

Analysis of Production Systems in the New Zealand Dairy Industry

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Executive Summary

The objective of this study was to investigate the aspects of production systems in the New Zealand dairy industry with profitability as the key driver, along with resilience to volatile price swings, international competitiveness and an environmental enquiry. Existing data was used for this analysis. Over the past 10 years there has been a substantial increase in supplementary feeding on New Zealand dairy farms, resulting in an increase of more than 100% in feed costs, while cost of debt increased over 40%.

Many decisions to increase farm intensity and supplement feeding are based on a perception that additional feeding will lead to further milksolid production, and therefore, further profitability and return on assets. Caution needs to be taken here, as the key driver of operating profit per hectare on New Zealand dairy farms is the cost of production, as this can be managed within the farmgate, while other variables lie beyond farmer control.

Analysis from this study suggests that although individual farmers operating intensive systems have done well, and can remain profitable in average farmgate milk price seasons, the New Zealand dairy industry as a whole has become less resilient to external factors, international competitiveness has been eroded, and profitability has become difficult in low to average milk price seasons with higher breakeven milk prices required. Intensive farm systems with off-paddock facilities such as cow housing barns, when incorporated in the New Zealand pastoral model, have also shown that it is difficult to achieve positive environmental outcomes whilst being profitable, with breakeven milk prices required in excess of \$6.50 per kilogram of milksolid.

International datasets show that the overall costs associated with supplementary feeding can be more than 50% of the purchase price when accounting for wastage, utilisation, capital infrastructure, fuel/energy, and repairs and maintenance.

Combining supplements into a pasture based system can have the possibility to enhance total feed intake, production and profitability. However, the real milk solid response is regularly inconsistent and less than anticipated. Results under ideal research conditions showed a response of 70-80g of milksolids per kilogram of supplement dry matter introduced into the diet, while commercial dairy farms only had a 55g response.

However, not all farm system decisions are necessarily based on profitability. Many decisions concerning farm systems, intensity and infrastructure can be based on non-economic factors. This does not mean they are poor decisions, so long as the long term viability of the farming operation is sustained, but farmers must be aware of the implications of doing so.

Farmers need to be cautious of making reflex decisions in altering their systems due to a short term shift in milk price. What needs to be understood is the key drivers and values of the operation, and make decisions based on the core objectives and strategy, current performance, and recognise opportunities to make strategic changes to increase business profitability and resilience.

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Objective

The purpose of this project is to determine the relationship between intensive production on New Zealand dairy farms and profitability, international competitiveness and environmental factors. In conjunction with other information on system intensification, this report will allow farmers to gain a wider perspective on farm systems and develop an institutional position on the topic.

Definitions

All dairy farms are categorised into one of five production systems based on the timing, purpose and amount of imported feed use, both purchased as supplements and grazing off for dry cows. Grazing policies of young stock are excluded when categorising herds into the five production systems described below.

System 1: All grass, self-contained

- All grass. No supplement feed purchased. No cows grazing off the milking platform

System 2: Dry cow feed purchased

- Approximately 4-14% of total feed imported and fed to dry cows including dry cows grazing off the milking area

System 3: Feed purchased for dry cows and to extend lactation

- Approximately 10-20% of total feed is imported to the milking area to extend lactation (usually autumn feed) and for dry cows

System 4: Feed purchased for dry cows and to extend both ends of lactation

- Approximately 20-30% of total feed purchased at both ends of lactation and for dry cows

System 5: Feed purchased for year round feeding

- At least 30% of total feed imported all year round including dry cows

In this report reference is made to low, medium and high input systems. These are defined as:

Low: system 1 and 2

Medium: system 3

High (intensive): system 4 and system 5

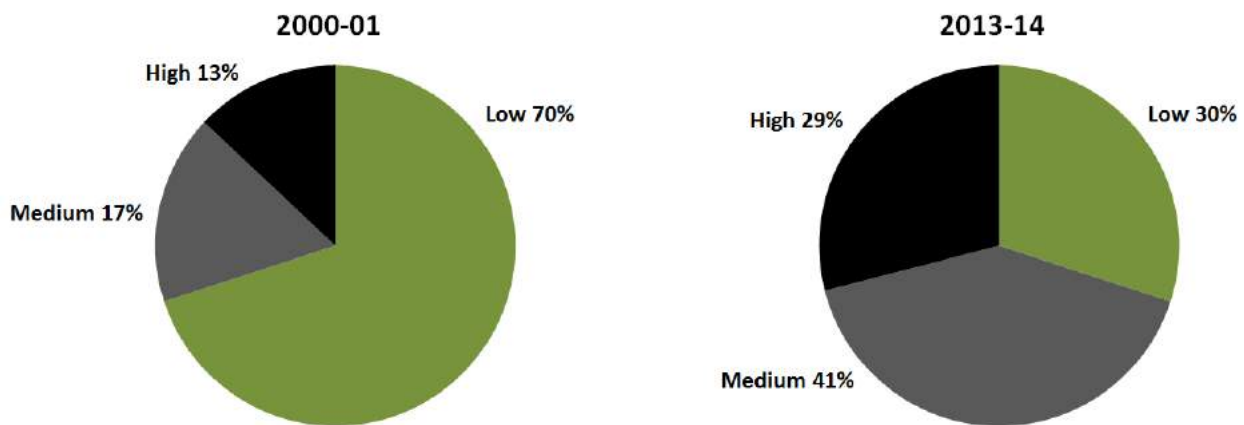
Source: DairyNZ Economic Survey



Introduction

In recent years there has been a material increase in the quantity of supplements fed on dairy farms within New Zealand (figure 1). This has resulted in a shift for many farmers up the intensity scale to a higher production system. The dairy industry within New Zealand is vastly different when compared to the previous decade. Farms and herds at present are much larger and more heterogeneity exists within production systems on farm. Many farmers have pursued an intensive farming system in the quest for further profitability.

Figure 1. Production System Changes in New Zealand



Source: DairyNZ

Supplements are defined as any feed supplied to dairy cows that is in addition to grazed pasture. Supplements are introduced into pasture-based farming systems for numerous reasons. Reasons can be strategic, for instance system intensification for revenue, or growing a farming business with fixed constraints, while others can be operational or tactical. The increase in intensity has been both intentional and unintentional. The incremental intensification, known as the systems creep, has also been driven by adverse weather conditions, particularly droughts, and the accessibility of supplements such as palm kernel.

The operating environment for dairying in New Zealand is shifting. Whilst it has always been complicated to forecast overseas commodity prices, or foretell production risks (weather, feed accessibility and cost), future dairy production will be set on a platform of uncertainty and increased volatility (Commodity Network, 2015). As a consequence, whatever intensity system New Zealand farmers decide to implement, they must be resilient to react rapidly and positively to change.

While sensible use of debt is an essential and effective way of building and growing business, many dairy farms in New Zealand are now heavily indebted and are notably exposed to volatile commodity prices, adverse climate, rises in input costs and changes in industry policy (Reserve Bank of New Zealand, 2015).

This report will not promote any particular system. It will provide a template for those wishing to secure their future in dairy by taking charge of their production system and ensure they are profitable and resilient. Different aspects of system profitability will be analysed, with a focus on the tactical use of supplements, with profit as the main driver of decision making within the business.

Background Information

There has never been more diversity in New Zealand dairy production systems than the current status quo (DairyNZ, 2015). There has been faster change over the past 10 years than the previous decades. The reasons for change vary, but may include:

- Focus on increasing milk production
- Higher milk prices, relative to feed prices
- Changes in seasonal weather patterns, particularly droughts
- Advice and pressure from feed sales consultants
- Public pressure towards animal welfare and desire to improve cow condition
- Other farmers seem to be doing well from it

Many dairy farmers have done very well at implementing and operating intensive input systems, however, many have not been so successful. If a farmer does not manage pasture well, it is highly likely they will not be able to get the most out of an intensive system. The decisions, skills and management required for intensive farming systems are far more intricate than a pasture based system.

Although higher input systems may have led to greater returns for individual farmer businesses, what is not apparent is if these alterations have enhanced the industry's overall profitability, competitiveness and resilience.

Methodology

This study involved using existing farm (owner operator) and industry data, sourced primarily from Statistics New Zealand, DairyNZ, Fonterra, LIC, AgriHQ and Rabobank. Using aggregate farm system data, analysis is done on high, medium and low input systems. Analysis of this data from several seasons provides insights into the financial performance of farms based on their production system.

Breakeven analysis entails the 2013-14, 2012-13 and 2011-12 season, as these seasons cover a range of scenarios including, an abnormally high payout (\$8.40), a relatively low payout (\$5.84), and a long run mid to high median payout (\$6.08). For the 2013-14 season, there were 301 farms in the study, whilst there was 217 in 2012-13, and 204 in 2011-12.

Sensitivity analysis is based on a forecast \$4.60 farmgate milk price, with operating expenses forecast for each system category (based on current 2013-14 data). From this, a scenario is developed to investigate the relationship between intensification and profitability. Performance is reported on a per hectare and per milksolid basis which is common within the New Zealand dairy industry. Limitations here include the difficulty in being definitive about the sector's vulnerability on the basis of aggregate data, recognising that aggregate data can possibly mask individual records.

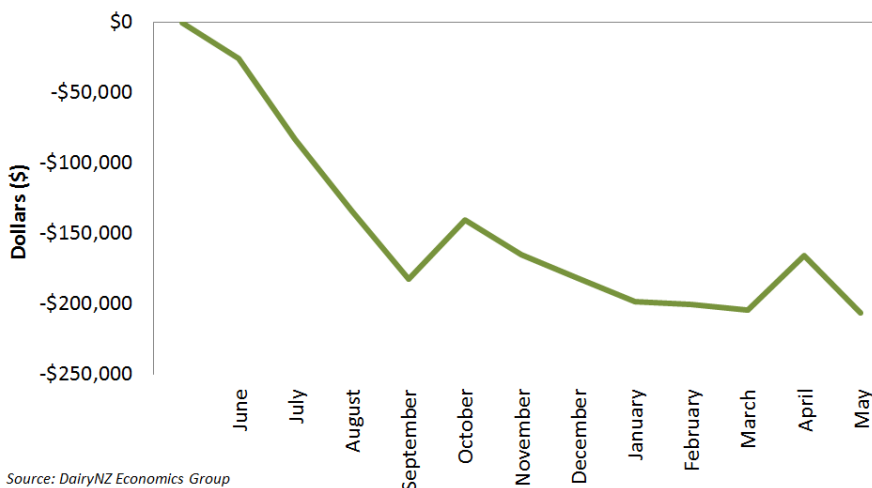
Note: 67% of all dairy herds in New Zealand are operated as owner-operators (LIC & DairyNZ, 2015).

Resilient Farming

Resilience in business and farming is the capacity to adapt to change, and this is a key factor for financial success when operating in a volatile commodity market (Ramsbottom et al., 2015). Resilient farm systems will have strategic flexibility to overcome unforeseen circumstances (low milk price, adverse weather etc) that can lower short-medium term profitability, whilst system principles remain constant (Roach & Horan, 2015).

The New Zealand dairy industry is currently experiencing one of the lowest farmgate milk prices in recent history (Lee, 2015). Recent forecasts have shown that up to 72% of dairy farmers will be unprofitable this season at a \$4.60 milk price (DairyNZ, 2015). Figure 2 below illustrates an average New Zealand dairy farm's closing bank balance this season with a \$4.60 milk price, \$3.91 farm working expenses and \$1.44 interest and rent (DairyNZ, 2015).

Figure 2. New Zealand Average Dairy Farm Closing Bank Balance (2015-16)

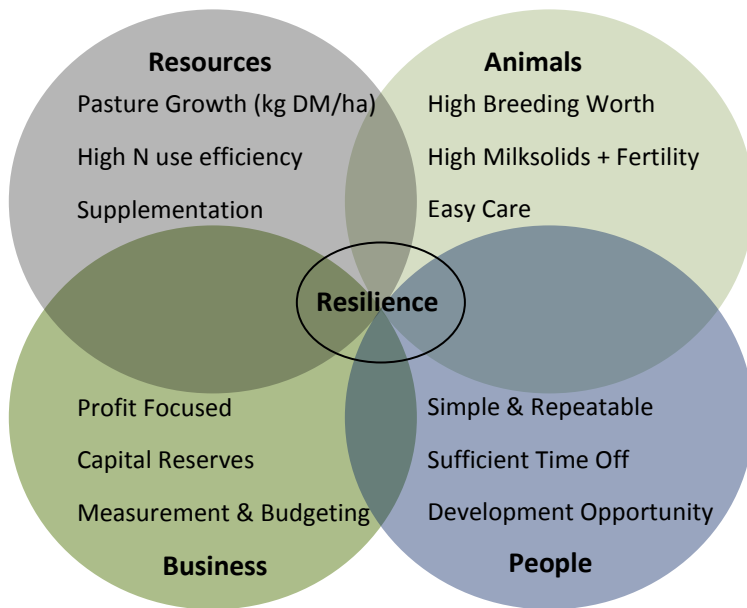


New Zealand dairy farmers will have their resilience tested this season. Figure 2 above would suggest that the New Zealand dairy industry is no longer resilient to price shocks and all farm systems will find it challenging to operate in the current environment. In order to be resilient farmers should have a low production-cost base to insulate the dairy farm business from price oscillations, and generate sufficient funds in better times to meet requirements in lean years (Ramsbottom et al., 2015). Recent forecasts indicate that up to 70% of dairy farmers will be unable to meet farm working and interest and rent costs in the 2015-16 season, with an average breakeven milk price of \$5.30 per kilogram of milksolid required (DairyNZ, 2015).

Resilient farming systems should have the ability to prosper and succeed in a volatile, changing production situation. A resilient farming operation must, for that reason, have an approach or strategy for how it will operate flexibly within a below average year.

Though there are numerous aspects to a successful dairy operating system, Roach & Horan, 2015 illustrate four "pillars" to represent a resilient farming system, regardless of region, rainfall and farming values.

Figure 3. Resilient Model



Source: (Roach & Horan, 2015)

The fundamental pillars (above) of a resilient farm system illustrate the efficient utilisation of land, business and management acumen, a strategy of continuous improvement for all parts of the business, and a fit for purpose motto (Roach & Horan, 2015).

This model suggests that successful farming systems require a constant system foundation (strategic plan), with the strategic proficiency to undertake tactical management decisions (Roach & Horan, 2015).

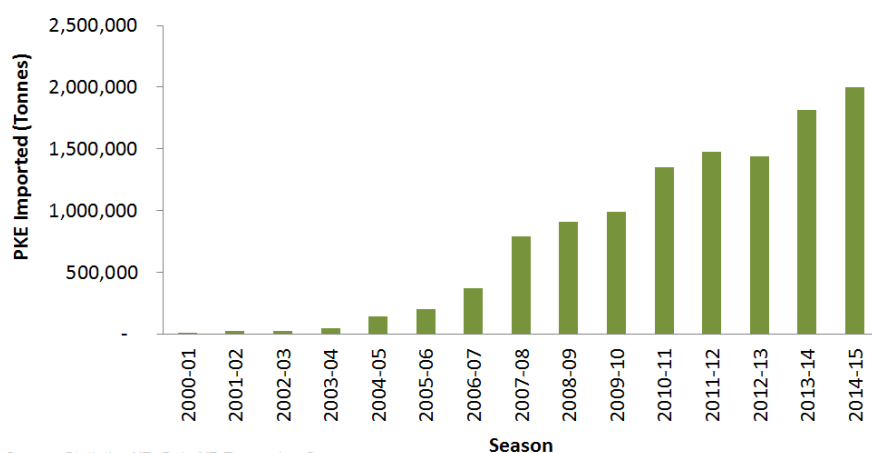
Farming systems that are resilient should be set up being mindful of the land production capability, typical rainfall, soil type, and the welfare of high performing animals. They must be very efficient per unit, be it land, labour or capital. This business and system must provide a sustainable return financially, be environmentally benign, and offer pleasant and gratifying work and lifestyle for those employed (Roach & Horan, 2015).



Palm Kernel Imports

In recent years there has been increasing competition for maize silage from palm kernel expeller (PKE) as a supplement feed. Palm kernel imports into New Zealand have shown a material increase over the past ten years (figure 4) as a result of New Zealand farmers intensifying their systems. Palm kernel is a waste product of the palm oil industry in South East Asia (Fonterra, 2015). Palm kernel now plays a significant role in feeding New Zealand cows. It is estimated that palm kernel is responsible for up to 7-8% of New Zealand's milk supply (Exporter, 2015). This feed is a dry gritty meal with somewhat of a soapy smell and has a low palatability. This supplement is now widely used in the New Zealand dairy industry due to its reasonably high levels of energy (ME) and protein, its relative ease in introduction to cows, and low cost. Palm kernel also has dry matter percentage between 88 to 95%. The profitability of palm kernel is highly dependent on its purchase price relative to milk payout, along with its utilisation alongside pasture (Farmfact, DairyNZ, 2015). Palm kernel imports into New Zealand have continued to increase despite the decrease in farm gate milk price from the 2013-14 season (refer to Appendix 1).

Figure 4. New Zealand Palm Kernel Imports



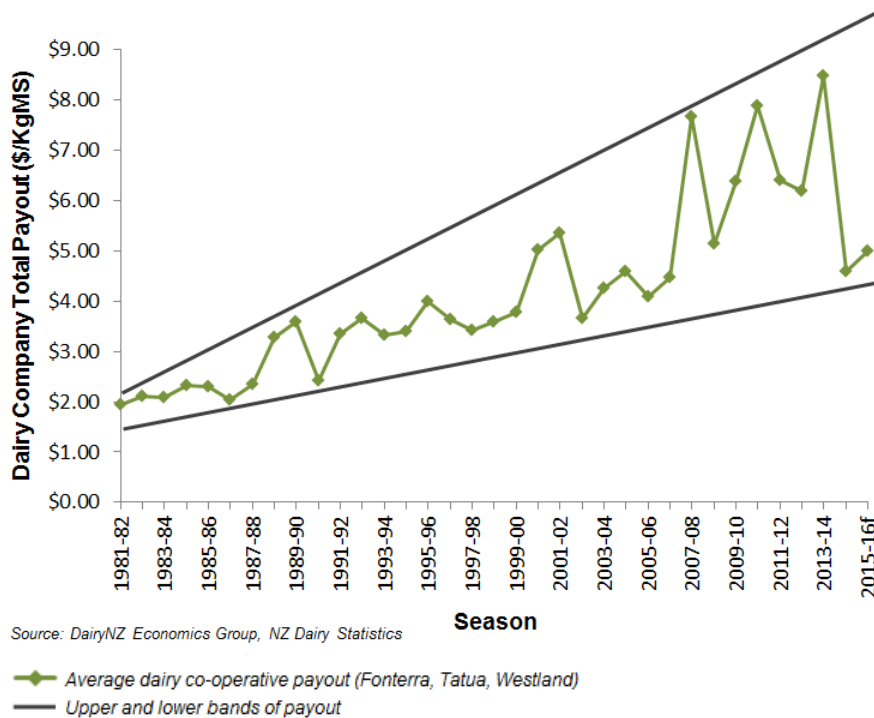
Source: Statistics NZ, DairyNZ Economics Group



Market Volatility

As New Zealand farmers have incrementally increased their production systems, market volatility has also increased. Market volatility can be described as “the degree to which prices fluctuate over time”. It is also commonly accepted “historical volatility is a guide to what future volatility may be” (Commodity Network, 2015). Figure 5 below shows the weighted average (Fonterra, Tatua, Westland) dairy company payout in New Zealand since 1981. The impact of a low milk price is now amplified due to an increase in farm breakeven payout, due to more intensive operating systems and higher debt levels (Reserve Bank of New Zealand, 2015).

Figure 5. Average New Zealand Farmgate Milk Price (Including Dividend)

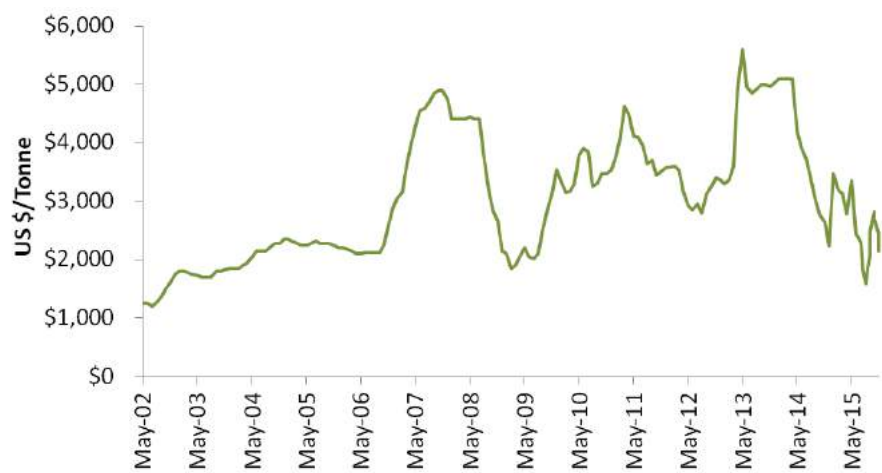


Dairy is one of the most volatile commodities, and this volatility is forecast to continue. This volatility is a result of the shift in demand and numerous unpredictable supply side issues, creating a difficult operating environment for producers, along with those both up and downstream of the dairy industry (NZX, 2014). When observing the price of other relative commodities, the dairy industry undoubtedly has price instabilities that indicate a need for financial instruments to mitigate risk. The volatility level in dairy is generally similar to that of corn, coffee and palm oil (NZX, 2014). In recent auctions however, New Zealand dairy has shown a 50% volatility within a 50 day average when compared to a 30% volatility for wheat and corn (Gray, 2015).

In the past, dairy commodities have had a moderately low price risk in comparison to other relative commodities. Price movements were generally insignificant, whilst also demonstrating a steady upwards trend (NZX, 2014). The Agrifax whole milk powder weekly price index only showed one occurrence where whole milk powder moved more than \$US100 per tonne between 1991 and 2006 (figure 6). Since then, over 75 occurrences have been recorded for a weekly price movement of more than \$US100 per tonne (Agrifax Report, 2014). No

matter which system farmers choose to operate, they should ensure their business is resilient to deal with the new reality of peaks and troughs of volatile commodity cycles.

Figure 6. New Zealand Whole Milk Powder Prices



Source: Agrifex, Global Dairy Trade, DairyNZ Economics Group

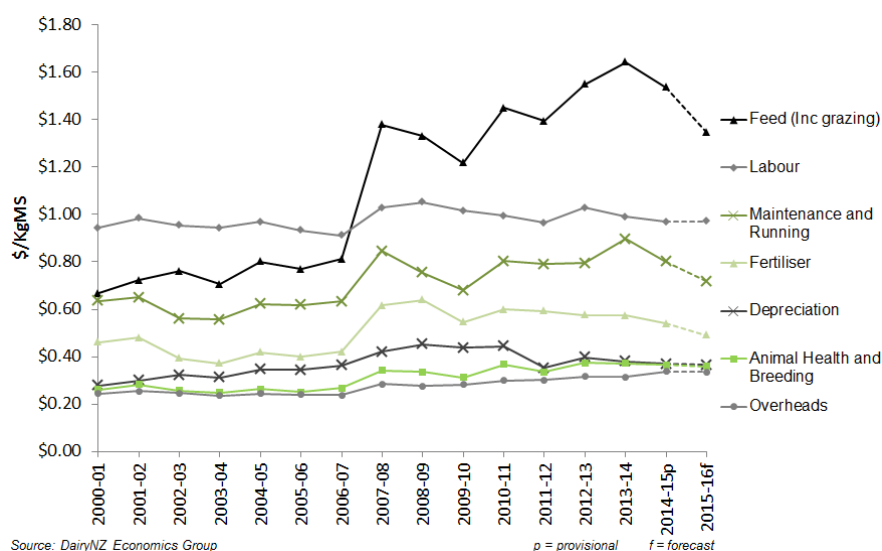


New Zealand Dairy Operating Expenses

High milk prices in previous years has resulted in increased revenue, but also, increased expenditure. Feed is now the largest category of expenditure at 31.8% in the 2013-14 season, up one percentage point from the previous season. Ten years ago feed only accounted for 22% of total operating expenses and labour was the largest cost item. Operating expenses per kilogram of milksolids have averaged \$4.88 over the past seven seasons. The last two seasons however have shown operating expenses surpass \$5 per kilogram of milksolids (DairyNZ, 2015).

You will notice in the graph below that most costs have remained fairly flat since 2004. Opposing the trend here is the total feed costs on New Zealand dairy farms, showing over a 100% increase (2013-14) from the base point in 2004. This rise in feed costs has seen New Zealand farm working expenses increase from \$3.66 in 2004-05 to \$5.17 in 2013-14 (refer to Appendix 3). The issue now is that in a more volatile commodity environment are dairy farmers resilient, and can they control costs on low milk price years to maximise profit within their farm system. Debt expenses have also increased by 70 cents per kilogram of milksolid since 2000-01, making farmers more susceptible to low payouts (DairyNZ, 2015).

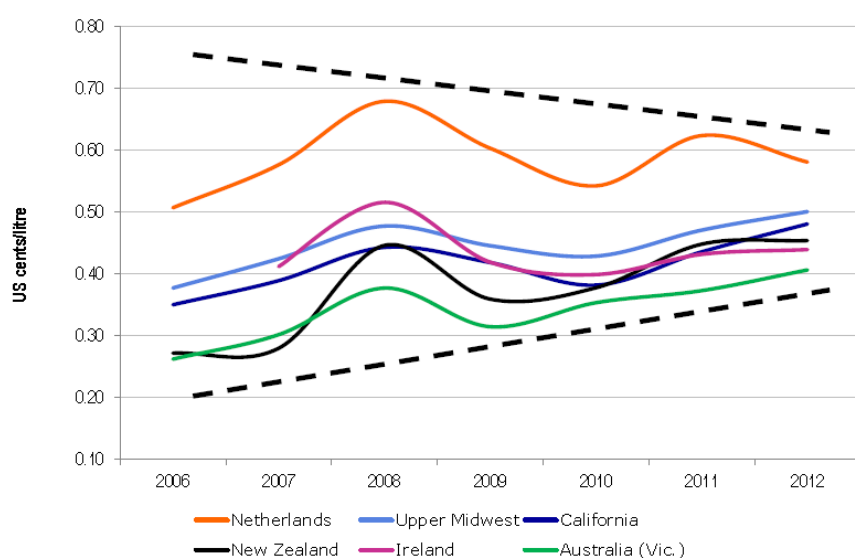
Figure 7. New Zealand Operating Expenses per Kilogram of Milksolid Since 2000



Global Milk Production Expenses Converge

In the past, nations within the Southern Hemisphere have been renowned for having low-cost dairy commodities and exports. Predominant pasture based grazing systems, an abundance of natural resources, along with low opportunity costs in alternative land use have given the hemisphere a competitive advantage (Rabobank, 2013). New Zealand and Australia have ample milk production proportional to the domestic demand of their low population base. In the 2013-14 season New Zealand produced 855% more milk than domestic market could consume (Dairy Report, 2014). This is in contrast to the likes of the US and EU who were regulated meet the conditions of their vast domestic markets.

Figure 8. Farmgate Milk Production Costs for Key Export Countries



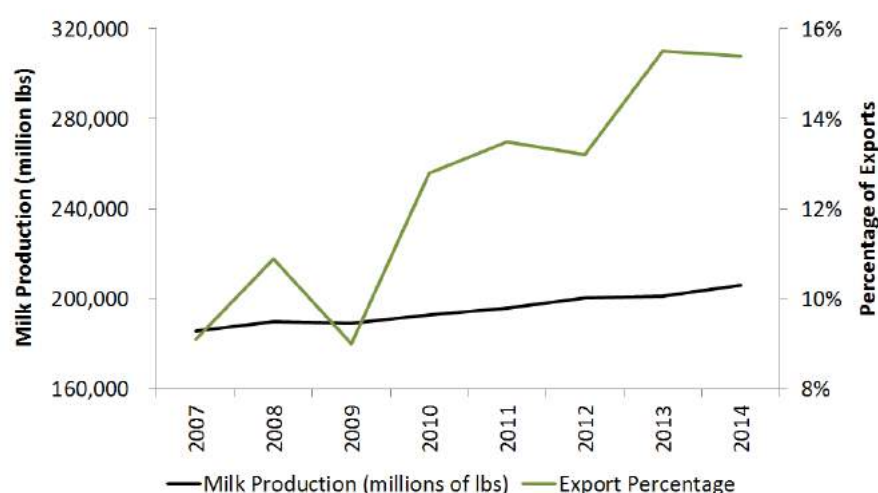
Source: OnFarm Consulting, DairyNZ, LEI, Teagasc, FADN, Genske Mulder, Rabobank, 2013

Note: Ireland data for 2006 unavailable

Production costs in recent years have converged in key dairy export nations (figure 8). The differential between the highest cost producer and lowest has tapered since 2006. This is due to low cost nations such as New Zealand increasing inputs to pursue profits, along with inflation costs (Rabobank, 2013). If you look back you will notice this is in line with figure 7, when New Zealand increased feed costs in 2007-08 and never looked back. Increasing feeds costs in New Zealand, which have led to more production, have also lead to higher operating costs. This has seen our international competitiveness erode due to a loss of efficiency, low cost base and resilience.

Many trading nations such as New Zealand also trade in US dollars, which results in additional volatility. Since 2002 the local currency of New Zealand has increased (on average) significantly against the US dollar, speeding up the convergence of production costs, therefore, making US exporters proportionally more competitive (Rabobank, 2013). Production in the US has shown an annual increase of 1.5%, while exports have nearly doubled to 15-16% of total production (figure 9) (Newman, 2015).

Figure 9. US Exports and Production



Source: US Dairy Export Council, USDA, Progressive DairyMan, DairyNZ

High performing US dairy farmers are now producing milk at a working expenses comparable to the bottom quartile of New Zealand farmers (DairyNZ, 2014). The use of scale, innovative technology, inexpensive labour, feed efficiency, attention to animal health and milk quality are all contributors to a high performing US dairy industry. The initial capital required to establish a dairy farm in the US is also less than half that required in New Zealand, on a per kilogram of milksolid basis, largely due to considerably lower land prices (ANZ, 2014).

For New Zealand to move towards an intensive mixed feed/pasture system the costs are much higher, due to the high prices of purchased feed, infrastructure and labour, when compared to our US competitors (table 1).

Table 1. Operating Costs of Intensive Confinement Systems in the US and New Zealand

	US	NZ
Feed costs (\$/kgDM)		
Corn silage	0.16-0.25	0.35-0.40
Lucerne hay/grass silage	0.3-0.4	0.3-0.5
Grain	0.24-0.38	0.45-0.55
Pasture		0.09
Labour cost (\$/hour)		
	\$8-\$10	\$14-\$30
Confinement infrastructure cost (\$/cow)		
	\$1100-\$1500	\$2500-\$3000

(Based on a NZD exchange rate of 80c against the USD) Source: DairyNZ

The US also have much higher and more stable milk prices, along with domestic support mechanisms such as margin protection and dairy product donation (ANZ, 2014). In the commodity industry cost-competitiveness is vital. New Zealand still leads at present with our pasture based system, but large scale dairies in the US are achieving similar results, when operating expenditure, interest rates and capital requirements are considered.

Production Response to Supplements

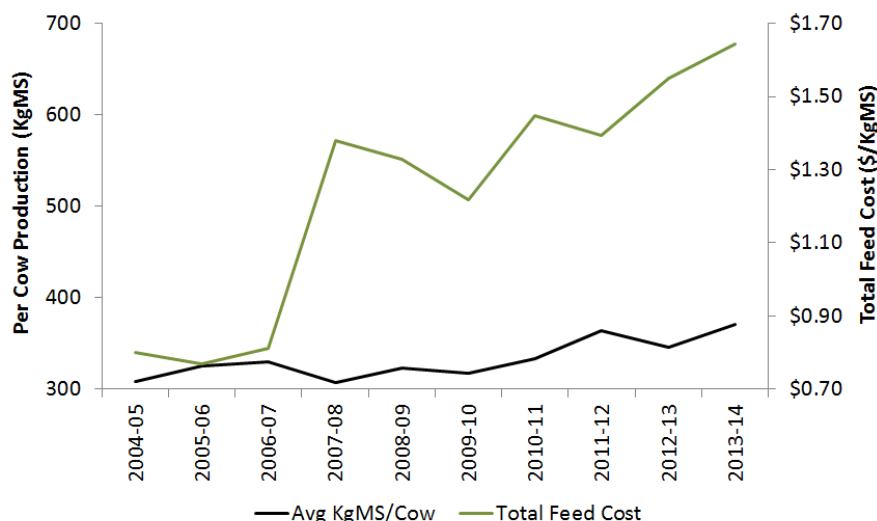
Under optimum research and test conditions cow production showed a response between 70 and 80 grams of milksolids per kilogram of supplement dry matter offered. In this circumstance, herd sizes were small, pasture was intensively managed, and wastage of supplement was limited. Therefore, it was not surprising that data from commercial farms reported an average milk solid response of only 55 grams of per kilo of dry matter supplement, two thirds of that achieved in ideal experiments (Kay, 2015).

Though combining supplements into a pasture based system can have the possibility to enhance total intake and production, the real milk solid response is regularly inconsistent and less than anticipated. This is due to several aspects that affect milk solid response (Kay, 2015). These are:

- Wastage of supplement – can differ between supplements depending on method of feeding and infrastructure
- The decline in pasture intake that arises when supplements are fed
- Energy that is not directed to milk yield – e.g. used for mating or body condition

Analysis on cow production over the past 10 years (2004-05 to 2013-14) reveals an increase in per cow production of 20% (LIC & DairyNZ, 2015), while feed costs have risen over 100% (DairyNZ, 2015).

Figure 10. Per Cow Production vs Total Feed Cost



In most cases the factor that has the most influence on milk solid response is pasture intake decline when supplements are offered into the diet. This is commonly referred to as substitution. How hungry a cow may be is the primary determinant of substitution, and this will be revealed in pasture residuals once grazed. The lower the grazing residuals are the hungrier the cow will be, therefore, a lower rate of substitution, and a greater rise in milk solid response.

A working example of this is a herd of cows in spring grazing down to residuals of 1,400 kilograms of dry matter per hectare. This would produce an extra 70 grams of milk solids for every 1 kilogram of high energy supplement introduced into the diet. However, if the herd of cows was only grazing down to residuals of 1,800 kilograms of dry matter per hectare, the response to the additional 1 kilogram of dry matter supplement would be 20 grams, or even less (Kay, 2015).

There are also other factors that can play a role in substitution and affect the production response to added supplements in pasture based systems. These can include the quantity of supplements, the type of supplement, and what time during season they are fed. These all need to be taken into consideration when looking at production response of feeding supplements (Kay, 2015).

What are the costs of feeding supplements?

The primary driver of operating profit/ha on New Zealand dairy farms is the cost of production. The cost of production can be managed by the farmer, while other elements lie beyond the farmgate and farmer control. This includes (but is not limited to) adverse weather, milk price and feed price. Therefore, it becomes crucial to be aware of the effect of supplementary feeding on operating costs, and understand the benefits and expenses of supplement use (Kay, McCarthy, & Roach, 2015).

When feeding supplements the cost of feeding machinery and infrastructure must be taken into consideration. This is commonly referred to as “margin over feed” and includes associated expenses such as labour, repairs and maintenance, fuel and energy and any infrastructure required. These costs can equate to 5% to 10% of the actual feed expense. It is estimated that the additional costs of feeding supplements such as palm kernel are 3.0 c/Kg for trailer feeding in the paddock and 2.7 c/Kg for in-shed feeding. For feeding silage in the paddock the associated costs are 5.7 c/Kg and 4.5 c/Kg for feeding silage on a feed pad (Kay, McCarthy, & Roach, 2015). It is also important to consider the amount of purchased supplement that is wasted. It is estimated that feed wastage is:

- 5% for in shed feeding
- 10% for feed offered on a feed pad
- 15% of feed offered in trailers in paddocks
- 20% of feed fed in paddocks in dry conditions
- 40% of feed offered in paddocks during wet conditions (Roach, 2015)

Based on the milk production response to added supplements in the diet, DairyNZ proposed a 5% rule to support farmers in decision making concerning the price of supplements. In order to be profitable with supplement feeding, supplement feed should be purchased below 5% of milk price (Roach & Horan, 2015). This proposed rule accounts for an increase in production of 80g of milksolid per 1 kilogram of supplement dry matter fed, and also the associated rise in non-feed costs. However, a response of 80g of milksolids per 1

kilogram dry matter supplement is close to 50% higher than the average response (55g) studied on commercial dairy farms. Therefore, new scenarios were established and analysed to account for different response rates to supplements and breakeven costs (Roche & Horan, 2015).

If we assume an average response rate (55g), the breakeven percentage of milk price moves down to 3.5%. If we look at the 2015-16 dairy season at a forecast \$4.60 payout, supplement feed should not be purchased for more than \$161 per tonne of dry matter. However, if we assume a response of 80 grams per 1 kilogram of dry matter supplement at a 5% breakeven, supplements can be purchased at \$230 per tonne (dry). Palm kernel is currently selling at \$237 per tonne (December 2015) (wet), excluding transport costs (DairyNZ Data Centre, 2015).

The breakeven price as a percentage of milk price for added supplements at varying response rates after accounting for all associated costs is shown in table 2.

Table 2. Breakeven Feed Price as a Percentage of Milk Price

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%

Source: DairyNZ

Further to being conscious of the price of added supplements, it is imperative to understand the volume of supplements that the farming operation relies on. Examining the necessity of supplements and the added risk of exposure to external economic factors beyond the farm gate should also be taken into account. In reducing the exposure of the farm business to increases in feed prices, it is proposed to limit supplement use to below 500 kilograms of dry matter supplement per cow annually (Roche & Horan, 2015). Reducing exposure and managing risk are fundamental when operating a higher input system, which is reliant on external feed and vulnerable to volatile milk prices.



Supplement Feed Price Volatility versus Milk Price Volatility

Price volatility in dairy commodities is here to stay, so it is necessary to understand pricing and mitigation of risk when assessing farm systems. Price volatility can be managed by decreasing exposure to market fluctuations or managing price risk (Kilsby, 2015).

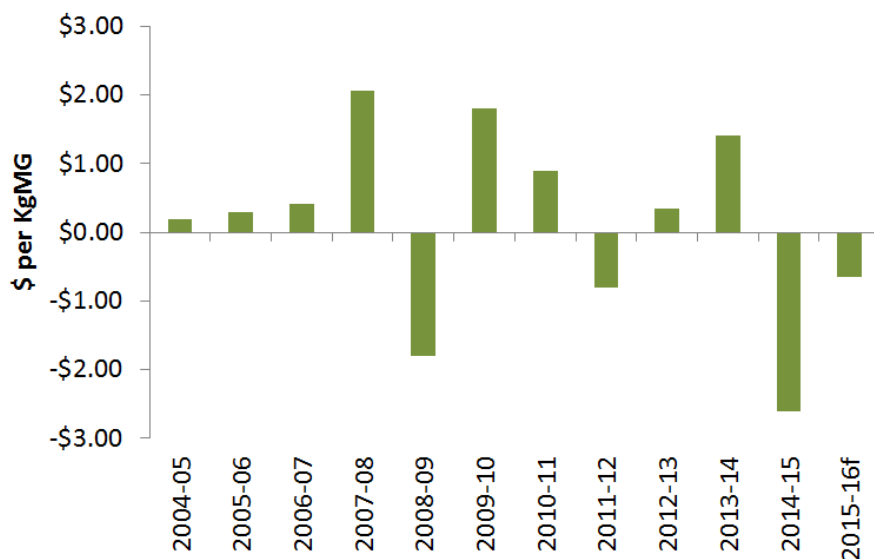
As with most things, timing is everything. As discussed prior, there is a tool to calculate the breakeven price of supplements as a percentage of milk price based on utilisation, expenses and wastage. However, the Fonterra milk price is generally forecasted every 3 months, and not finally set until October the following season.

Commodity markets, when combined with currency markets, are volatile and exceptionally difficult to forecast (Steel, 2015).

Therefore, farmers are faced with balancing short term decisions against longer term milk price forecasts. While there may be a strong short-term price signal to act, longer term prospects could potentially signal otherwise come season fruition. Initial and once perceived benefits can be eroded by changing milk price forecasts throughout the duration of the production season.

The Fonterra forecast and closing milk price has varied close to \$1.30 per kilogram of milksolid over the past ten seasons (Farmgate Milk Prices, 2015).

Figure 11. Difference in Fonterra Announced Farmgate Milk Price vs Actual



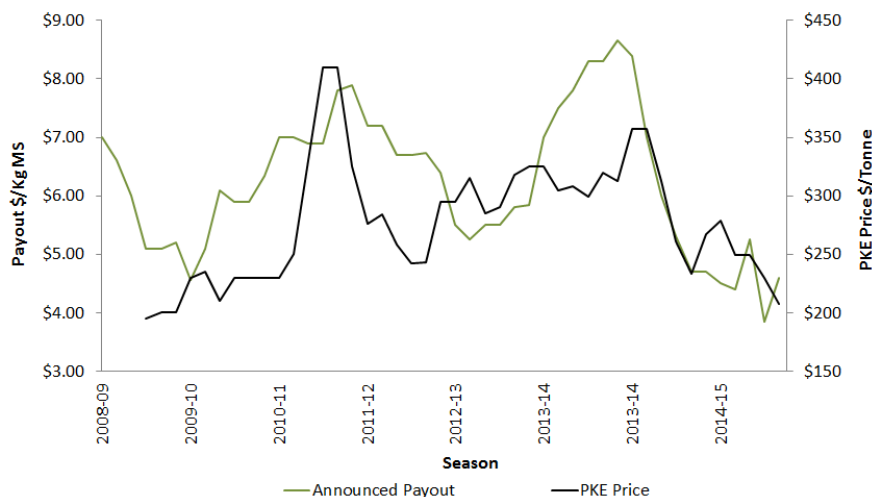
Source: Fonterra, AgriHQ, DairyNZ Economics Group

This makes it very challenging to price supplements into farming systems, and understand at what point they will be profitable. If we take the 2014-15 season as a case study, the opening milk price was \$7.00 per kilogram of milksolid. However, the final price paid was \$4.40 (Farmgate Milk Prices, 2015). At the beginning of the season (when you will most likely need supplement due to feed a deficit) you could have purchased supplements at \$245 per tonne (based on 55 gram production response). At end of the season with the milk

price confirmed at \$4.40, the breakeven price of supplements was in fact \$154 per tonne of dry matter. In this season many farmers paid far more for supplements based on the initial benefits that price signals represented.

Palm kernel prices are typically highly correlated to the forecast milk price, as this is the optimum assessment of the market at the present time. The graph below shows the Fonterra announced milk price and the price of palm kernel.

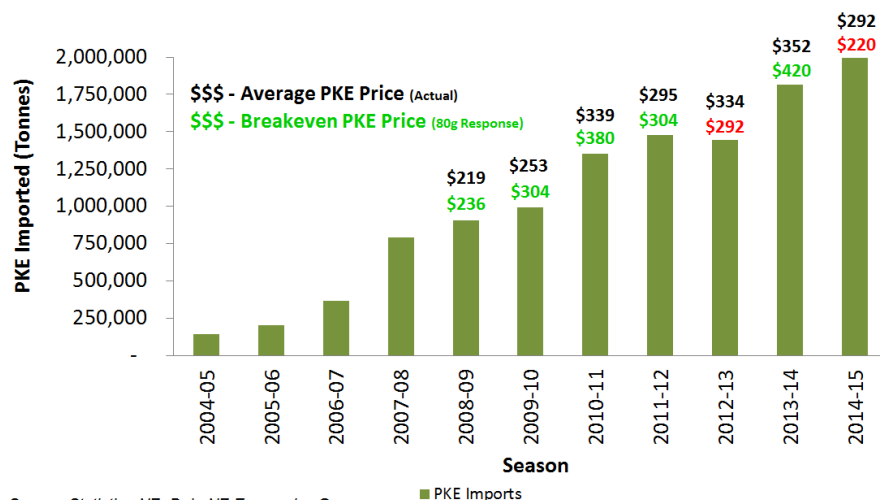
Figure 12. Fonterra Announced Farmgate Payout vs Palm Kernel Prices



Source: Fonterra, AgriHQ, DairyNZ Economics Group

Many of the prices paid for palm kernel are based on parameters that are not set (milk price), leaving farmers vulnerable to external factors. Using DairyNZ's supplement breakeven price table, conclusions can be established regarding prices paid by New Zealand dairy farmers. The graphs below show the palm kernel imports into New Zealand, the actual prices paid for palm kernel (DairyNZ Data Centre, 2015), and the breakeven palm kernel price based on varying production response rates and milk price.

Figure 13. New Zealand PKE Imports and Prices (KgDM) vs Breakeven – 80g Response

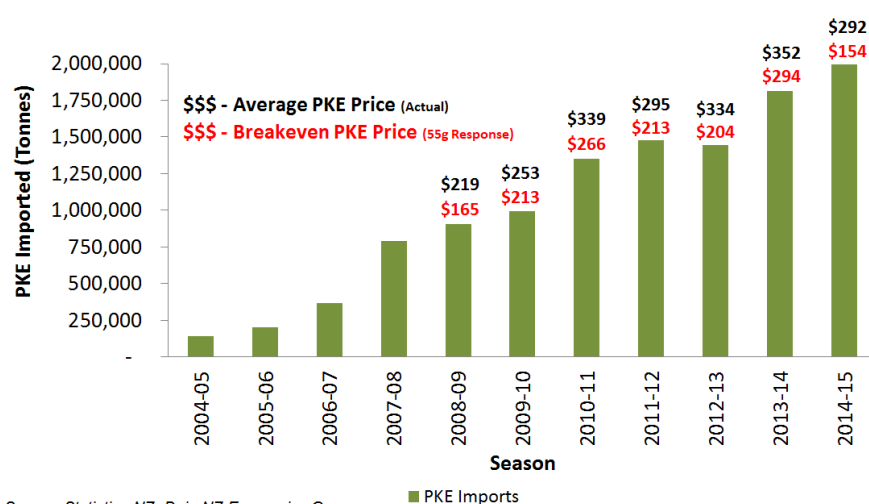


Source: Statistics NZ, DairyNZ Economics Group

You can see here that supplements implemented into the diet effectively (80g response) show that since the 2008-09 season only two years have been unprofitable by utilising added palm kernel as a supplement when managed correctly and utilised to its potential.

However, remembering that an 80g response is close to close to 50% higher than the average response (55g) studied on commercial dairy farms. If we look at the breakeven price of palm kernel based on an average response (55g), all years from 2008-09 have been unprofitable for the average farmer trying to introduce palm kernel into their system when profit is the motive.

Figure 14. New Zealand PKE Imports and Prices (KgDM) vs Breakeven – 55g Response



Source: Statistics NZ, DairyNZ Economics Group

This scenario of an average response (55g) indicates that the actual cost of palm kernel in the all the previous seasons was too high for the average farmer to be profitable by utilising them, if profitability was the core driver. Other drivers for intensive feeding may have been identified here, such as cow health or reproductive issues. However, analysis of DairyBase data indicates spending more on supplement feed per cow does not result in a higher in calf rate (Kloeten, 2014).



Variability in Decisions with Intensive Systems

Intensive systems have greater variability due to additional convolution and more strategic decisions that are required on a daily basis. This includes supplement use, pasture management with integrated supplement, sourcing supplement at the right occasion and at the right cost, and maximising the utilisation and conversion of supplements to milk (Kloeten, 2014).

If a farm operator has a 5% error rate in their decision making for example, the more decisions and judgements, the greater the impact of errors.

- If two decisions are necessary

$$0.95 \times 0.95 = 0.90$$

- If four decisions are necessary

$$0.95 \times 0.95 \times 0.95 \times 0.95 = 0.81$$

The management capability of the team (on farm) is very important here. A low input operation that is performing poorly due to management ability is unlikely to get better or improve by shifting to an intensive system.

High input systems have a greater level of risk and uncertainty, whilst also being more sensitive to feed and milk prices. Some farming businesses will alter their system to reduce risk in a particular area, for instance, increasing intensity to minimise the risk of climatic effects. Changing intensity and farming system will not eliminate risks, it only shifts the risk from one part of the business to another (Kloeten, 2014), and remembering one of the inherent risks of a high system is milk price, which has shown increased volatility in recent years. Modelling data from the Waikato region has shown that milk price has a larger impact on return on assets on farms with high systems when compared to medium and low intensity farms (Kloeten, 2014).

At what point is an intensive system more profitable

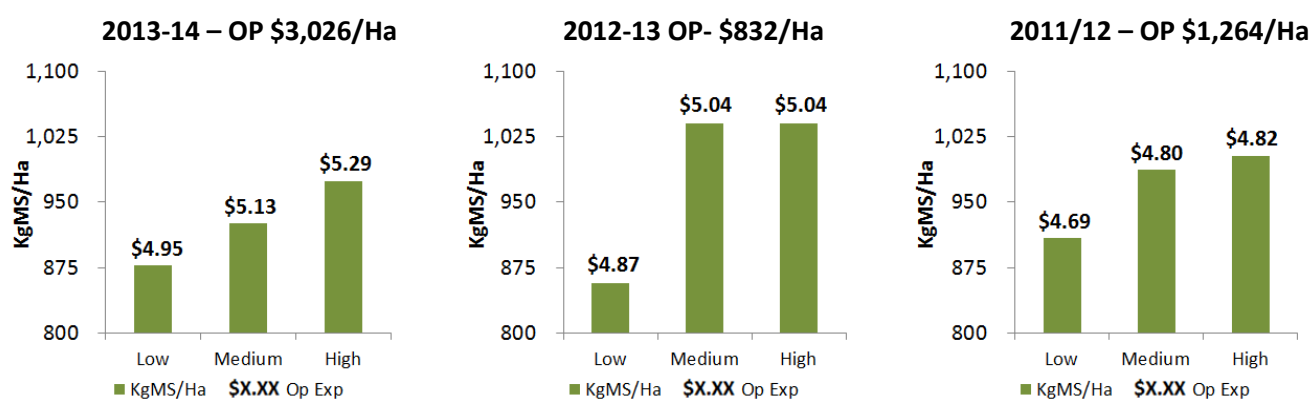
Using data published in the DairyNZ Economic Survey, analysis can determine the performance of different farm systems. A breakdown of the last three recorded seasons (2013-14, 2012-13, 2011-12) shows insights into the operating expenses of different production systems at a milk price of \$8.40, \$5.84 and \$6.08 (per KgMS). These years represent a record high milk price (\$8.40), a lower milk price (\$5.84), and a median milk price (\$6.08) which is closer to what industry commentators are considering to be the long term average status quo (Reserve Bank of New Zealand, 2015).

The 2013-14 season had an all-time high milk price, and based on high input farmers operating expenses (\$5.29 per KgMS), they needed to produce an additional 11% of milk to breakeven with their low input counterparts (\$4.95) in terms of operating profit per hectare (\$3,026). However, if farmers wanted to receive the same level of return on assets as low input farmers they would have needed to produce 22% more milk (based on an average valuation of \$36,369 per hectare, and \$39,989 per hectare for more intensive farm operations) (LIC & DairyNZ, 2015).

In the 2012-13 season when milk price were lower at \$5.84, high input farmers with \$5.04 operating expenses needed to produce an extra 21% of milk solids to breakeven at \$832 operating profit per hectare with low system farmers showing \$4.87 operational costs per kgMS. If intensive farmers wanted to receive the same level of return on assets as low input farmers they would have needed to produce 30% more milk (based on an average valuation of \$33,557 per hectare, and \$36,075 per hectare for more intensive farm operations) (LIC & DairyNZ, 2015).

The 2011-12 season showed similar results to the 2013-14 season. High input farmers needed to produce 10% more milk due to having costs of \$4.82 per kgMS in order to breakeven with low input farms showing a \$1,264 operating profit per hectare and costs of \$4.69 per KgMS.

Figure 15. Operating Profit per Hectare Breakeven based on Operating Expenses



The current season (2015-16) milk price forecast of \$4.60 will present challenges to all dairy farmers, no matter the system. Current forecasts show that up to 70% of farmers will suffer a negative cashflow this season at this milk price when accounting for farm working costs and interest and rent (DairyNZ, 2015). In response to a lower

milk price farmers have had to trim operating expenditure, whilst trying to uphold productive capacity. It is estimated that farmers have been able to reduce operating expenditure by approximately 11% (cash) of that in the 2013-14 season (DairyNZ, 2015). With that operating expenditure and milk price forecast, low input farmers on average will show a slight profit of \$179 per hectare, while high input farmers will be unable to breakeven when analysed at an aggregate level. While some high input farmers will in fact break even and generate a profit this current season, on average, the majority will not, based on this analysis. It is clear that milk price and external factors drive profitability here for all farmers, but primarily for higher input systems.

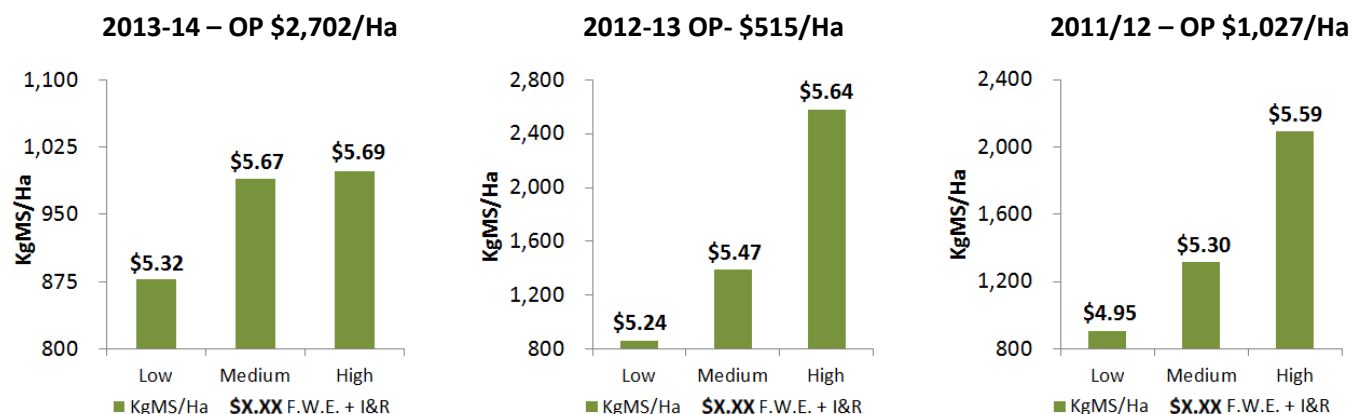
Operating profit per hectare does not take into account interest costs for the farm business. The cost of debt has risen by 70 cents per kilogram of milksolid (100% increase) since 2000-01, and now makes up 22% of total costs when added to farm working expenditure (DairyNZ, 2015). When this expense is included into the operating costs the results change dramatically here in terms of breakeven.

For the 2013-14 season high input farmers had an interest expense of \$1.21 per KgMS, and farm working costs of \$4.48 per KgMS. They needed to produce 14% more milk to breakeven with low input farmers with farm working costs of \$3.97 per kgMS, and an interest expense of \$1.35 per KgMS, to achieve a margin of \$2,702 per hectare.

For the 2012-13 season high input farmers had an interest expense of \$1.44 per KgMS and farm working costs of \$4.20 per KgMS. They needed to produce 200% more milk to breakeven with low input farmers with farm working costs of \$3.81 per KgMS, and an interest expense of \$1.43 per KgMS, to achieve a margin of \$515 per hectare. You will see here that the interest expense here for both sets of systems is similar, noting that farm working costs is the driver of profitability.

For the 2011-12 season high input farmers had an interest expense of \$1.48 per kgMS, and farm working costs of \$4.11 per KgMS. They needed to produce 130% more milk to breakeven with low input farmers with farm working costs of \$3.70 per KgMS, and an interest expense of \$1.25 per KgMS, to achieve a margin of \$1,027 per hectare.

Figure 16. Operating Profit per Hectare Breakeven based on Farm Working Expenses plus Interest and Rent

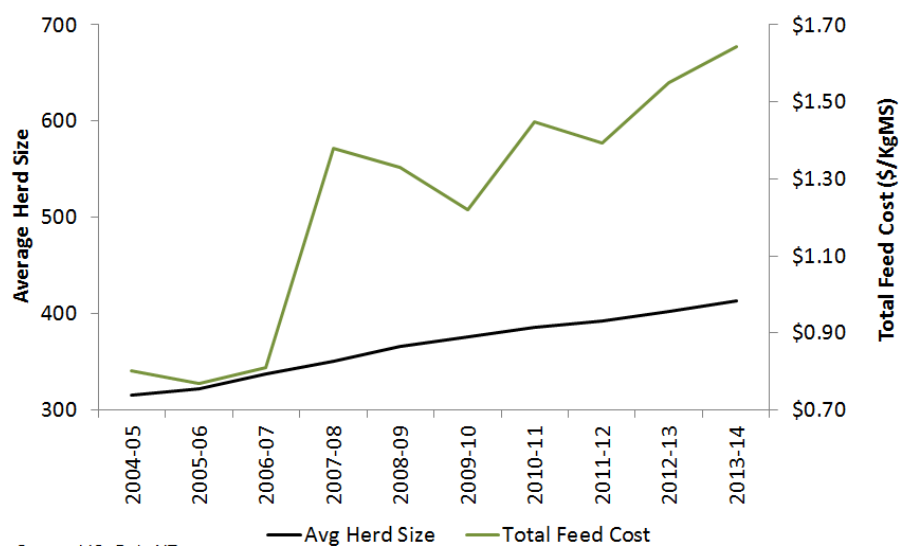


Intensification vs Status Quo – a 10 Year Analysis

In the ten years from 2004-05 the total number of cows in New Zealand has increased by 27% to 4,922,806. The consolidation of dairy herds has shown a similar trend with a 31% increase, reaching an average herd size of 413 cows in 2013-14. Over this time the average farm size has also increased 25% to 144 hectares (LIC & DairyNZ, 2015).

However, feed costs have increased 105% over this time to a record high of \$1.64 per kilogram of milksolid, while interest and rent costs have increased 45% since 2004-05 to an average of \$1.29 in 2013-14 (DairyNZ, 2015).

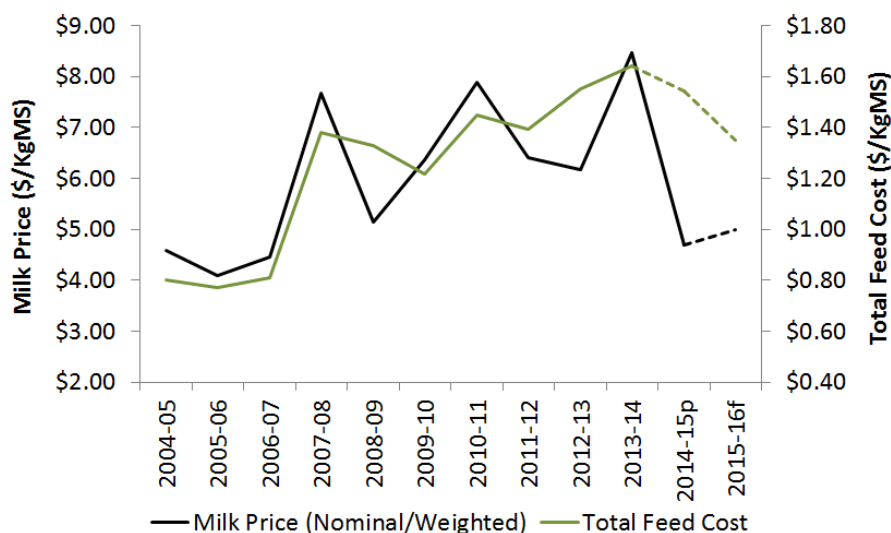
Figure 17. Average Herd Size and Feed Price



With this expansion and consolidation has the New Zealand dairy industry been profitable for doing so? Farmers are suffering a 45% loss of income (\$4.60 forecast) this season, down from the high of \$8.40 two years ago (Farmgate Milk Prices, 2015). Are farm systems resilient, and can they cut costs back to make up the loss of income? Time series data shows that farmers are unable to cut feed costs in line with the milk price (figure 18). Remembering figure 4 indicated a record level of palm kernel imports in 2014-15 despite the lowest farmgate milk price in 9 years.



Figure 18. Farmgate Milk Price vs Feed Price

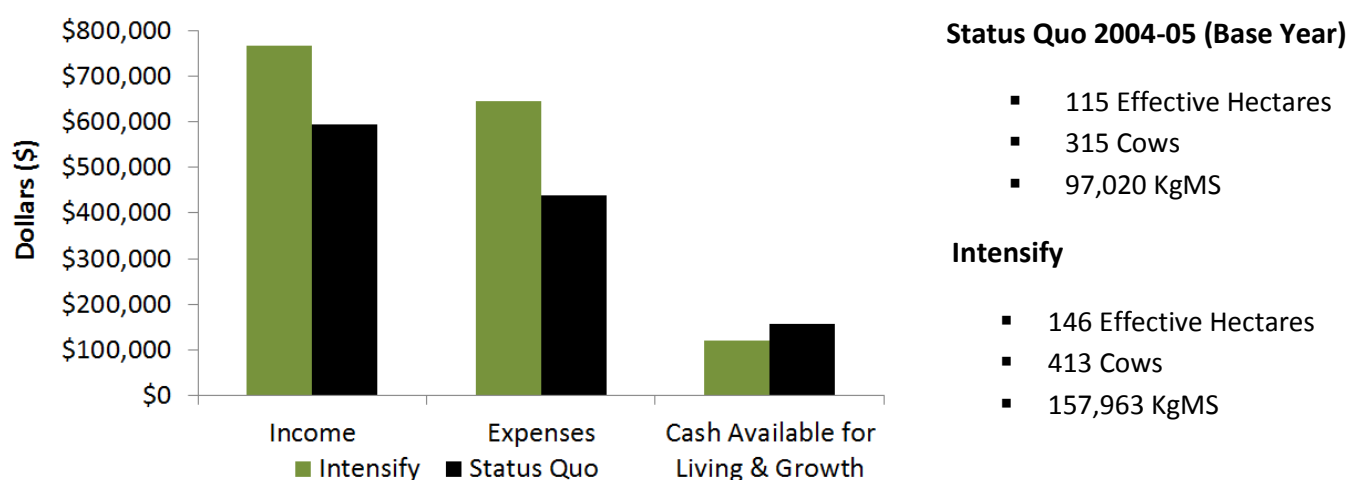


Source: Fonterra, DairyNZ

p = provisional f = forecast

Analysis of aggregate farm working costs along with interest payments shows that the average farmer who has consolidated and increased cow numbers, land holdings and associated costs over the past decade has been no more profitable for doing so when looking at cashflow (figure 19). This analysis accounts for the actual increase in farm working costs and additional interest from further land and infrastructure, while holding the base year (2004-05) constant and adjusting expenses and interest for inflation. The base year (2004-05) also had adjustments made in drought years, where extra feed costs were incorporated to accommodate a feed deficit. Revenue here was the weighted average milk price (Fonterra, Tatua, Westland) plus dividends paid. This analysis revealed that farmers as a whole were milking approximately 100 more cows and were no more profitable when focusing on cashflow.

Figure 19. Intensify vs Status Quo Profitability – 10 year average



Analysis of DairyNZ Economic Survey Data, StatsNZ, RBNZ, LIC

Note: Limitations of this particular analysis when focusing exclusively on cashflow can be that it does not take into consideration any capital gain made from additional land/buildings or profit from productivity.

Case Study: Intensive Dairy Farms with Cow Housing Facilities

Intensifying for Environmental Benefit

More recently the New Zealand dairy industry has shown a trend in building off-paddock infrastructure to house cows and operate intensive feeding systems (Hall, 2013). Off-paddock infrastructure can be built for a number of reasons including farm management preference, improved utilisation of supplement feed, decrease in pugging, greater control of pasture, improved working conditions, reduction in grazing costs and greater profitability (Journeax & Newman, 2015).

A study was conducted on 14 New Zealand dairy farms by DairyNZ and AgFirst with the purpose of analysing the economic costs and benefits of constructing and operating cow-housing infrastructure, along with an environmental investigation. This analysis has shown that when intensive cow housing systems are implemented into the New Zealand pastoral model there can be both financial and environmental risks.

Nitrogen leaching on most of the case study farms increased as a result of the more intensive system. One farm in the study increased nitrogen losses by as much as 47%. Similar results were noted on phosphorus losses, with the vast majority of farms increasing phosphorus leaching per hectare, with one farm increasing by more than 300% (Journeax & Newman, 2015).

The study showed that an environmental gain can be sought in regards to nitrogen leaching and phosphorus run-off, but at a cost of not intensifying the farm system to make the barn profitable. The outcome was either/or: either you make money out of the barn and intensive system, or you decrease your environmental footprint. It was difficult to accomplish both (Journeax & Newman, 2015).

The influence on greenhouse gases was also analysed in this study. The implementation of the cow-housing facilities saw a rise of methane emissions, largely due to an increase in cow numbers on most farms. There was also an increase of carbon dioxide as a result of increased supplementary feeding. Nitrous oxide levels also showed an increase due to more cropping and farms using compost. Some farms did manage to show a decrease in nitrous oxide as a result of less of nitrogen fertiliser use, as more effluent was used as part of the cropping system, causing lower volatilisation levels (Journeax & Newman, 2015).

This study of dairy farms throughout both the North and South Island showed that the inclusion of a barn without intensification of the farming system would result in an improvement to the environment, but at a potentially significant financial cost (Journeax & Newman, 2015)

Intensifying for Profitability

This study indicated a breakeven milk price of over \$6.50 per kilogram of milksolid sold. This is in line with other previous studies that show environmental benefits were difficult to achieve with cow housing facilities if the

milk price was below \$7.00 per kilogram of milksolid. In order to achieve a discount rate of 8% the 14 farms needed an average milk price of \$7.50 per milksolid (Journeax & Newman, 2015).

The profitability of the barn incorporated into the system is also conditional on good management practice, and is highly dependent on milk price, feed expenditure, and capital outlay. When intensifying the farm operation to increase profitability (or breakeven) with a barn there is a rapid loss of the environmental benefits (Journeax & Newman, 2015).

Intensifying to Add Value to the Farm

Another element taken into consideration is the value of the barn once incorporated into the farming system and the total value it creates for the farm. Results here showed that constructing the barn would in fact increase the capital value of the land and buildings, and farm business. However, it was not directly proportional to the price of the infrastructure. For example, if you built a cow housing facility for \$1 million, a farm business previously valued at \$5.2 million was not worth \$6.2 million. Any increase here in farm value would be relative to the lift in production output as a result of the intensive system. For example, if there was an increase in production per hectare of 500 kilograms of milksolids, then the increase in value was proportional to the additional production. However, this extra value is also relative to the marginal value of the additional production, due to further cows and supplementary feed necessary to achieve this extra production. If the property was previously valued at \$50 per milk solid before the barn, the additional milksolids produced on the farm due to the cow-housing facilities would not be valued at \$50, but the marginal value of the extra 500 kilograms of milksolids per hectare (Journeax & Newman, 2015).

Commentary from real estate agents suggests that it may however result in a faster sale, but also runs the risk of being over capitalised. In many respects, adding value to the farm by building depreciating assets related to the individual situation of the property and the performance of the barn and system itself (Journeax & Newman, 2015).

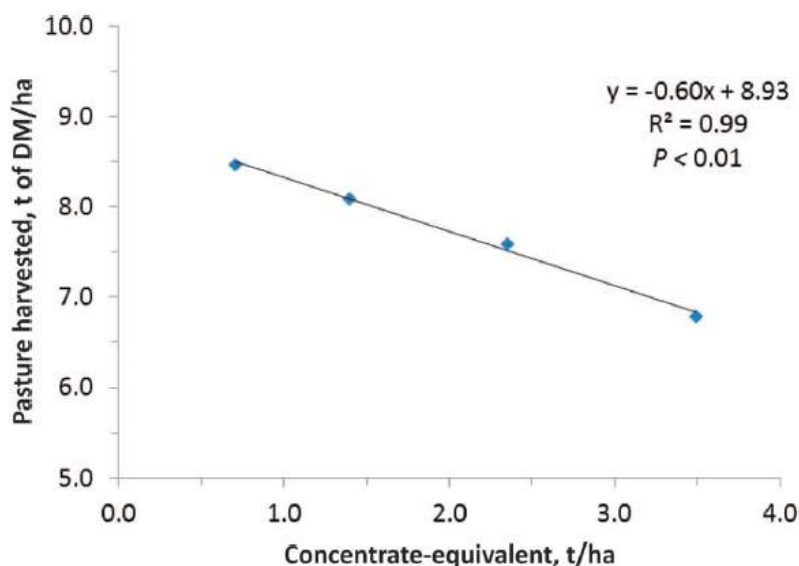


Supplements: An International Perspective

Analysis of the UK national dairy database (2012) highlighted a rise in total farm expenditure of £1.62 for every £1.00 spent on supplement feed such as concentrates and forages (DairyCo, 2013). In line with this research, examination of over 2,700 farms in Ireland over four years indicated that, on average, the overall expenses of production showed an increase of €1.52 for every €1.00 spent on purchasing additional supplementary feed. Within the Irish database almost every expense both fixed and variable indicated an increase with additional supplements (Kay, McCarthy, & Roach, 2015).

Additional research from Ireland indicated that the increased use of supplementary feed saw pasture harvested per hectare decrease linearly. For every 1 tonne of dry matter supplement per hectare introduced to the farm, pasture harvested decreased by 0.60 tonne of dry matter per hectare (Ramsbottom et al., 2015).

Figure 20. Increased Supplements and Pasture Harvested

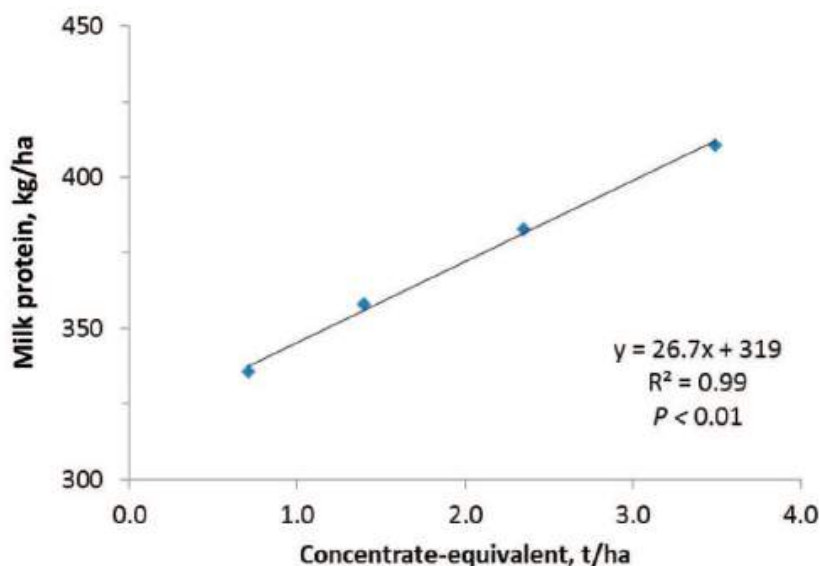


The graph above represented a 60% substitution rate of concentrate supplement for pasture over the entirety of the production season. A decrease in the pasture eaten per cow is expected when supplements are consumed (Stockdale, 2000). The factor that influences substitution the for the most part is the pasture allowance per cow, as many farmers fail to properly adjust pasture allowance to account for the additional supplements offered (Wales, Doyle, & Dellow, 1998).

The substitution rate in this study is somewhat higher relative to that in the literature for a well-managed pasture based system (Horan et al., 2004; Linnane et al., 2004).

However, milk yield here increased as a response to the additional feed. Milk production grew per cow and per hectare of 672 and 829 litres per 1 tonne of supplement dry matter fed, respectively.

Figure 21. Increased Supplements and Milk Production



Variable milk production expenses per litre, per hectare and per cow grew linearly from production system 1 to system 4. In this study for every 1 tonne of supplement dry matter fed variable costs showed a rise of 3.1 cents per litre, or €236 per cow. Overall net profit declined per hectare, per cow and per litre for every additional 1 tonne of dry matter supplement introduced into the system. Net profit decreased €111 per cow, €78 per hectare and 3.7 cents per litre for every additional tonne of dry matter supplement consumed per hectare (Ramsbottom et al. 2015). The increase in purchased feeds resulting in decreased profitability is consistent with recent studies that have indicated the vital contribution of pasture grazed to net farm profit per hectare (Berry, et al., 2009).

If the pasture harvested per hectare did not decrease with the increased use of supplement feed, milk yield per hectare may well, believably, increase by 0.25 litres per 1 kilogram of supplement dry matter consumed. This would have been in line with other marginal response research studies. That would have resulted in a rise of revenue with little added fixed or variable costs. Provided both the feed and milk were appropriately priced, this would have concluded with a positive return to the farm for the investment in supplementary feed (Ramsbottom et al., 2015).

It is important to note here that many of the farming systems analysed overseas already possess the capital infrastructure for feeding and housing cows. Yet, their total expenses increase 50-60% more than the feed price when further supplementary feed is fed (Kay, McCarthy, & Roach, 2015).

An observation in New Zealand is the gravitation towards intensive feeding systems and providing off-paddock facilities to shelter/house cows to achieve efficiencies in the quest for greater profit (McMillan, 2015). However, great caution needs to be taken here with this direction (Cronshaw, 2014). This study highlights that even with existing infrastructure (i.e. not as much capital outlay or interest expense to carry costs as would be the case in New Zealand) costs increase more than just the price of feed, with pasture substitution a likely risk leading to eroded profitability.

Supplements: A Scientific Perspective

An increase of supplements in the diet results in a decrease in pasture eaten per cow (Stockdale, 2000). When cows consume supplements or concentrates neuroendocrine factors are secreted from a variety of tissues to notify the brain of the energy status of the animal (Macdonald et al., 2008).

When cows consume concentrates or supplements, satiety signals cause the animals to graze for a shorter time period (Bargo et al., 2003; Sheahan et al., 2011) and consume less bites per minute or have a lower chew rate (Shehan et al., 2013).



Conclusion

Ultimately, the best production system and farm operation is one that results in the greatest profitability per unit of the most limiting input (land), and remains resilient to external factors. In pastoral grazing systems profitability per hectare and pasture grazed is considered to be a vital criterion for analysis.

All systems can achieve a high level of results when managed correctly. However, analysis of the New Zealand dairy industry as a whole would suggest that many farming systems have focused on production rather than profitability over recent years and have subsequently eroded their resilience and international competitiveness. With such volatility and limited financial tools available to farmers at present, many businesses are not insulated against external factors such as milk and feed price volatility.

When intensifying for environmental purposes, such as building off-paddock cow housing, it can also be difficult to achieve profitability and deliver positive environmental results, with higher breakeven milk prices required.

There are many other benefits from feeding supplements, including improved cow condition, health and reproduction (if energy is limiting), and reducing over grazing if there is a feed deficit. However, international datasets show that there are many costs associated with supplements, which can be as high as 50% more than the purchase price when considering capital, wastage, labour, energy/fuel and repairs and maintenance.

If intensive systems and added supplements result in substitution of grass, this lost on farm feed and reduction in grass quality and future growth must be considered.

Farmers who are considering intensification with profit as the core driver must consider all elements and risks associated, such as pasture management, cost control to attain the full benefit of supplement feeding, complex structures and the increased exposure to external factors.

No two farms are the same, and farmers have different objectives and values. Just because it does not gratify financially does not mean it should not be implemented. If the medium term milk price forecasts present a “downward shift” in the status quo milk price then this allows dairy farmers to take advantage of the changes they have made in recent seasons to be profitable. The objective here will be to focus on building a sustainable business which is profitable at a lower milk price, with a simple and repeatable farm system that is clearly understood by those involved. The farm system should require very little change between a “good” year and an “average” year with clearly defined business and farming principles that focus on maximising pasture growth, regardless of system operated to deliver a profitable business. Does this lower milk price forecast present the opportunity for a fundamental correction in the New Zealand dairy industry in terms of working costs and operating systems?

Future dairy production in New Zealand will be set on a platform of uncertainty and increased volatility. As a consequence, whatever intensity system New Zealand farmers decide to implement, they must be resilient to react rapidly and positively to change.

Recommendations

Farmers contemplating system intensification must consider all possible associated risks. This can include pasture mismanagement, cost control to achieve the full benefit of intensive systems, complicated structures, additional exposure to external influences and unintended environmental outcomes.

No matter what system operated, the key focus to improve productivity and profitability should be to manage pasture for maximum growth, manage pasture for maximum intake by the herd, manage the herd for maximum intake (including young stock) and manage the diet for optimum production. Up to 74% of the variation in farm profitability can be determined by pasture management (Sandles, 2010).

When adding supplements into the operation ensure target grazing residuals are still maintained. There is no advantage in substituting high quality pasture with alternate feed. Thus, supplements should only be utilised when there is insufficient pasture available to provide energy. Source additional feed (and all inputs) at the best possible price, look at purchasing on a per kilogram of dry matter basis, or per megajoule of metabolisable energy (MJ ME). The focus needs to be on optimisation rather than maximisation of production, with a firm understanding of marginal cost.

Before putting in or cutting back on any feed input, the impact on profitability must be understood – will the additional feed return more than the purchase price (including feeding costs, utilisation, wastage etc.) or will the saving outweigh the potential loss in income. Production targets should not be set in isolation without a corresponding financial objective.

In a low payout or dry year profit per kilogram of milksolid may already be down. It is important that the drop in production is outweighed by a fall in working expenses for profit to be improved.

Understand why you may be implementing supplements into your system. Is it to grow milk revenue, improve cow condition, increase herd health and reproduction (if energy is limiting), or reduce overgrazing?

The need for an understood and resilient system is more important now than ever with dairy commodities becoming increasingly volatile as well as a growing focus on potential compliance issues. Resilient farming systems must have appropriate tactical flexibility to overcome unforeseen events that may hinder short term profitability with the foundation principles remaining unchanged. The system must be simple and repeatable and understood by all those involved with the running of the farm. There must be clearly defined business and farming principles that deliver profitability and sustainability with a strong focus on maximising and utilising pasture, along with regular monitoring.

Modern dairy farming has increased in complexity. Farmers will need a greater understanding of financial and business management principles alongside traditional farming skills in order to succeed and prosper in a volatile and uncertain environment.

Appendices

Appendix 1: PKE imports into New Zealand

Season	Tonnes
2000-01	3,068
2001-02	25,198
2002-03	25,822
2003-04	44,890
2004-05	140,496
2005-06	202,966
2006-07	368,059
2007-08	790,682
2008-09	905,718
2009-10	993,318
2010-11	1,352,179
2011-12	1,478,554
2012-13	1,442,838
2013-14	1,813,102
2014-15	1,996,648

Source: StatsNZ

Appendix 2: Average Dairy Company Payout

Season	Payout	Season	Payout
1980-81	\$1.52	1998-99	\$3.58
1981-82	\$1.95	1999-00	\$3.78
1982-83	\$2.11	2000-01	\$5.01
1983-84	\$2.09	2001-02	\$5.35
1984-85	\$2.33	2002-03	\$3.66
1985-86	\$2.29	2003-04	\$4.25
1986-87	\$2.03	2004-05	\$4.58
1987-88	\$2.34	2005-06	\$4.10
1988-89	\$3.28	2006-07	\$4.46
1989-90	\$3.59	2007-08	\$7.67
1990-91	\$2.42	2008-09	\$5.14
1991-92	\$3.34	2009-10	\$6.37
1992-93	\$3.66	2010-11	\$7.89
1993-94	\$3.32	2011-12	\$6.40
1994-95	\$3.40	2012-13	\$6.18
1995-96	\$3.99	2013-14	\$8.47
1996-97	\$3.63	2014-15	\$4.60
1997-98	\$3.42		

Average dairy co-operative payout
(Fonterra, Tatua, Westland)

Includes milk price and dividend

Source: LIC, DairyNZ, NZ Dairy Statistics

Appendix 3: New Zealand Farm Working Costs

	Operating Expenses per KgMS															
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15p	2015-16f
Interest and Rent	0.73	0.73	0.81	0.79	0.89	1.08	1.13	1.40	1.71	1.66	1.54	1.31	1.39	1.29	1.35	1.44
Feed (Inc grazing)	0.67	0.72	0.76	0.71	0.80	0.77	0.81	1.38	1.33	1.22	1.45	1.39	1.55	1.64	1.54	1.35
Labour	0.94	0.98	0.95	0.94	0.97	0.93	0.91	1.03	1.05	1.02	0.99	0.96	1.03	0.99	0.97	0.97
Maintenance and Running	0.64	0.65	0.56	0.56	0.62	0.62	0.63	0.85	0.75	0.68	0.80	0.79	0.79	0.90	0.80	0.72
Fertiliser	0.46	0.48	0.39	0.37	0.42	0.40	0.42	0.62	0.64	0.55	0.60	0.59	0.58	0.57	0.54	0.49
Depreciation	0.28	0.30	0.32	0.31	0.35	0.34	0.36	0.42	0.45	0.44	0.44	0.35	0.40	0.38	0.37	0.37
Animal Health and Breeding	0.26	0.28	0.26	0.25	0.26	0.25	0.27	0.34	0.33	0.31	0.37	0.33	0.37	0.37	0.36	0.36
Overheads	0.24	0.25	0.25	0.24	0.24	0.24	0.24	0.28	0.28	0.28	0.30	0.30	0.32	0.31	0.34	0.34
Total	3.49	3.67	3.50	3.37	3.66	3.55	3.64	4.92	4.84	4.49	4.95	4.73	5.03	5.17	4.92	4.59

- Feed, (includes supplementary feed made and purchased, cropping, stock grazing, regrassing, weed and pests, run-off lease, feed inventory adjustment, and owned run-off adjustment);
- Labour, (includes wages and the adjustment for unpaid labour and management);
- Maintenance and running, (includes farm dairy, electricity, irrigation, vehicles and fuel, repairs and maintenance, and freight and general);
- Fertiliser, (includes nitrogen and the cost of application);
- Overheads, (includes administration, insurance, ACC and rates).

Source: DairyNZ

Appendix 4: US Milk Production and Exports

Year	Milk Production (millions of lbs)	Export Percentage
2007	185,654	9.1%
2008	189,982	10.9%
2009	189,334	9.0%
2010	192,848	12.8%
2011	196,164	13.5%
2012	200,537	13.2%
2013	201,231	15.5%
2014	206,046	15.4%

Source: US Dairy Export Council, USDA, Progressive DairyMan, DairyNZ

Appendix 5: New Zealand Dairy Statistics

Dairy Statistics					
	No of Dairy Cows	Avg Herd Size	Avg Eff Ha	Avg KgMS/Cow	Avg KgMS/Ha
2002-03	3,740,637	285	111	315	828
2003-04	3,851,302	302	111	322	889
2004-05	3,867,659	315	115	308	862
2005-06	3,832,145	322	118	325	907
2006-07	3,916,812	337	121	330	934
2007-08	4,012,867	351	126	307	873
2008-09	4,252,881	366	131	323	921
2009-10	4,396,675	376	134	318	912
2010-11	4,528,736	386	140	334	923
2011-12	4,634,226	393	139	364	1028
2012-13	4,784,250	402	141	346	988
2013-14	4,922,806	413	144	371	1063
2014-15	5,018,333	419	146	377	1082

Source: LIC, DairyNZ, NZ Dairy Statistics

Appendix 6: Breakeven Production Point – Operating Expenses

	2013-14			2012-13			2012-13		
	Op Exp	KgMS/Ha	OP/Ha	Op Exp	KgMS/Ha	OP/Ha	Op Exp	KgMS/Ha	OP/Ha
Low	\$4.95	877	\$3,026	\$4.87	858	\$832	\$4.69	909	\$1,264
Medium	\$5.13	926	\$3,028	\$5.04	1,040	\$832	\$4.80	988	\$1,264
High	\$5.29	974	\$3,029	\$5.04	1,040	\$832	\$4.82	1,003	\$1,264

Appendix 7: Breakeven Production Point – Farm Working Costs plus Interest and Rent

	2013-14			2012-13			2012-13		
	F.W.E. + I&R	KgMS/Ha	OP/Ha	F.W.E. + I&R	KgMS/Ha	OP/Ha	F.W.E. + I&R	KgMS/Ha	OP/Ha
Low	\$5.32	877	\$2,702	\$5.24	858	\$515	\$4.95	909	\$1,027
Medium	\$5.67	990	\$2,703	\$5.47	1,392	\$515	\$5.30	1,317	\$1,027
High	\$5.69	998	\$2,705	\$5.64	2,577	\$515	\$5.59	2,095	\$1,027

Appendix 8: Farm Expense Price Index

Farm expense price index - Expense categories (Qrtly-Mar/Jun/Sep/Dec)

Dairy farms - ALL INPUTS INCLUDING LIVESTOCK

2000Q1	684	2007Q4	890
2000Q2	692	2008Q1	907
2000Q3	704	2008Q2	952
2000Q4	721	2008Q3	..
2001Q1	727	2008Q4	..
2001Q2	754	2009Q1	935
2001Q3	764	2009Q2	..
2001Q4	764	2009Q3	..
2002Q1	763	2009Q4	..
2002Q2	769	2010Q1	913
2002Q3	770	2010Q2	..
2002Q4	773	2010Q3	..
2003Q1	773	2010Q4	..
2003Q2	758	2011Q1	946
2003Q3	753	2011Q2	..
2003Q4	750	2011Q3	..
2004Q1	752	2011Q4	..
2004Q2	760	2012Q1	991
2004Q3	769	2012Q2	..
2004Q4	777	2012Q3	..
2005Q1	782	2012Q4	..
2005Q2	802	2013Q1	1003
2005Q3	817	2013Q2	..
2005Q4	820	2013Q3	..
2006Q1	827	2013Q4	1000
2006Q2	840	2014Q1	1010
2006Q3	846	2014Q2	1037
2006Q4	844	2014Q3	1042
2007Q1	849	2014Q4	1037
2007Q2	859	2015Q1	1030
2007Q3	877	2015Q2	1029

Source: Statistics New Zealand

Appendix 9: Consumers Price Index

M1 Consumers price index (CPI)

	(Index)		(Index)
Sep 2000	860	Jun 2008	1061
Dec 2000	870	Sep 2008	1077
Mar 2001	869	Dec 2008	1072
Jun 2001	876	Mar 2009	1075
Sep 2001	881	Jun 2009	1081
Dec 2001	886	Sep 2009	1095
Mar 2002	891	Dec 2009	1093
Jun 2002	900	Mar 2010	1097
Sep 2002	904	Jun 2010	1099
Dec 2002	910	Sep 2010	1111
Mar 2003	913	Dec 2010	1137
Jun 2003	913	Mar 2011	1146
Sep 2003	918	Jun 2011	1157
Dec 2003	924	Sep 2011	1162
Mar 2004	928	Dec 2011	1158
Jun 2004	935	Mar 2012	1164
Sep 2004	941	Jun 2012	1168
Dec 2004	949	Sep 2012	1171
Mar 2005	953	Dec 2012	1169
Jun 2005	962	Mar 2013	1174
Sep 2005	973	Jun 2013	1176
Dec 2005	979	Sep 2013	1187
Mar 2006	985	Dec 2013	1188
Jun 2006	1000	Mar 2014	1192
Sep 2006	1007	Jun 2014	1195
Dec 2006	1005	Sep 2014	1199
Mar 2007	1010	Dec 2014	1197
Jun 2007	1020	Mar 2015	1195
Sep 2007	1025	Jun 2015	1200
Dec 2007	1037	Sep 2015	1204
Mar 2008	1044		

Source: Reserve Bank of New Zealand

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