices decline in periods of commodity and/or severe economic shocks as the 'willing seller/willing buyer' concept gets distorted. The number of willing sellers falls to be replaced by vendors under increasing pressure from cash flow issues arising from too much debt for the current situation, an inability to cope with the low prices, adverse weather or a combination of all three. Unhappy domestic circumstances caused by the above may be an added pressure on the vendor, their families and advisors. Downturns also provide opportunities which the canny purchaser exploits. That again is business. The cycle has been repeated three times in the past 30 years and maybe a fourth is about to start. Do we not learn or is re-learning old principles part of business?

Price or value

Price can be described as the units of exchange received at the point in time that a good or service is exchanged. Price often appears to be more influenced by immediate economic, political and social circumstances than by a longer-term economic view. Worth or value is an economic concept. It can be described as the present value of future benefits, especially for an income-generating asset. The present value of a cash flow is calculated from a stream of future income less a stream of future costs at a discount rate. Obviously the answer is sensitive to inputs viz. the estimates of income, costs, discount rate and the time period of the analysis – all of which are a matter of opinion. The discount rate reflects any risk associated with the cash flow. Convention is that the discount rate is based on a risk-free rate (a government bond) plus a premium for risk.

Value calculated as described is a point in time estimate, but assumes a degree of stability because of the extended time period considered. Economic value will gradually change over time as the assumptions shift and it is independent of the number of buyers or sellers. It does not reflect any subjective qualitative aspects of the investment that may influence price.

Prices for commodities and land can increase when there are more buyers than sellers and/or confidence is high. Arguably, price exceeds economic value at this point unless the market applies a lower discount rate than was used in an earlier calculation. Share markets are considered over-valued when price earnings ratios trend well above 14 or 15, but the market still 'values' the total number of shares issued on the high price of the day. The price received for a portion of the shares on issue is assumed to be the value of the total number of shares.

The converse logic is also applied. However the high price could be expected to fall, or maybe collapse, if the total shares issued by a company were all offered for sale on the same day. Also the 'value' would remain assuming the underlying profitability of the company was sound. Price is conceptually more volatile than value and there will be periods of divergence and periods of alignment.

Figure 1: Conceptual diagram of trends in value and price over time

The value of land in New Zealand is based on the informed 'willing seller/willing buyer' concept captured in the Valuation of Land Act 1948, subsequent amendments and case law. That is, the value of land is based on price and price is taken to equal value at that point in time. Price is a hard fact, whereas a net present value calculation is a matter of opinion. But does a lower price for a reduced number of rural land sales reflect in a lower value of all farm land? It is very difficult to imagine all farms in New Zealand for sale at the same time at any price level or the consequences of such a situation.

An economic value calculation for rural land would/should take account of the inevitable price cycles of the produce from the land. The economic value of land would be more stable than price. An increase in the value of land is an unrealised paper gain and is only realised when the asset is sold at a price. Value is not gained or lost until the asset is realised for money at more or less than the original purchase price plus any capital spend in the interim period. Timing of both entry and exit from an investment is critical in determining whether value is gained or lost. Unfortunately, not everybody gets that right.

Summary

Commodity and land price cycles are repetitive, come and go with unpredictable frequency, with varying degrees of magnitude between highs and lows, and with different time periods at each part of each cycle. Business behaviour in booms and busts does not change over time, nor do the implications for new businesses caught in the unfavourable part of a price cycle. But the lessons of history are re-learned at each cycle. Commodity prices do influence the price of rural land, but in conjunction with one or more other factors. It is argued that the price of land does not always reflect economic value, as price can be influenced more by the immediate business environment than by the underlying economic value. Finally, value is not gained or lost until the asset is sold at a price.

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PAUL MUIR

Plantain pastures to increase resilience in summer dry areas

With the current predictions of yet another El Nino, it is timely to consider how our response to drought has changed over the years.


In true dryland profitable farming during summer is almost impossble

Flexible systems

In the 1980s, most dryland East Coast farms had herds of breeding cows and flocks of breeding ewes (albeit often low-producing ewes) with very little room to move when the big dry arrived. Now there are much more flexible systems, with many of those breeding farms now having flexible stock policies such as finishing bulls and winter trade lambs. In the 1990s, we also had a phase of trying to beat the drought by growing more summer feed with species like fescue and cocksfoot that produced more in a drought. The reality though is that when it is really dry, 10% of bugger all is still bugger all, and it is extraordinarily difficult to make money through the summer on what is traditionally a falling schedule.

Developing a robust dryland system is really all about maximising production when moisture is available and not 'farming' when it is not.

Poukawa research

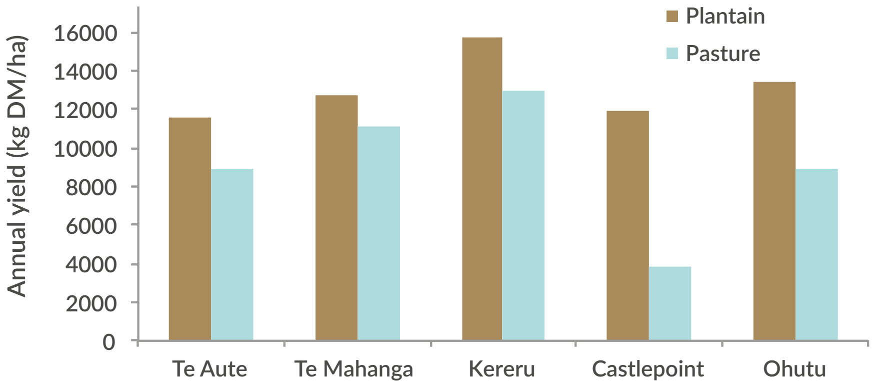
Developing a robust dryland system is really all about maximising production when moisture is available and not 'farming' when it is not. Poukawa was originally set up as research site by MAF because it is the driest part of the North Island. Our growth is generally reliable from May to October, but the worry beads are usually out by November. Developing better systems in winter and spring, so that more stock are finished before the summer dry, is paramount. This is the focus of the Future Forage Systems project funded by the MPI Sustainable Farming Fund, Beef + Lamb NZ and the Hawke's Bay Regional Council.

Within this project we have been measuring the performance of plantain and annual clovers across a range of farm types to get truly robust data. Plantain was always known as a roadside weed, but we now call it a herb because that is an easier sell. It is a vigorous seeder with a modest taproot and a growing reputation as a high quality feed. We have four sites with at least two full years of data comparing the production of newly-sown plantain swards with nearby permanent pasture swards. These sites and their respective rainfalls are Poukawa (750 mm), Te Aute (800 mm), Kereru (1100 mm) and Castlepoint (1026 mm). The first three sites were cultivated, but as Castlepoint is uncultivable hill country, it was aerially oversown by helicopter following a double spray and summer fallow to remove the resident vegetation.

Plantain growth rate

Figure 1 (page 20) shows the average performance of plantain swards over two years as compared to pasture controls. For the cultivated sites, plantain pastures produced around 13,300 kg/DM/ha and out-performed nearby pasture paddocks by an average of 21%. For the hill site (Castlepoint), plantain out-performed resident hill pasture by 170% and produced 11,400 kg/DM/ha, not far behind what plantain produced on the cultivated properties. For all this, plantain has a shallower taproot than lucerne, chicory and red clover, so its real strength is winter (in warmer regions) and spring and until the lack of summer moisture becomes limiting.

Figure 1: Average annual yield of plantain/clover pastures in the first two years after establishment and compared to resident pasture



Across three trials, the growth rate of trade lambs on plantain over winter and spring was 21% higher than on resident pasture.

Animal performance

We measured animal performance over winter and spring over a range of sites. Across three trials, the growth rate of trade lambs on plantain over winter and spring was 21% higher than on resident pasture. As plantain is a high quality feed its rate of passage through the rumen is fast, and at slaughter lambs have lower rumen contents and heavier carcasses at a given liveweight. As a result, dressing out (DO) percentages are around 2% higher off plantain so the liveweight gains are actually understated. If we account for the reduced rumen contents, lamb liveweight gains on plantain are 33% higher than on resident pasture.

Many farmers are using plantain as a ewe lactation feed with very good results. After accounting for the difference in dressing out percentage, lamb liveweight gains were 302 g/d on hoggets across three trials and 364 g/d on ewes across five trials (**Table 1**). These lamb liveweight gains are a real game-changer, enabling a much higher percentage of lambs to be drafted off the ewe. Moreover, there are very significant increases in hogget and ewe bodyweights. Hoggets on plantain put on an average of 4.7 kg more than those on pasture – this increased to 7.4 kg after adjustment for gut fill differences. Mixed aged ewes on plantain put on an extra 12 kg.

The average crossbred ewe (excluding East Friesian and Poll Dorset genetics) has a limit to their milk production that is around 350-360 g/d across a group of lambs. Once this lactation ceiling is reached, surplus ME goes into ewe bodyweight gain. It is only on a high energy feed that there is sufficient energy for this to occur. This has big implications for the farm system, because as well as easier ewe feeding over summer, every extra 1.0 kg of ewe liveweight at tupping increases lambing by 1.5%.

Table 1: Liveweight gains of lambs on hoggets and ewes fed plantain and pasture

	Lambs on hoggets	Lambs on ewes
Number of trials	3	5
Growth rate on grass (g/d)	229	297
Growth rate on plantain (g/d)	280	242
Growth rate advantage to plantain (g/d)	51 (+22%)	45 (+15%)
Growth rate on plantain after DO% correction (g/d)	302	364
Advantage to plantain after DO% correction (g/d)	72 (+32%)	67 (+22%)

Table 2. Weaning weights of hoggets and ewes off plantain and pasture

	Hoggets	Ewes
Number of trials	3	4
Weaning weight off grass (kg)	57.1	66.4
Weaning weight off plantain (kg)	61.8	75.3
Weight advantage to plantain (kg)	4.7 (+8.2%)	8.9 (+13%)
Weaning weight off plantain after DO% correction	64.5	78.6
Advantage to plantain after DO% correction (kg)	7.4 (+13%)	12.2 (+18%)

Role of clovers in a plantain stand

The Future Forage Systems project is also working with erect, aerially flowering annual clovers such as Persian, balansa and arrowleaf. These are all adapted to hot dry climates, having been used extensively in Australia for 20 years. All seed supplies are currently imported from Australia. In warm areas, these clovers are capable of


Annual clovers in Poukawa cutting trial


Balansa and Persian clover give plantain a one-off clover boost


Plantain, a weed, but it delivers remarkable animal peformance

producing 8-10 tonne of very high quality dry matter between August and December as a one-off crop. Because arrowleaf does not tolerate wet feet, balansa and Persian clover are probably the most versatile for many areas. These latter two, particularly balansa, also have better early spring growth than arrowleaf.

The difficulty lies in getting annual clovers to re-seed as they flower at the top of the stem, meaning grazing and setting seed are usually incompatible. This means that at this stage their role is as a specialist crop or as a legume in the first year of a plantain sward. For annual clovers to germinate and establish, they must be autumn sown, so there is no point including annual clovers if spring sowing of plantain is being considered. Including 3.0 kg of balansa and 3.0 kg of Persian clover with plantain was first tried at Te Mahanga in 2012, and resulted in 38% legume in the plantain stand between August and December in the first year.

Because they are one-year wonders it is important to also sow red and white clovers, especially erect types with large leaves, as these take over the legume role in subsequent years. The open erect growth habit of plantain means it is very compatible with legumes and they have a much better chance of expressing themselves in a plantain stand than they do in a standard pasture sward.

Management issues

There is never a free lunch and plantain/clover stands require more careful management than traditional pastures. They are best sown as a stand without grass, as grass is too competitive for the plantain and clover seedlings. A post-emergence spray is often necessary to prevent competition from grass and weed seedlings. Because plantain is so palatable, there are a lot more than stock wanting to eat it – slugs, springtails, plantain moths and ducks are all in the queue.

Plantain swards should be rotationally grazed so just putting in a single paddock for a look see is destined for failure – there needs to be enough area and suitable subdivision for a rotation to be established. Plantain needs to be grazed from 20-30 cm down to 7-10 cm, and getting stock off the plantain is much better than decking

There is never a free lunch and plantain/ clover stands require more careful management than traditional pastures.

the stand. Plantain stands can last from two to five years depending on the management of stock, weeds and pest and diseases. Management and observation is critical.

A stand that only lasts two years has typically been overgrazed and/or suffered insect damage. There is no point in putting plantain at the back of the farm – it needs to be where it can be observed frequently, from both a grazing management and a weed and pest perspective. Subdivision is important and paddock sizes no greater than 2.0 ha are required, as are appropriate stocking rates that ensure that a paddock can be grazed within two to three days in spring and early summer. Ewes can be lambed onto plantain/clover, commencing with a sward of 30 cm and balancing ewe and lamb numbers so that the sward is slowly reducing to 15 cm when a rotation can be started.

On the plus side, plantain is true to its background as a weed and seeds freely, and this can be a way of rejuvenating the stand. One issue we have observed is that allowing excessive seeding can result in too many seedlings per hectare and all struggle to thrive and survive because of competition with each other.

Conclusion

A plantain/clover sward can be a game-changer that allows summer dry areas to capitalise on their strengths – good winter and spring growth. The rewards are higher animal performance. As seen at Castlepoint, the increase in the amount of high quality forage on hill country can be dramatic. But the effective utilisation of this forage requires a change in thinking – around rotational grazing, maintenance of higher pasture covers and increased vigilance around weed and pests.

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LEIGH CATLEY

Horticulture in New Zealand: 2015

The horticulture industry in this country is currently thriving. In the year to 30 June 2013, the industry generated more than $3.6 billion in export revenue, with the major products being wine ($1.2 billion) and kiwifruit ($934 million).

Horticulture NZ

Horticulture NZ (HortNZ) is the industry association which represents the 5,500 commercial fruit and vegetable growers operating throughout the country. HortNZ is funded by a levy on the sale of all New Zealand-grown fruit and vegetables. The association undertakes advocacy for growers in the key areas of biosecurity, resource management, people capability and labour availability, food safety and health and safety.

HortNZ tends to fly under the radar relative to the attention its primary sector cousins, such as the dairy industry, receives. In 2014, horticultural products now account for 8% of New Zealand's total merchandise exports and it is the fourth largest exporter. The biggest gains were seen in onion exports, which increased by 47% over 2012 values to a total $90 million, and apple exports, which increased by 40% to $475 million.

Pacific Rim countries are an increasing export focus for New Zealand, accounting for more than 71% of exports, compared to 59% in 2000.

Productivity growth continues

Total produce from the horticultural industry was valued at $6.7 billion, including $770 million of domestic spend on New Zealand-grown fruit and $1.09 billion on vegetables.

Plant & Food Research CEO Peter Landon-Lane believes that the success of our horticultural exports has been founded on a keen understanding of market needs and a passion for delivering high quality product that commands a healthy premium.

Pacific Rim countries are an increasing export focus for New Zealand, accounting for more than 71% of exports, compared to 59% in 2000. To continue increasing our exports to these countries we need to understand the requirements of these consumers and deliver products that exceed their expectations, as well as meet increasingly stringent requirements for food safety and sustainability.

Market access encouragement

The signing of the Trans Pacific Partnership (TPP) trade deal ushers in a new era of trade for New Zealand's horticulture industry. HortNZ congratulated the government, particularly Trade Minister Tim Groser, for their determination and patience in seeing this deal through. HortNZ president Julian Raine believes this is a goal that has looked at times to be almost impossible to score, and they have finally done it.

The most critical result in the deal for New Zealand horticulture exporters is the reduction of tariffs to Japan, New Zealand horticulture's third largest market. This will have a significant impact on the earnings of growers of kiwifruit, buttercup squash, capsicum, onions and virtually all other horticulture exports to Japan, The elimination of tariffs will benefit New Zealand producers by an estimated $28 million per year.

Market access is an issue the New Zealand horticulture industry works with on a daily basis, and it is a key aspect of the industry's goal to achieve value of $10 billion by 2020. As always, HortNZ will keep an eye on opportunities in markets all over the world. We will now be keen to see what impact the settling of the TPP agreement will have on other markets in the region not included in the original 12 signatories. We also look forward to capitalising on this very significant trade agreement.

New biosecurity levy welcomed

New Zealand horticulture's determination to highlight our dependence on good biosecurity and border protection was rewarded this year with the government's implementation of a new border clearance levy for all visitors arriving in this country. The levy is designed to help cover the cost of the increasing number of biosecurity checks required at the border, as the number of visitors to the country rises.

It is obvious to New Zealand's horticulture industry that the spread of the Queensland fruit fly is out of control in Australia and the interstate regulators are powerless to stop its progression south.

Queensland fruit fly 12 trap in citrus tree

The horticulture industry was very aware of the contentious aspect of the implementation of the new levy, which met with considerable opposition from tourism industry bodies, airlines and the cruise ship industry. But the simple fact is that passengers need to take some of the responsibility for protecting our primary industries, home gardens and our native species.

HortNZ's biosecurity manager Richard Palmer notes that every passenger entering this country presents a risk and we must have systems in place to process and check that risk.

HortNZ will continue to work constructively with air and cruise lines, as well as the Ministry for Primary Industries, to help improve both passenger compliance and passenger experience. Given our industry's biosecurity expertise we can bring some value to the discussion about border compliance.

However, protecting our agriculture, horticulture and viticulture, and New Zealand's unique natural flora and fauna which forms a key part of the tourism experience, must be our first consideration.

Queensland fruit fly

The introduction of the border levy was particularly well received by the industry, given the discovery of the country's first ever breeding population of Queensland fruit fly in the Auckland suburb of Grey Lynn in February. HortNZ immediately called for the reinstatement of 100% passenger bag x-ray screening at international airports. It was the fourth time in three years that the Queensland fruit fly had been detected on our shores. HortNZ laid the blame for the breach of our border on Australia's inability to control the pest.

KEY FACTS

- **At more than $1.2 billion, wine exports were 33% by value of New Zealand's horticultural exports in 2013**
- **The largest increases in export value were seen in apples (+$134 million), onions (+$29 million) and wine (+$31 million)**
- **In the 10 years to 2012, land in horticulture increased by 9% to 123,480 hectares – the largest change was seen in wine grapes (+17,220 hectares)**
- **Natural honey exports increased by 13.5% on 2012 values to $144.9 million**
- **Export of horticultural machinery and components was valued at $79 million, close to a 70% increase since 2008.**

Just weeks beforehand the residents of Adelaide were told of the second detection of these fruit flies in their city in less than two months. South Australia is supposed to be a Queensland fruit fly free state. It is obvious to New Zealand's horticulture industry that the spread of the Queensland fruit fly is out of control in Australia and the interstate regulators are powerless to stop its progression south. The Queensland fruit fly can only enter via Australia and some Pacific islands, most likely via a passenger coming off a plane or on a consignment of imported fruit.

HortNZ believes the resumption of 100% x-ray of passenger bags coming from across the Tasman would go a long way towards helping improve protection and lower this risk. The risk to the horticulture industry (including fruit, vegetables and wine) from the Queensland fruit fly is two-fold: first, from the destruction caused by the pest and the ongoing cost of attempting to control it; and then from the cost of international markets closing to our products because they do not want to be exposed to the risk of the pest either.

Young talent developed

Horticulture takes succession and leadership in the industry seriously, and the industry has seen significantly increased engagement in leadership programmes and other training opportunities in the past few years. One of the most successful events is the annual 'Young Grower of the Year' award. The competition, now in its seventh year, aims to challenge younger participants in the industry to assess their skills and test their knowledge. It is supported by a dedicated family of volunteers and sponsors, led by platinum sponsor NZ Horticentre Trust.

This year Hamish Gates from Pukekohe won the title of Young Grower of the Year. He secured his place at the national competition after being named New Zealand Young Vegetable Grower 2015 in April. Hamish is a carrot washline supervisor at AS Wilcox & Sons in Pukekohe.

The final phase of the competition saw five regional champions battle it out in a series of practical and theoretical challenges that tested their essential industry knowledge and skills. HortNZ's senior business manager Sue Pickering says that we have come to expect an outstanding level of talent in the competition and this year's finalists were no exception. The knowledge and skills Hamish showed throughout the competition clearly demonstrated his ability to succeed in this industry. He gave each challenge his all, and it was this commitment that helped him come out on top.

The challenges ranged from an environment and sustainability exercise, to pest and disease identification, and quad bike health and safety. Competitors also had to participate in a leadership panel, and present a three-minute speech on the role of innovation and technology in the industry.

Bay of Plenty's Craig Ward, from Apata Group Ltd in Katikati, was named Young Fruit Grower of the Year and

The importance of good science and research has never been more significant for rural businesses than it is now.

runner up for the overall competition. Young Fruit Grower of the Year runner up was awarded to Andrew Kearney, orchard operations and development assistant manager for T&G Pipfruit in Hawke's Bay.

Environment challenges continue

The horticulture industry continues to find itself battling on numerous fronts across the country, with the more than 70 district, regional and other territorial authorities controlling New Zealand's use of its land, air and water. It is a particularly expensive area of advocacy for HortNZ. One area of major concern was an Environment Court decision this year to uphold an appeal from Ngati Kahungunu in the Hawke's Bay, which was based on the interpretation of the words 'maintenance and enhancement' of freshwater bodies.

The court says those words mean the water quality within every single water body must be managed in a way that water quality is maintained or enhanced. HortNZ believes this interpretation is going to cause huge problems because it goes against the direction the government has taken in its national policy for freshwater, which allows local communities to decide how their water bodies are maintained. The decision could be used to challenge the development of land across the country for any purpose. HortNZ natural resources manager Chris Keenan believes this is simply unworkable. Land use is always changing to meet the needs of communities. This cannot always happen while maintaining or enhancing all the aspects of water quality in a catchment.

Activities such as urbanisation, farming, and the development of roads and other infrastructure, can all have adverse effects on freshwater. Now activities like regional development, greenfields subdivision and infrastructure development can all be challenged if they have impacts on water quality.

Science and research

The importance of good science and research has never been more significant for rural businesses than it is now. HortNZ has invested heavily in recent years on developing science-based resources to further the case for resource management regulation in horticulture. Economic impacts are also becoming essential to the resource management decision-making process, as is improving the understanding of existing projects, particularly those that have been running for some time.

Hamish Gates, Young Grower of the Year

This year HortNZ received the go-ahead to start an $800,000 project to measure the effect of best management practice for soils on farms. The project titled 'Don't Muddy the Water' received $490,000 in funding support from the Sustainable Farming Fund. Other contributors included the Vegetable Research and Innovation Board, the Foundation for Arable Research and four regional councils. The research will quantify the effectiveness of sediment control on cultivated land. It will be focused on keeping soil in the paddock and out of the waterways, which is a win for the environment and for farmers.

The project will run trials of different good management practices to test which give the best results for reducing sediment and phosphorous entering waterways. It is intended that the results of the study will provide evidence that good management practices are effective across all regions, confirming the advice and research of the last 15 years.

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MIKE CHAPMAN

Industry update – strongest possible mandate from kiwifruit growers

Eighteen months of industry consultation has resulted in a very strong mandate from kiwifruit growers.

Strategy review

In February this year New Zealand kiwifruit growers were asked to vote on 10 propositions to put in place the structural foundations for kiwifruit industry reform. The goal was to future-proof the industry for at least the next decade and lock in wealth creation for the industry and New Zealand and, in particular, to:

- Ensure a high-performing marketing structure (the single point of entry or SPE) that works for growers
- Establish enduring grower ownership and control of the New Zealand kiwifruit industry
- Strengthen industry transparency and flexibility and create a regulatory structure that supports the sustainable, long-term growth of the industry.

Growers were also asked to adopt the underlying principle that the industry will act responsibly and ethically on all economic, sustainability, environmental, social and regulatory issues for the benefit of New Zealand kiwifruit growers and the wider community.

The Kiwifruit Industry Strategy Project (KISP) that developed the 10 propositions lasted over 18 months, so that all growers could understand what was being proposed and had the opportunity to contribute to the final 10. Over 100 grower meetings were held and over 600 submissions were received, many made by groups of growers. Grower feedback was used to shape the final 10 propositions that were put forward. The very high level of acceptance for each of the propositions endorses the effectiveness of the consultation process. This was a strategy for growers that was developed and shaped by growers.

Project results

The result was that growers turned out in record numbers to vote and gave a very solid mandate for the 10 propositions they were asked to vote on:

- By number of growers, two-thirds voted, i.e. 1,866 growers
- By production (the number of kiwifruit trays produced for export), just under 80% of production voted
- All 10 propositions were supported by 91% or more of growers, giving a very solid mandate for the strategy and the proposed changes.

The results in summary are set out in **Table 1**.

Table 1: KISP Project results

Support for the industry's marketing system, the SPE	97% voted yes
Grower ownership and control of Zespri – two propositions as follows:	
• A grower mandate for amending the Kiwifruit Export Regulations 1999 (the Regulations) to permit amendment to Zespri's Constitution	92% voted yes
• A grower mandate putting in place a share cap.	92% voted yes
Zespri's funding system More transparent funding system and minimal Zespri margin for the New Zealand fruit business.	91% voted yes
Grower representation and reporting NZ Growers Forum to reduce from 37 to 27 members, with an increased focus on grower equity, supply chain performance and independent monitoring of Zespri, and the performance of the industry's marketing structure, the SPE. This proposition included a rationalisation of the on-shore committee structures.	94% voted yes
Grower control – supply agreement/supply chain/market signals • Future supply agreements to be negotiated and agreed between Zespri and supply entities • Supply and logistics within the SPE structure to become more commercial for the benefit of growers • Market signals to growers to continue to ensure premium pricing can be maintained in the industry's off-shore markets • Increased grower input into supply chain decisions, particularly grower equity decisions.	95% voted yes
Zespri Board Zespri's Board to have three dedicated independent directors and a maximum term of three years for all directors.	94% voted yes
Kiwifruit New Zealand Board Board Members become a majority of growers with the appropriate skill-set.	97% voted yes
Zespri's core business – the regime from the Regulations Expand Zespri's 'core business' (as defined in the Regulations) to include all current shareholder approved activities: kiwifruit marketing, cultivar development, plant variety rights (PVR) ownership, 12 month supply (in the definition called a global supply programme), R&D and supply chain management.	92% voted yes
Collaborative marketing Enhancement of collaborative marketing by using it as an integral part of the industry's market plans. An additional recommendation is for more funding flexibility under Regulation 39 for Kiwifruit New Zealand funding from collaborative marketers. This would give the organisation the ability to determine how best to fund its operations rather than being restricted to charging its costs where they fall. No regulatory changes are required to implement this proposition.	92% voted yes

The industry's marketing structure received the highest level of support, with 97.37% of growers supporting it. While voting was underway there was a media campaign and a call made by a group to vote 'no' to all 10 propositions, which included a call to vote 'no' against the current marketing structure. This campaign did not find favour with growers and managed only 2.52% support (there were 0.11% invalid voting papers.) The overwhelming majority of growers were very firm in their support of the industry's marketing structure. A vote of 97.37% in support of it is an emphatic and resounding result.

More importantly, this result affirms that the vast majority of growers support the industry, and the industry is in fact very cohesive and unified, which is something many of us have known for a long time. There will always be calls for improvements, which are encouraged and are always carefully evaluated to see what can beneficially be changed. A good representation of how unified and cohesive the industry is can be seen in how it has worked together to manage the PSA bacterial disease, and as a result is returning to a growth path.

This result affirms that the vast majority of growers support the industry, and the industry is in fact very cohesive and unified, which is something many of us have known for a long time.

There are more challenges coming for the kiwifruit industry. What the voting confirms is that the industry is well placed to meet these challenges. This vote was an extraordinary and enormous affirmation and mandate for the industry going forward – the very foundation stone for its future success.

Work streams

To support implementation of the changes mandated by the results in the referendum, the following work streams have been developed:

- Grower ownership of Zespri – the government has been asked to make the required regulatory changes after which Zespri's shareholders will be asked to amend Zespri's Constitution
- The formation of the NZ Kiwifruit Growers Forum was put in place, with changes made to NZKGI's Rules at their AGM on 22 July 2015, and with grower elections for the new forum members running in October/November 2015
- Implementation of structural changes to Zespri funding, supply and collaborative marketing mandated by the KISP referendum are under action, with timelines being finalised that coincide with the season and financial years.

Marketing structure

The industry's success and ability to respond to challenges is based on its marketing structure, the SPE, which received solid support in the referendum with a 97% vote in support.

The single point of entry

The Regulations require that Zespri be authorised to export kiwifruit from New Zealand, excluding the domestic market and for consumption in Australia. Collaborative marketers may also be authorised to export kiwifruit under the Regulations. In return, Zespri delivers the benefits of the SPE to growers.

Benefits from Kiwifruit New Zealand's SPE structure

The SPE structure delivers scale in the marketplace. It means Zespri can select a few motivated distributors to serve each market. Kiwifruit becomes an essential part of business for these distributors. If multiple distributors were used, kiwifruit would simply be a small part of their business and their livelihood and profit would not be so dependent on selling kiwifruit for the best possible value and giving their customers excellent service. Quality, category management and customer relationships are the essence of the SPE structure in-market. This gives Zespri market power in the key markets and the ability to sell kiwifruit at premium prices.

There are other advantages:

- Promotional spend in the market that creates market demand
- The integrated supply chain delivers efficiencies and speed to successfully launch new varieties
- Viable returns to growers in difficult financial times
- An iconic international brand allowing Zespri to differentiate its product; the Zespri brand is a globally recognised one that symbolises quality, vitality and freshness
- In market presence, Zespri has off-shore offices to market and promote our product
- Coordinated innovation
- The largest new cultivar breeding programme in the world
- Maintenance of quality that delivers Zespri a premium price over its competitors
- Confidence for growers to invest in the industry.

Zespri's SPE role

To get the best performance out of the SPE, and to ensure its continuation, Zespri has a vital role to play. Zespri is not only the champion of the SPE, but it also uses it to underpin its entire operations as shown in **Figure 1** (page 30).

Continuation of the SPE

Kiwifruit New Zealand's SPE belongs to the growers. For it to remain in place, it must continue to serve all growers. The key measure is growers' return. Market return needs to be kept as high as possible and supply chain and orchard costs kept as low as possible. New varieties need to be developed and commercialised, keeping the New Zealand kiwifruit industry in the top position and ensuring grower support. These are all roles that Zespri must effectively perform for the continuation of the SPE.

Foundation of the SPE

Maintaining the SPE marketing system is the key ingredient for the industry's success, as it has the ability to generate increasing returns to counter the increased cost of growing, picking, packing and shipping our kiwifruit. Zespri delivers the benefits of the SPE to growers. Provided these benefits are tangible, the growers in turn will support the SPE. The other key element is the ownership and control of Zespri needs to be in the hands of growers who currently supply it for the reasons outlined above.

Zespri performance review – delivering tangible benefits to growers

Zespri, the kiwifruit industry's main marketer, has as its purpose maximising long-term sustainable returns for New Zealand kiwifruit growers. The strategy used to deliver this is to market the world's leading portfolio of kiwifruit 12 months of the year. The strategic pillars which support Zespri's strategy are quality, new varieties and innovation, our integrated industry structure, the brand, in-market distribution and 12 month supply. In the fruit business it is critical to develop demand for our products ahead of supply. To do this, Zespri invests strongly in sales and marketing. Zespri's future growth will come from three sources:

- By developing distribution
- By continuing to grow the kiwifruit category through marketing health, taste and convenience to consumers
- By continuing our long-term programme to bring new products to market.

Zespri's performance in delivering its strategy is measured in a variety of different ways, but two of the most important metrics are total orchard gate return across all hectares and orchard gate return as a percentage of retail sales (figures supplied by Zespri Group Ltd).

Figure 2 (page 30) shows orchard gate return across all hectares. It is important because it gives a view of overall grower return across Zespri's product portfolio, which reflects its performance in developing demand, the balance of its portfolio, and also the underlying rate of innovation as Zespri seeks to bring new products to market.

Figure 1: Building blocks for success

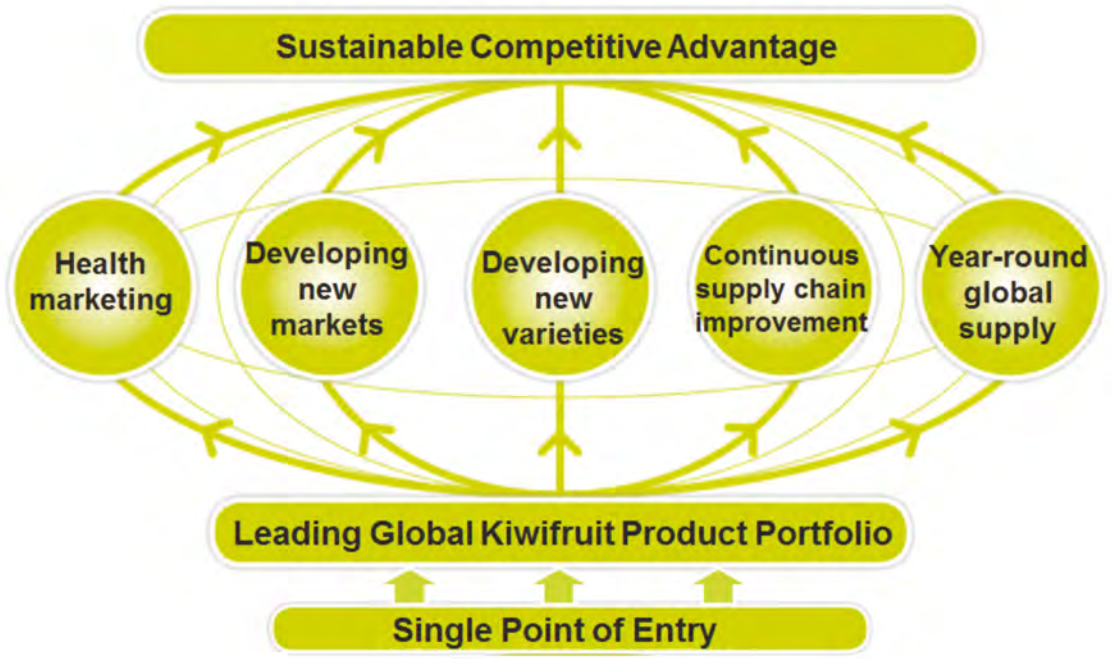


Figure 2: Total orchard gate return

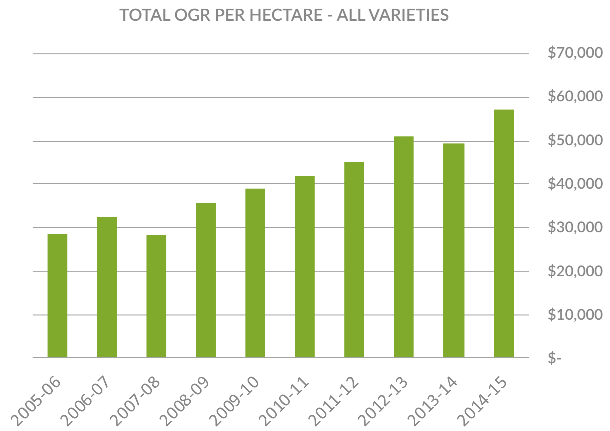


Figure 3: Total volume

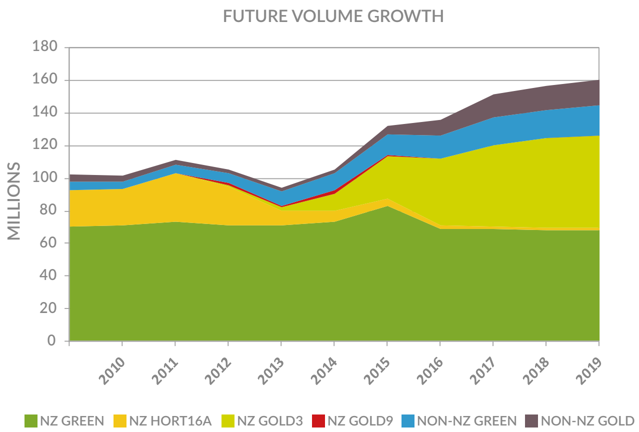


Figure 3 gives a picture of the New Zealand kiwifruit industry volume growth from 2010 to 2019. The industry grew at about 10% for the 2000s and then lost 20 million trays of Gold from 2011 to 2013 when PSA was discovered in New Zealand. The industry is returning to pre-PSA levels in 2015. Zespri earned $1.6 billion in sales revenue last year. Over the next four years we expect to grow from 30 million trays of Gold this year (up from 11 million in 2014) to around 60 million trays by 2019. Perhaps most significantly we expect that by around 2018 approximately half of the crop will be Gold, underlining the transformation of the New Zealand kiwifruit business into a genuine multi-crop industry. The industry is growing strongly.

SunGold has been very well received in markets around the world as indicated in **Figure 4**.

Figure 4: SunGold Volume projection

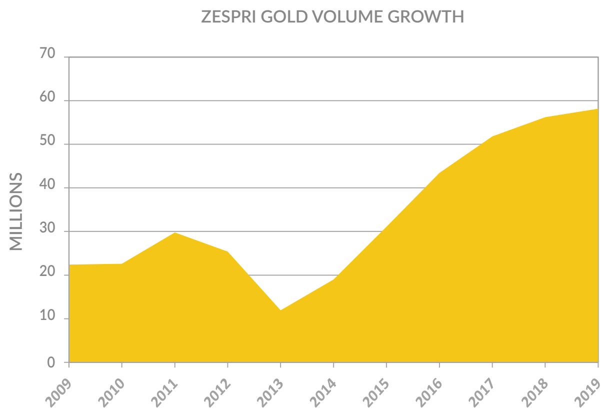
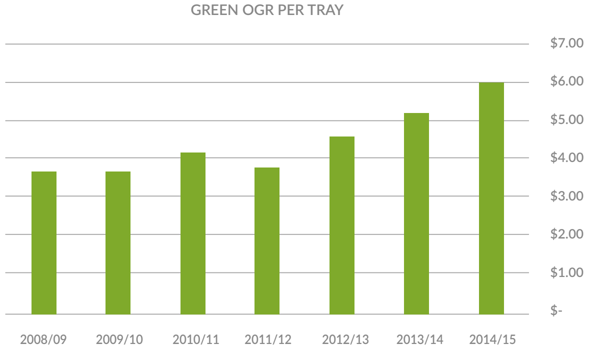


Figure 5: Hayward returns



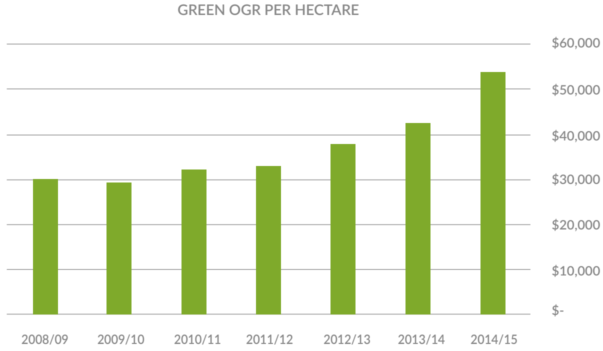
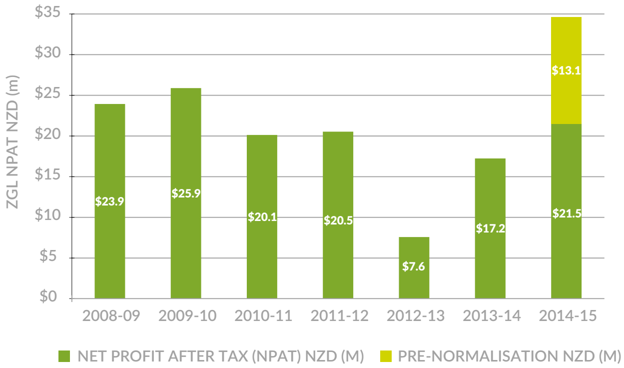


Figure 6: Corporate profit



A critical element of its recovery has been the industry's strategy review and grower referendum to support changes that will future-proof the industry for at least the next decade and lock in wealth creation for the industry and New Zealand.

Figure 5 shows that Hayward returns hit record levels on a per hectare basis in 2014 – at over $53,000 per hectare.

As shown in **Figure 6**, Zespri's corporate began to recover profitability with a normalised profit of $21.5 million, reflecting stronger total volumes of 108 million trays. The reported profit of $34.6 million was mainly due to including unpaid revenue from new cultivar licences from previous years. Without including that revenue from the previous year's new cultivar licences, Zespri's normalised profit would have been $21.5 million – a figure that better reflects its current volumes and the strong investment Zespri is making in the growth to come.

Conclusion

The kiwifruit industry is recovering from PSA and building its strategy to maximise its growth over the coming years. A critical element of its recovery has been the industry's strategy review and grower referendum to support changes that will future-proof the industry for at least the next decade and lock in wealth creation for the industry and New Zealand. These are very exciting times for the industry and represent that kiwifruit has a bright future.

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PHILLIP WILCOX AND SATISH KUMAR

Speedy breeding with genomics – new approaches to fruit and forest tree breeding in New Zealand

DNA sequencing is frequently profiled in the media, particularly in regard to the human genome and associated advances in medical treatments. DNA technologies are now beginning to impact on the agricultural sector.

A new breeding technology

A new breeding technology – called genomic selection – is changing the way New Zealand's economically important plant species are being bred. These technologies take advantage of differences in DNA sequences that exist among individuals within species (**Figure 1**). It is these same differences that collectively contribute to the heritable variation that breeders have exploited for hundreds of years to improve the properties of important plant and animal species. This approach has been pioneered by livestock breeders and is already being applied in dairy, sheep and beef in New Zealand.

However, in the past plant breeders selected solely on the differences in the phenotype, i.e. a plant's physical characteristics. Now, with the sequencing of the genomes of our economically important species and the advent of cost-effective technologies that can detect differences in DNA sequences on a genome-wide scale, selection can be performed based on DNA sequences without the need to grow a plant to maturity. In this article we describe how genomic selection works, where it is being applied to New Zealand's economically important forest and fruit species, and what the likely benefits will be – and when. We also describe future developments and ongoing challenges.

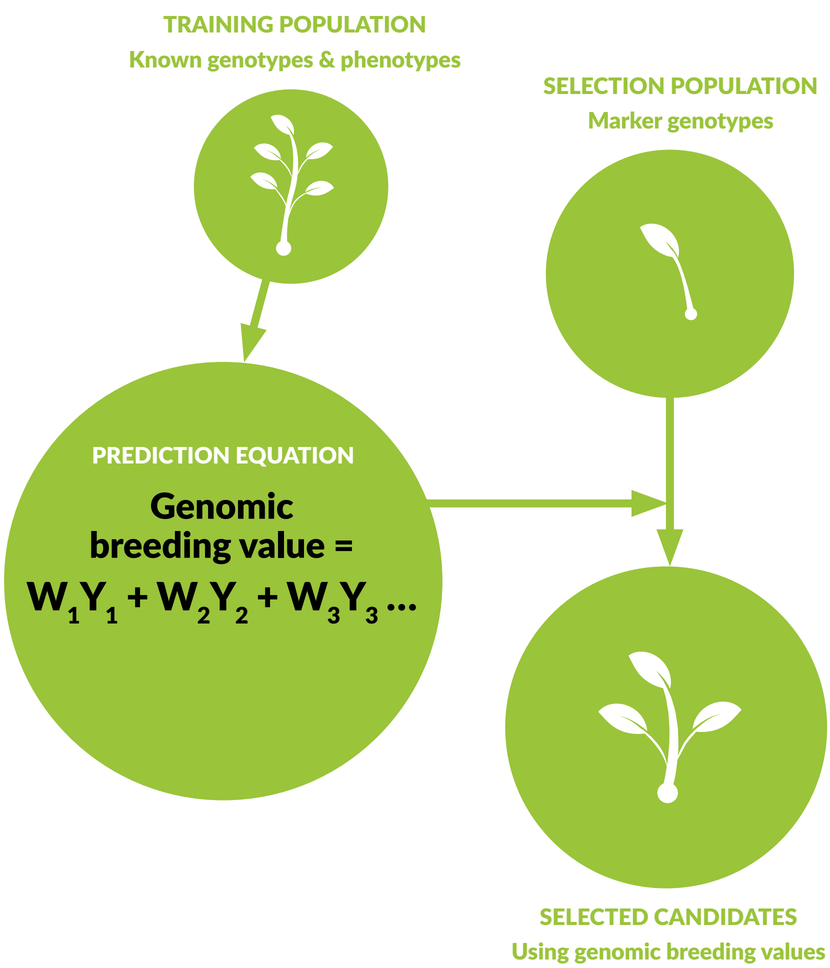

Figure 1: How does genomic selection work?

In virtually every plant species, most economically important plant characteristics are generally controlled by many genes, each with a very small effect on phenotype. The DNA sequences causing this variation are spread throughout the genome. Genomic selection works by assaying a subset of DNA sequence variation across the genome, and the combined affects of this subset of variation are then correlated with physical variation in the plants to develop a predictive model.

This model is then applied to the next generation of offspring at seed or seedling stage, i.e. well before the expression of mature traits, to identify the best genotypes. The selected offspring are then inter-mated and the process repeated. Genetically superior material from each generation is used for commercial deployment, sometimes involving further field testing.

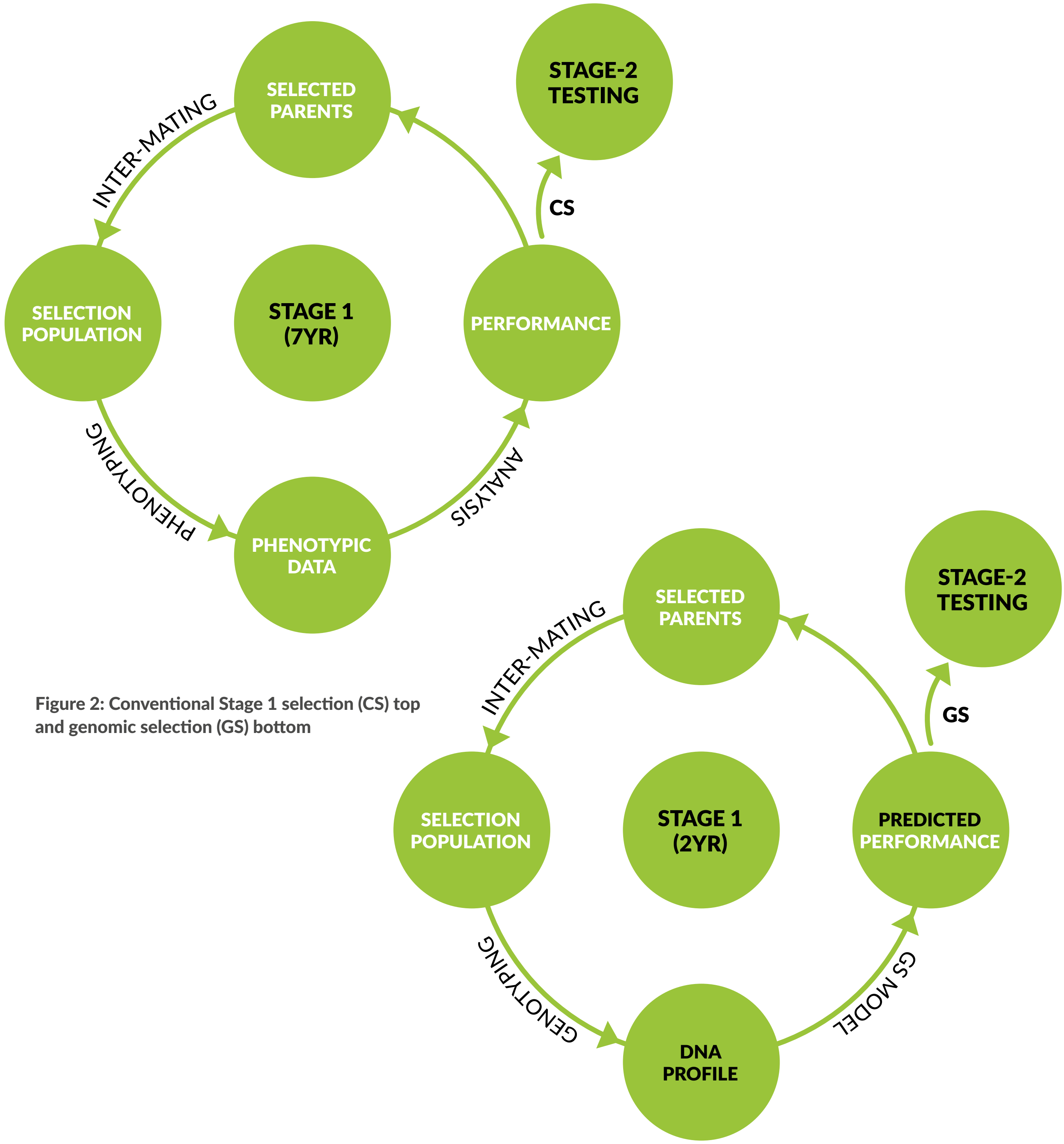

Figure 2: Conventional Stage 1 selection (CS) top and genomic selection (GS) bottom

> Successful genomic selection relies upon having sufficiently small closed breeding populations where ancestry can be easily traced.

How does genomic selection work?

Successful genomic selection relies upon having sufficiently small closed breeding populations where ancestry can be easily traced. This extensive co-ancestry also leads to a genome-wide accumulation of associations between assayable differences in genome sequences, and the multitude of DNA sequence variations that cause actually trait variation – termed 'linkage disequilibrium' (LD). A statistical relationship is developed using the offspring of parental lines, which are measured (phenotyped) for breeding-relevant traits and also 'genotyped' using genome-wide DNA marker panels (**Figure 1**). This relationship is then used to predict the genetic merit of subsequent generations, based on DNA marker genotypes rather than phenotype.

Integration of genomic selection into conventional apple breeding programmes has the potential to significantly increase breeding efficiency.

Extensive simulation and empirical studies in species such as forest trees have shown that the accuracy of this predictive relationship is impacted primarily by the number of parental lines (effective population size) and offspring used to develop the predictive relationship, and the density and coverage of genome-wide DNA marker panels. Other factors are also important such as trait heritability, number of genes actually controlling heritable variation, and the statistical methods used to develop the predictive relationship.

Benefits of genomic selection

The primary benefit of such a technology and why it has been successful in the livestock sector is the reduction in breeding cycle, i.e. the ability to accelerate genetic advances. In plants, this is achieved by selecting at seed or seedling stage on DNA sequence, rather than waiting for full expression of a plant's inherent characteristics. While the rate of breeding cycle acceleration is largely dependent on the species and how genetic improvement is delivered to the market, the reduction is generally equivalent to the difference in time required for field testing and the age of reproductive maturity.

The length of the conventional apple breeding cycle in New Zealand conditions is seven years, including three years for the assessment of phenotype. Integration of genomic selection into conventional apple breeding programmes has the potential to significantly increase breeding efficiency, as outstanding seedlings can be identified for further testing as cultivars or as breeding parents in two years, hence reducing the time required for developing new cultivars by at least five years (**Figure 2, previous page**).

In forest tree species such as radiata pine, where advance generation breeding has involved sublining into small 'elite' populations with effective population sizes of 25 to 35 individual (or equivalent to this), there is opportunity to develop predictive relationships using extant genetic tests. Because the next generation of offspring have only recently been generated by the Radiata Pine Breeding Company, whose genetic material is planted in all of this country's radiata pine forests, these predictive relationships can then be applied to this next generation to achieve much faster genetic gains. Cloned propagules of these populations are already in archives, thus selected individuals can be identified and managed for seed production. This will reduce the next generation of breeding by seven to 10 years.

There are other potential benefits from using genome-wide DNA marker panels for selective breeding. First, in the case of expensive-to-measure traits, possible reductions in breeding costs are possible as DNA-based assessments are inevitably cheaper. Another benefit is the opportunity to select among more plants. Selecting at seed or seedling stage increases the number of plants that can be screened, because seeds and seedlings take up much less space than needed for field screening of adult plants, particularly in the case of woody perennials such as forest and fruit trees. Significantly larger numbers of offspring can therefore potentially be screened.

Accelerating the response to disease and pest threats can also be achieved via genomic selection. Disease and pest resistance is sometimes due to a few discrete genes of large effect, which are often found in germplasm with relatively low genetic merit for other important traits. By using genomic selection, introgression of resistance genes can be undertaken concomitantly with selection for other characteristics, therefore reducing the impact of inferior genetic background of resistant trees. This is particularly important for heterozygous species such as trees, where genes for high performance are still found within lower performance germplasm, albeit at lower frequency.

Genome-wide marker panels can also accelerate genetic gains from natural or undomesticated species, such as indigenous trees, by utilising DNA marker panels to detect and quantify relatedness that naturally occurs in natural populations. A trait is considered heritable if genetic relatedness is correlated with phenotypic similarity in that trait, potentially facilitating selection in wild populations and avoiding the need for time-consuming and expensive common-garden testing. While this is not yet applied in native or undomesticated tree species, it is being applied to the management of rare and endangered New Zealand native bird species. Such an approach could be useful for accelerating the development of kauri (*Agathis australis*) germplasm resistant to the dieback-causing *Phytophthora agathidicida*.

Genomic selection in NZ's economically important plant species

Currently in this country there is research underway in virtually all of New Zealand's economically important tree species (**Table 1**), with some advancing into applied breeding. In radiata pine, an MBIE-Industry Partnership programme is underway to develop the underpinning DNA marker panels and apply these to develop improved seedlings. The first tranche of genomic selection-selected germplasm is expected to be available in approximately three to five years' from now, substantively reducing the time required for the development of new germplasm.

Because genetic gain is deployed in radiata pine plantations via various means (ranging from open

Table 1: Key genomic characteristics of commercially important NZ tree species

Species	Genome size*	Estimated number (and type) of sequence variations	Estimated number of expressed genes
Radiata pine *Pinus radiata*	25 billion base pairs	229 million (single nucleotide variants only)	35,000
Apple *Malus domestica*	742 million base pairs	3 million (single nucleotide variants only)	57,386
Pear *Pyrus bretschneideri*	527 million base pairs	3 million (single nucleotide variants only)	42,812
Kiwifruit *Actinidia chinensis*	758 million base pairs	2 million (single nucleotide variants only)	39,040
Human *Homo sapiens*	3 billion base pairs	88 million total	19,313
Maize *Zea mays*	2 billion base pairs	55 million (single nucleotide variants only)	34,540

* Genome is the sum of DNA of an organism – its composition and how it is physically arranged. This also includes the differences in DNA sequence – how many, what types, and where they occur within the genome. These differences also contribute to those we observe between individuals of the same species and it is these same differences that breeders have taken advantage of for millennia. Two well-studied genome – human and maize – are provided for comparison. We also provide estimates of the number of actual genes.

Table 2: What species is this technology being applied to in NZ? Expected year of release of first germplasm from genomic selection

Species	Research provider(s)	Funding mechanism	Year of first genomic selection-developed germplasm release
Pinus radiata	Radiata Pine Breeding Company	MBIE Partnership Programme	2018
Douglas Fir	Scion	Core	Unknown
Eucalyptus species	Scion	Core	Unknown
Apple	Plant & Food Research Ltd	MBIE Partnership Programme	2017
Pear	Plant & Food Research Ltd	MBIE Partnership Programme; Core	Unknown
Kiwifruit	Plant & Food Research Ltd	MBIE Partnership programme; Core	Unknown

pollinated seed to tested clonal varieties, all of which are amenable to genomic selection), this selection is expected to have a continual contribution to ongoing genetic improvements in New Zealand forests. Genomic selection is also being investigated by Scion in other species (primarily *Eucalytpus*) for which marker resources have been developed overseas, and also Douglas Fir.

Genomic selection technology has revolutionised pipfruit breeding in New Zealand by helping to develop better cultivars faster than ever before. The MBIE-Industry-funded Pipfruit Research Consortium (aka Prevar) has adopted genomic selection to fast-breed new red flesh apple cultivars. The Prevar programme has successfully combined genetic markers for the red flesh trait and genomic selection for eating-quality traits to identify elite candidates for Stage 2 trials without needing Stage 1 trials.

The preliminary field performance of these red flesh apple elite candidates agreed well with their genomic selection-predicted phenotypes. Genomic selection technology for pear breeding is also being developed with funding support from the Prevar and Core programmes. It is expected that robust genomic selection models for selecting pear elite candidates would be available by 2017. The optimal training populations and genotyping platforms are currently being evaluated for some polyploid fruit crops, e.g. kiwifruit.

Over the past five years research into genomic selection has begun in several of New Zealand's economically important forest and fruit species (**Table 2**). This has involved:

- The development of genome-wide DNA marker 'chips' or 'panels' – these technologies reveal DNA polymorphism in a suitably large number of genomic regions, rather than sequencing the whole genome of each individual in a breeding population. DNA marker chips are significantly cheaper, costing tens to hundreds of dollars per individual, compared to whole genome sequencing of each plant which cost many tens to hundreds of thousands of dollars with current DNA sequencing technologies. DNA marker chips have been developed for a wide range of species, often via collaboration with international colleagues.

- Whole genome sequencing of various plant species to assist in the design of chips or panels.
- Using existing populations in breeding programmes as 'training populations', where genome-wide SNP profile and phenotypic traits are obtained for each individual. These are then analysed to develop statistical models, which correlate the DNA information with physical properties of plants in such populations. In turn, they are then used to predict properties of unmeasured plants such as newly-generated offspring.
- Development of strategies to use the predictive models in a manner that accelerates breeding with limited or no risk to the breeders. This is virtually always specific to individual breeding programmes.

Challenges

Some key challenges remain to be overcome. First, implementation costs of genomic selection are currently very high. For example, DNA extraction for at least some plant species is still around $15 to $20 per sample, and single nucleotide polymorphism (SNP) array genotyping costs can range from $50 to $500 per sample, depending upon scale. Significant reductions in these costs are needed, particularly in programmes where large numbers of offspring need to be evaluated.

Second, better utilisation of within-family genetic variance is needed. To date, many genetic gains made from genomic selection in livestock programmes have been made via tracing ancestries. Strategies are required that more effectively exploit within-family genetic variation. Similarly, because genomic selection offers new paths to genetic gain, strategies are required that optimise genetic gains for multiple traits, as breeding objectives typically involve multiple traits and often multiple environments. Strategies will also be needed to offset the more rapid accretion of inbreeding, particularly in faster-reproducing species. Computer simulation and financial analyses are likely to be useful here.

In both radiata pine and apples, efforts are underway to design breeding programmes that optimally use the available resources in order to maximise genetic gain per unit time or input. Such evaluations will also need to account for increasing quantities of genomic information as whole genome sequences and associated catalogues of

A key challenge is how to transfer genomic information among genetically distinct populations and even species.

DNA sequence variation improve, as well as information from other 'omic' technologies (transcriptomics, metabolomics and proteomics).

A further key challenge is how to transfer genomic information among genetically distinct populations and even species. Relatively limited success has been achieved in livestock genomic selection when applying predictive models to populations unrelated to those used for developing these models. Strategies and prediction methodologies are required for clonally reproducible and inbred plant species to effectively utilise non-additive quantitative genetic variation. In addition, periodic recalibration of prediction models is needed due to the dissolution of linkage disequilibria over generations. This means that phenotypic information is still required, so more investment is needed in the future to develop cost-effective high-throughput phenotyping platforms.

Conclusions

Despite these challenges, the promise of accelerated breeding and genetic gains from genomic selection has already been realised in livestock in New Zealand, and will likely be realised within the next five to 10 years in our major horticultural and forestry species. Moreover it is likely that, should costs of the DNA-based evaluations reduce, genomic selection will be applied to more species. Conventional field testing is likely to become less important, although will not be completely replaced, particularly as periodic recalibration of predictive models will still be needed. Although optimal strategies for the utilisation of genomic selection still need to be determined, genomic technologies are finally making a meaningful impact on New Zealand's key fruit and forest tree species.

Acknowledgements

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PHIL JOURNEAUX

The quality of Waikato water – the journey

The Waikato is, along with many other regions in the country, on a journey of discovery about how to improve their quality of water and still maintain a reasonable economic base.

This article discusses the process being undertaken in the Waikato to improve the quality of water in the Waikato and Waipa Rivers and progress to date, recognising that it is yet to be completed. The process is driven via the Resource Management Act 1991 (RMA), and a subset of this, the National Policy Statement (NPS) for Freshwater Management which requires councils to set objectives, targets and methods for achieving improved water quality. In addition, the Waikato also has the Vision and Strategy for the Waikato River, a legal document which gives effect to the NPS in plans affecting the Waikato and Waipa Rivers, particularly requiring the rivers to be:

- Safe for swimming
- Safe to harvest kai
- Able to support abundant and diverse fisheries, flora and fauna.

To give effect to the Vision and Strategy, the Waikato Regional Council, working with the five river iwi – Tuwharetoa, Te Arawa, Maniapoto, Raukawa and Tainui – set up a Collaborative Stakeholder Group (CSG) made up of 24 representatives of sectors and the community who were elected or appointed to the CSG. The make-up of the CSG includes representatives from these areas:

- Horticulture sector
- Rural advocacy
- Energy
- Sheep & beef sector

The National Policy Statement for Freshwater Management requires councils to set objectives, targets and methods for achieving improved water quality.

- Local government
- Forestry
- Tourism and recreation
- Community groups (seven representatives)
- Environment NGOs (two representatives)
- Māori interests (three representatives)
- Dairy sector (two representatives)
- Water supply takes
- Industry
- Rural professionals.

The group is chaired by an independent chairman and facilitated by an independent facilitator. The CSG reports through to the Healthy Rivers Wai Ora Committee (Waikato Regional Council plus the five river iwi). The objectives for the CSG are:

> *To come up with limits, timelines and practical options for managing contaminants and discharges into the Waikato and Waipa catchments to ensure our rivers and lakes are safe to swim in and take food from, support healthy biodiversity and provide for social, economic and cultural wellbeing.*

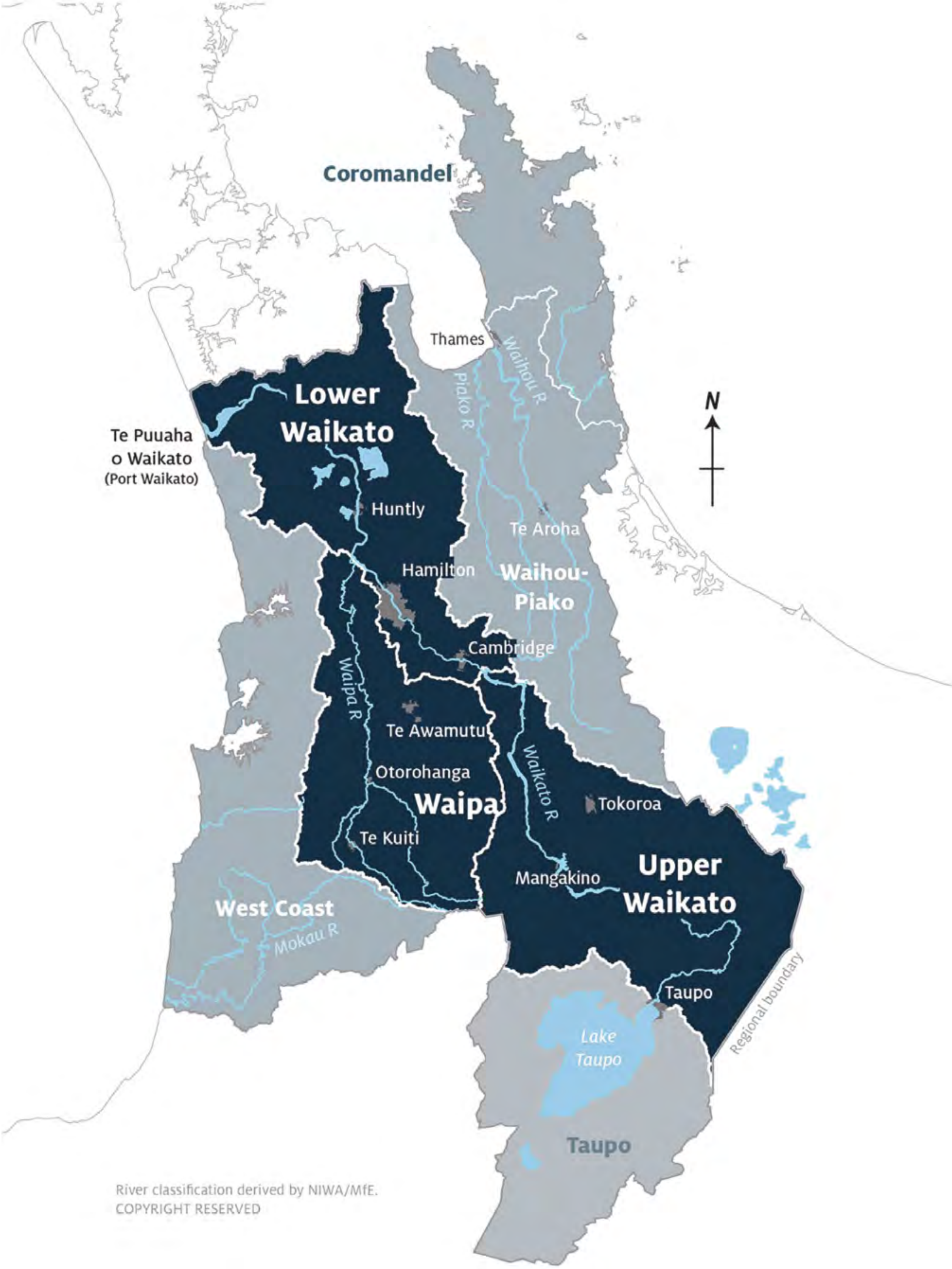


Figure 1: Area affected by CSG deliberations

In addition to the CSG, a Technical Leaders Group was set up to provide scientific advice to the CSG. The area under consideration is the Waikato and Waipa catchments is shown in **Figure 1**.

The general process the CSG has been working through is illustrated in **Figure 2**.

Figure 2: The process – how it fits together

The decision was made to split the catchment into five Freshwater Management Units:

- Upper Waikato (Huka Falls to the Karapiro Dam)
- Mid-Waikato (Karapiro Dam to Ngaruawahia)
- Waipa (encompassing all of the Waipa catchment)
- Lower Waikato (Ngaruawahia to Port Waikato)
- Lakes (which have been further subdivided into peat, riverine, dunes and volcanic).

The CSG has also debated the values and uses of the water within the catchments, around the outcomes communities want to achieve from freshwater management, and how the freshwater bodies will be managed to achieve these values and uses. The CSG has also developed selection criteria to assist in developing policies. (The full list of draft values/policy selection criteria and modelling reports can be found at www.waikatoregion.govt.nz/healthyrivers/.)

The next debate was around the attributes and bands within each attribute. The attributes were the indicators which would be measured relative to particular values, as illustrated in **Table 1**.

Table 1: Example of attributes

VALUES	ATTRIBUTE
Human health	E. coli Planktonic cyanobacteria Water clarity
Ecosystem health	Phytoplankton Total nitrogen Total phosphorus Periphytons Nitrate Ammonia

From here, the CSG needed to decide the bands the various attributes would need to fall into. These bands are based on the National Objectives Framework (NOF), where:

- **A = excellent**
- **B = good**
- **C = satisfactory**
- **D = not acceptable**.

Under the NPS, a 'D' band is by law required to be lifted to at least a 'C' band. The discussion around which attributes to lift to which band is the basis of determining what water quality is acceptable. The next step was to carry out some modelling work, based on a range of scenarios, in order to estimate the cost of each one. These scenarios were:

Scenario 1:

Protect and restore: water quality that will achieve Vision and Strategy objectives

Scenario 2:

Improve to at least minimum state everywhere and no degradation

Scenario 3:

Improve but may not achieve minimum state everywhere

Scenario 4:

Maintain – no further decline despite N load to come.

The modelling involved aligning several models, whereby the physical implications of lifting the attribute bands were initially modelled, the effects of which on the land were then modelled as to their economic impact based on derived abatement curves. This, in turn, flowed through to a regional impact model (based on Input/Output) as to the impacts at the FMU, regional and national level.

Figure 3: Modelling sequence

The modelling was done based on two 'constraints': for the main modelling runs, reverse land use change (i.e. dairy back to sheep & beef, sheep & beef to forestry) was constrained to the same average level as land use change that has occurred within the catchment over the last 40 years. A second run was also made, where reverse land use change was unconstrained. The initial modelling showed the following results:

Figure 4: Catchment-level annual profit (constrained)*

*Also includes the cost of mitigating point source contamination

This shows the annual catchment-level profit decreasing from $915 million/year under the current situation, down to $465 million/year under Scenario 1, in as much as Scenario 1 is closest to achieving the Vision and Strategy and the CSG has concentrated on this as the desired strategy going forward. The modelled impact of this at a regional level, with respect to impact on GDP and employment, is shown in **Table 2**.

Table 2: Impacts by FMU, region and NZ, annual figures for Scenario 1, change determined relative to current state

	UPPER	MID	LOWER	WAIPA	WAIKATO	NZ
Value added ($m)	-93	-109	-126	-115	-529	-1,060
Employment (FTE)	-1,209	-1,079	-1,036	-913	-4,958	-10,833
Exports ($m)	-15	-154	-22	-65	-406	-655

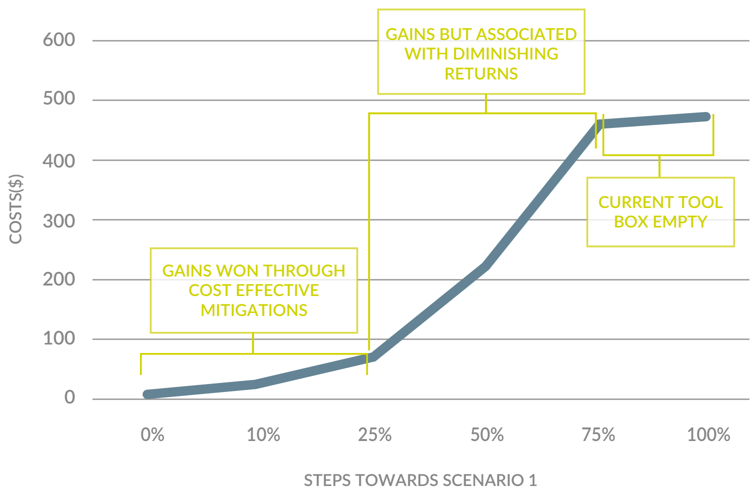
Overall, the modelling directly indicates that the cost of achieving the Vision and Strategy is quite high, both with respect to GDP and employment, and with the impact also more likely to fall on the smaller rural towns. This 'constrained' modelling estimated a reverse land use change of 32,579 ha (see **Table 3**).

Table 3: Estimated land use change – Scenario 1

LAND USE CHANGE	HECTARES
Dairy to drystock	15,656
Dairy to forestry	5,579
Drystock to forestry	11,251
Horticulture to drystock	93

In the unconstrained modelling, the water quality aspirations were achieved by a reverse land use change of 400,000 ha, out of a total catchment area of 1.1 million ha, and approximately 668,000 ha of pasture, which perhaps indicates that this approach is somewhat unlikely. Further modelling, breaking down Scenario 1 into various 'steps', can be seen in **Figure 5**.

Figure 5: Impact on catchment profit via graduated steps in Scenario 1



This indicates that the model achieved 25% of Scenario 1 via the use of various, generally lower-cost, mitigations, but the cost of achieving from 25% through to 75% of the target was only gained via increasingly costly mitigations and reverse land use change. There was very little gain beyond the 75% mark, as the model had run out of mitigation options.

The modelling also indicated that as the percentage achievement of Scenario 1 increased, there was also an increase in the 'breaches' of limits for the various attributes. In other words, the total water quality aspirations of Scenario 1 could not meet with current mitigations. The value of the modelling is that it enables the CSG to explore a range of scenarios within a consistent framework, in understanding a complex issue, and in understanding the amount of change required.

Given the cost and complexity, the CSG has come up with a preferred timeline for change:

- 10% of Scenario 1 achieved in 10 years
- 25% within 20 years
- 50% within 60 years
- 100% within 80 years.

This is currently out for public debate and comment.

All regions, sooner or later, will implement policies restricting contaminant discharges – if it hasn't happened already, it will be coming to a region near you.

The CSG is also currently discussing the policy approach to achieve the required water quality standards. At this stage the discussion involves two approaches:

(i) Catchment-wide rules which would affect everyone:
- Bottom lines which everyone would have to meet, e.g. stock exclusion from waterways, setbacks (5 m) from waterways, sediment and erosion control plans for cultivation, earthworks, tracking and forestry harvest, and
- Interim controls on further intensification, e.g. require consent to increase nitrogen loss more than 10% of benchmark figure.

(ii) Tailored property plans:
- Individual plans which would take account of the complexities and differences of each property
- Would detail actions to reduce contaminant discharges, and
- Would move to a property level limit over time.

These would operate under a permitted activity rule and be supported by industry. Plans would be drawn up by certified people and audited by an independent body. The current intent is that these would be required by all properties over four hectares. Again, this policy approach is out for public debate and comment.

Currently the CSG is undertaking a public consultation on options. Recommendations on the final policy package will be made to the Healthy Rivers Wai Ora committee by early 2016. The Waikato Regional Council will notify the plan change by mid-2016, after which it then goes through the formal RMA process.

The end result of this process, as in other regions, will have a fundamental effect on the way farming is carried out in New Zealand. And all regions, sooner or later, will implement policies restricting contaminant discharges – if it hasn't happened already, it will be coming to a region near you.

PHIL JOURNEAUX is an Agricultural Economist working as a consultant with AgFirst Waikato. He is the Rural Professional representative on the Waikato CSG. Email: phil.journeaux@agfirst.co.nz

Con Williams, ANZ Agri-economist

Farming background

Con grew up on a sheep, beef, deer and crop farm in Central Hawke's Bay where he gained his passion for farming and the primary sector. He was actively involved in all aspects of farming from a young age, and while at Massey University spent most of the summer breaks in full-time employment at various meat and fibre enterprises in the Manawatu.

At Massey he completed a Bachelor of Applied Science with first class honours in agri-business. When he finished in 2004 he was undecided about what to do next, but was offered an assistant lecturer role in agri-business, supply chain management, applied mathematics and international food exporting and marketing. This involved half-time lecturing and the rest studying toward a PhD in agri-food value chains.

Senior economist – Meat & Wool

Con had applied for several other roles when he finished university, but was unsuccessful. One of these roles was the senior economist role for the Meat & Wool New Zealand (M&WNZ – now Beef + Lamb NZ) Economic Service. At the time he missed out to someone else with more experience, but when the same opportunity knocked a year later in 2006 he had made up his mind it was time to leave university life behind.

At the time he was really just a junior with much to learn, especially since he had not specifically studied economics. The first 12 to 18 months was about learning the ropes and then it became much more varied as experience was gained. The day-to-day role included running and updating the M&WNZ Economic Service and New Zealand Meat Board databases. These databases held a large collection of production, export, price and other macroeconomic indicators on the New Zealand sheep and beef sector.

Con was also involved in the daily running and operation of an annual survey of 550 sheep and beef farm businesses throughout New Zealand. The survey has been run for a long time and has collected over 900 data points per farm on the physical and financial performance of different farm types throughout the country.

All the collected industry and on-farm data was then used for the forecasting and formulation of regular industry reports/presentations on in-market and farm-gate prices, meat and wool production, meat and wool exports, farm input costs and the sector's financial performance. These were then used by a variety of stakeholders as key sector benchmarks for the year ahead. The collected data was also used for economic analysis and policy support in response to ad hoc queries on the sector from a wide range of stakeholders including government, meat and wool processors, research institutions, rural professionals and farmers.
The queries often numbered about 600 per year.

As experience was gained Con branched out into other areas. Some of the highlights included input into M&WNZ's new strategic direction in 2010 during the change-over to Beef + Lamb NZ. He also provided information and analysis on sector performance and restructuring, specifically the Meat Industry Taskforce set up in 2008 and the Red Meat Sector Strategy developed by Deloitte in 2010.

Con was involved in the daily running and operation of an annual survey of 550 sheep and beef farm businesses throughout New Zealand. The survey has been run for a long time and has collected over 900 data points per farm on the physical and financial performance of different farm types throughout the country.

Con makes individual presentations to boardrooms of large clients and prospective clients on a range of issues concerning the primary sectors, and gives media commentary on topics related to these sectors. He is also involved in the collection and provision of a range of important statistics for the primary sectors.

Other projects were the development and completion of a range of contract work that financed approximately 30% of the budget for the M&WNZ Economic Service. Annual contracts included the MAF Farm Monitoring for the sheep and beef sector and Inland Revenue National Standard Values for Livestock. He also gave presentations to various audiences from farmers through to accountants and consultants on key topics including production trends, price/profit/cost forecasts and other general topics of interest such as food security.

Con was instrumental in the development and implementation of a quantitative cost-benefit model in 2008 alongside standardised investment criteria. This provided senior staff and board members with objective standardised information and analysis when making investment, i.e. research and development, decisions.

Climate change policies

Other areas branched out into included domestic and international climate change policies. This involved economic analysis, policy development and advocacy on the inclusion and design options of including the agricultural sector in the NZETS. Con was also involved in international negotiations on climate change (the UN Framework Convention on Climate Change in 2009), including advocacy for a separate science and policy platform for agricultural emissions within the international negotiations. This was to address food security, including developing countries in future agreements, and to improve the understanding of the challenges and opportunities for reducing agricultural emissions.

Another area of involvement was in life-cycle analysis of New Zealand lamb, mutton, wool and beef products. Con also provided information and analysis to M&WNZ's environment group, which was used to inform discussions on a wide range of environmental issues for the sheep and beef sector, such as changes to regional council plans.

Agri-economist – ANZ

Con became the agri-economist at ANZ five years ago. The main attractions for him in this career change were getting into the private/commercial sector, learning more about financing and covering/gaining experience in a wider range of sectors including dairying, forestry, horticulture and viticulture. The first 12 to 18 months were another steep learning curve, especially since he needed to do much upskilling and knowledge-seeking on the other sectors he had not previously covered in-depth.

The role is wide and varied but core responsibilities include the production of *Agri Focus*, a bi-monthly publication with a domestic and international circulation of over 12,000 readers. The publication covers all aspects of the primary sectors and includes two research pieces expressing ANZ's views on topical issues. There is also an update on the rural property market, financial markets, soft commodity markets and rural production/weather scene.

Con also provides bi-annual budgeting and longer-term forecasts for a range of key parameters and benchmarks that are used in the credit assessment process for different primary sectors and farmers. This includes farm-gate prices, agri-interest rates, livestock valuations and fair value assessment of Fonterra shares. He also contributes to other economic publications as required on a range of topics, but usually with a primary sector focus, such as the *Market Focus* (weekly), *Morning Brief* (daily), the ANZ commodity price index (monthly) and Quarterly Economic Forecasts.

He makes presentations to a range of audiences and ANZ clients from milk, meat and horticultural processors/exporters through to large institutional investors, and service providers such as accountants and farmers/growers. Con also makes individual presentations to boardrooms of large clients and prospective clients on a range of issues concerning the primary sectors, and gives media commentary on topics related to these sectors. He is also involved in the collection and provision of a range of important statistics for the primary sectors. These are used by a wide range of personnel in ANZ for budget forecasts, risk assessments and client pitches/presentations.

He is also General Counsel for major policy changes in lending practices to the primary sectors due to events such as PSA in kiwifruit and Fonterra's change of capital structure.

Rugby interests

Outside of work Con played rugby for a long period of time, but retired last year due to work and family commitments. He mainly played for university sides and age grade reps in the Manawatu, saying 'I never quite cracked the big time'.

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NZIPIM ACKNOWLEDGES THE SUPPORT OF OUR STRATEGIC PARTNERS

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