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Forestry in the hill country sustainability and survival

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Primary Industry Management

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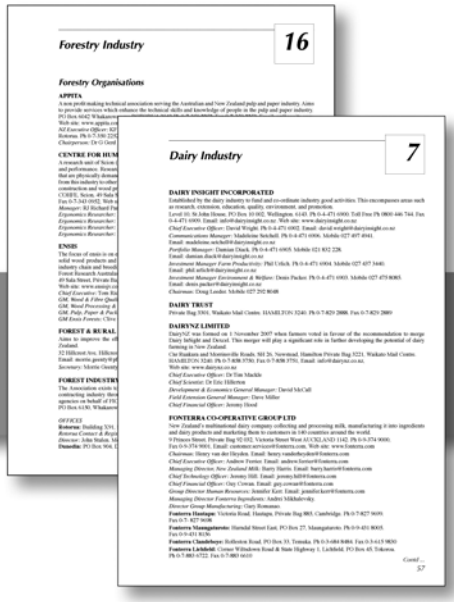

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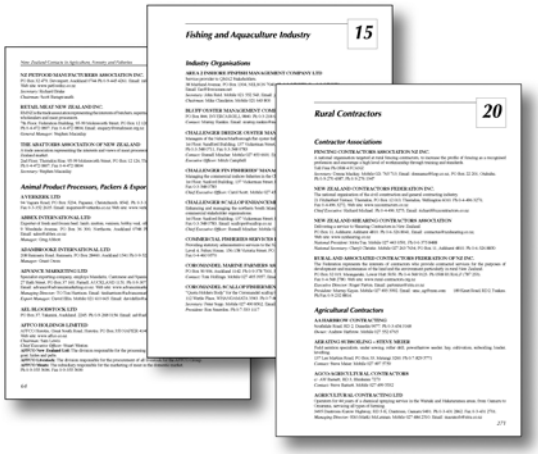

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Primary Industry Management is dedicated to the publication of articles on all aspects of agricultural science and the management of primary industry resources. The opinions of the contributors are their own and not necessarily those of the publishers or editor.

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Editorial

Risk management in primary industry

Julian Bateson

We are well used to taking risks at all levels. Crossing the road is a daily risk, but most of the risk is eliminated by taking the simple precaution of looking to see if any traffic is coming and waiting until it has passed. This does not eliminate all risks but significantly reduces them so that regularly crossing the road is not life-threatening.

In the primary business environment we can never eliminate all risks, but we can make good decisions based on sound planning and common sense. As time passes the risks change and decisions have to be made to allow for these changes.

Complex or simple

Nature manages to cope with risk remarkably well. It has to be able to adapt and modify or plants and animals would not survive in the long term. Many natural systems are very complex with numerous pathways and links. If one of these is broken or lost a number of others are already available to take on the work. The food web is one of the first things studied in biology at school and it is a good example of a complex system with a number of alternatives. Multiple redundancy is the term that describes this, if one part fails there are others ready to take on the work.

Alternatives to complex systems or multiple redundancy are automatic fail-safe systems that are simple but effective without any outside interference. The drain cover or communications access cover on a road can demonstrate this quite simply. A circular cover may become dislodged, but however much it is moved it will not fall down the hole. However if a square or rectangular cover is disturbed it can easily fall through the gap causing damage and be difficult to recover. To negate the risks all you need to do is ensure you make a circular hole and cover, no extra costs are incurred

We have to take some risks as without risks we would not move forward. However, we should all think ahead and plan and develop various solutions for potential problems, some or all of which will occur. If you do not expect problems in business you will be unpleasantly surprised when they crop up. Many of the solutions will be quite simple, and not cost any extra, such as the circular drain cover mentioned earlier. Others will incur significant expense such as a multiple computer system with back-ups for aircraft control. But in this example failure is potentially catastrophic so the cost is necessary.

In farming, the list of risks is virtually endless including drought, floods, storms, pests, diseases, injury, the dollar rising in value or the dollar falling. Planning to cope with risks is the professional way to work. You need to weigh up the costs and the risks, a simple assessment process. Farm advisers are trained to plan for risks, put them in the mix and explain to their clients how to minimise their effects.

A balanced view

The first few articles in this issue of *Primary Industry Management* are concerned with risk and risk management. Colin Riden tries to provide a balanced view of the credit-driven world that led to the current world recession and shows servicing debt in a recession is a key problem. Rob Brazendale in his article explains how supplementary feeding cows has the potential to reduce risk but can in fact increase the risk by eroding the profitability of the farm. William Brown and Marv Painter look at financial planning and suggest you first make reasonable assessments of what is likely to happen in the future. Then you look more carefully for the risks and plan how to deal with them as they occur, a pleasantly simple approach.

When it comes to the crunch, simplicity is the key, but not always the solution. To risk investing in more land and more cows to make more milk when the payout is over seven dollars a kilo may seem simple with little or no risk. One of the risks is that the payout may fall significantly in value but debt still has to be serviced.

Look for the problems before they happen, plan for solutions, minimise the risk.

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Making sound decisions about risk

Colin Riden

For at least the last two decades our prevailing mix of culture, politics and economics has led to poor allocation of many of the worlds resources. In the process many of our values and decisions became distorted.

We expected more, and in turn were promised more than was sustainable. We were encouraged to think of ourselves as special – even uniquely special. Individually and collectively we have made mistakes and it is now time to pay. This article may make uncomfortable reading for some, but it is intended to make people recognise an uncomfortable reality.

To make sound decisions about risk you need to think for yourself and make your own assessments from as broad an understanding of your environment as possible. The main alternative to sound decisions, the lazy one, is to follow the herd. This article is intended to provide some balance to what has been the pervading neo-classical economic view of the world. This view has been economic growth driven by credit, effectively consumption of future production, managed by central bank economists under government direction.

The world

The world is not comfortable accepting it, but we are entering a depression. A depression is the unavoidable correction to a prolonged cycle of expansion of credit to fund consumption. Funding consumption beyond production has been the cultural-political choice of society. The current cycle of credit expansion has existed since the World War II in most Western economies. In essence it has the same characteristics as the cycle of 1874 and earlier ones. But of course we believe this one will be different because as a culture we are now so much smarter.

The current cycle of expansion started after World War II and was initially relatively benign – the world had lower population and much greater potential for real growth. The last 20 years have been the opposite, requiring more effort and more extreme measures to keep credit expansion going and maintain perceptions of growth. The last 10 years have been even more so.

Unravelling the bubble

We are looking at a cultural phenomenon – a cultural-political interaction that takes place without significant intelligent and reflective philosophical input. Economics fails to bring the promised requirements for real growth but instead provides complex models of increasing notional wealth. The mathematics of compounding wealth remain pervasive and offended. In time what passes for science and technology becomes similarly affected.

The inevitability of a depression is the outcome of compounding debt. A point comes where the debt can no longer be serviced. Markets then lose confidence and the bubble starts to unravel as markets become unwilling to take on more debt. There has been stimulus and expansion of credit with governments taking on debt normal markets are unwilling or unable to take on. How situations of excessive total debt are to be remedied by additional government debt is unexplained. It has never worked before. The movement of private debt to collective debt is also making options to repudiate debt less tenable.

A contraction in money supply and credit is occurring – the correct definition of deflation. This is producing the required contraction in asset values and should lead to a repudiation of much debt. Instead we have government and central bank efforts to preserve debt, inspire confidence and re-inflate asset values. This is very much about defending privilege and expected future privileges.

Economics and economists are being very accommodating. But they are yet to adequately explain how wealth can continue to compound, or why it should. How growth can be sustainable or why we need growth other than to support compounding wealth. How inflation can increase the stock of capital, or how excessive levels of debt can be solved with governments taking on even more debt.

Non-economists are becoming less accommodating. The credit driven growth model is increasingly being regarded as one of a number of models that are failing or have already failed. There is declining tolerance of, and widespread anger at, any socialisation of private debt, financial and accounting fraud and political corruption.

There is a possibility we will only have a recession. I hope not. If we only have a recession we will then return to a weak credit expansion cycle saddled with additional government debt from the stimulus packages. The required structural and cultural changes will not have been made. The required deflation of asset values relative to incomes will only have been postponed.

New Zealand

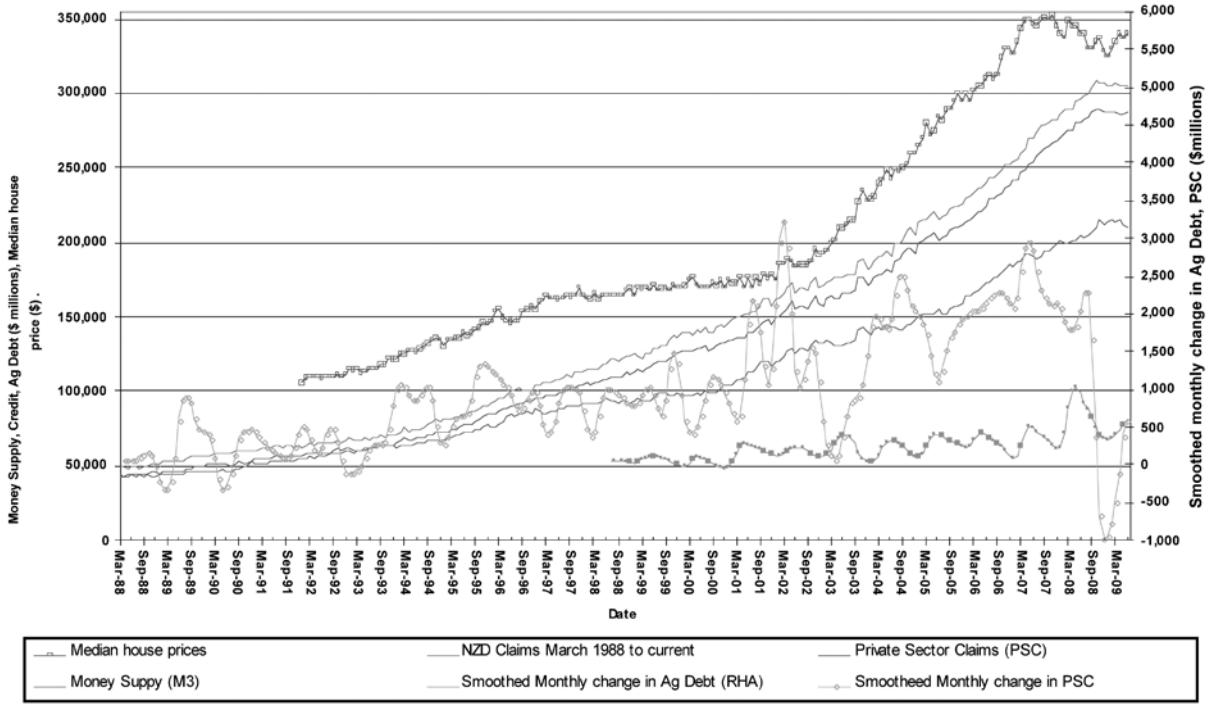
On a per capita basis New Zealand has been a top participator in the worldwide expansion of credit. Only Iceland did better. The last time we had a monthly current account surplus was in 1973. Most people currently living in New Zealand have never been here in a month where the country paid its bills without increasing its borrowings.

We have a long history of debasing our currency in real and relative terms. This has lowered our living standards relative to the rest of the world. We have compensated by borrowing to live beyond our means. Our collective debts have such a large foreign component that we no longer have an option to manipulate our currency down. We require an alternative means of lowering living standards, but the government is not prepared to overtly lower wage rates.

Money supply

New Zealand entered a recession in the first quarter of 2008. Lehman Brother's collapsed in September 2008. Trends in expansion of money supply and credit reversed from October 2008. Money supply (M3) is reducing faster than total claims, implying an increased percentage of borrowing is coming from offshore.

New Zealand credit and money

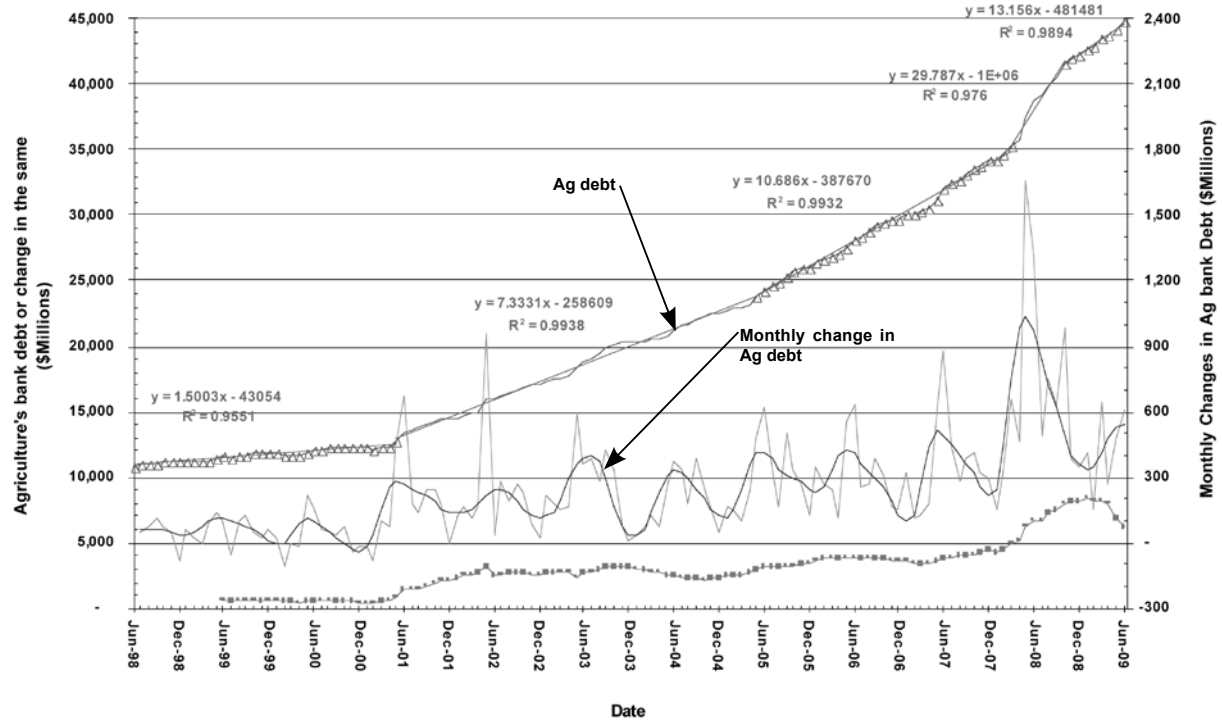


Why is M3 decreasing? Are we not saving more? We are working fewer hours, and commodity prices are down. We are not consuming as much. Where possible we are reducing debt. Those reliant on interest from savings are getting lower returns and are therefore eating into their capital, as are many others, just to survive. Tax from this source is also down. Many of those paying reduced interest are unlikely to be liable for increased taxable income from the lower interest rates.

Over the 20 years to October 2008 growth in credit was exponential getting to about $2 billion a month before dramatically changing to an average contraction. This was despite stimulus from tax cuts, a very low OCR, a limited amount of quantitative easing and a constant barrage of confidence boosting news from banks and government agencies.

For the first seven months of this year the government has been borrowing at a rate of $200 million a week, over $10 billion

Trends in New Zealand agriculture's debt



annually. The suspicion is that this rate is likely to increase.

Term interest rates are expected to increase steeply over the next year despite anything the Reserve Bank may do with the OCR.

Productivity over the long term is a problem we recognise. Why we have a problem with productivity may not be so accepted. An advanced ability to filter out information we do not want to know should perhaps be added high on our list of issues to address, along with a tax system that distorts investment decisions and principal-agency problems.

New Zealand Agriculture

To understand New Zealand agriculture you have to come to grips with its underlying culture. Agriculture provides a great example and clues as to why our level playing fields and best practice systems have given average or below results. The culture includes a consistent message regards increasing the volume of production and the bright future of New Zealand agriculture as long as capital continues to be injected. The culture in summary is defend the status quo, keep clipping the funding ticket and suck in as much other money as possible.

The Roger Douglas and Treasury model of agriculture put in place in the 1980s was one of perfect markets and the government became hands off. That helped for a while, but the model lacked a centre of intelligence to ensure the integrity of the system.

Farm asset bubble

New Zealand agriculture's medium term future was effectively defined late in 1999 when Clark and Cullen modified the Treasury model and approved the formation of Fonterra, together with increasing the Reserve Bank's policy target for inflation to one to three per cent. These were political decision whose consequences were understood. Most of those consequences have come to pass or are in the process of doing so.

A farm asset bubble was guaranteed. This bubble spilled over into the residential housing market. Dairy farming was dominating all agriculture and distorted costs and asset values for other producers. Inflation, particularly of non-tradeable costs, had been assured but was largely ignored. Operating costs did not appear particularly relevant to owners, regulators or government in the light of rapid inflation of farm assets.

Increasing production at low or negative marginal return was confused with farm productivity but was used to justify a rapid rise in farm asset values. Agriculture appeared blinded by its notional success and provided little innovation, poor returns to public research and development and low productivity gains. Agribusiness thinking provided academic support to the business of farming for capital gains.

The farm asset bubble has now burst. Asset values are down 30 to 40 per cent, or to 20 per cent below 2006 values. There is currently no market for farms – rural real estate agencies have few buyers. The money available to purchase farms is negligible, and overseas buyers non-existent. Banks are not making finance available – some being so blunt as to explain there will be no new lending except where interest is being capitalised.

Agricultural debt currently exceeds 400 per cent of agricultural GDP and is still increasing at $13 million a day from $46 billion at the end of June 2009. This debt marks a steadily rising percentage of New Zealand lending. The trends are clear from the graph on the left.

Debt is agriculture's most immediate problem, and may flow on to seriously affect those who have provided finance to agriculture. But the farm asset bubble must deflate if New Zealand agriculture is to have a viable future. This is helped by farm values being assessed on farm profitability. An increasing number of farms are under bank management, and a large number will be sold over the next year. Interest rates have dropped, but are expected to start rising again. Risk premiums will also be much higher.

Why have our level playing fields and best practice agricultural systems produced a highly indebted industry for the most part struggling to make reasonable profits? I am not going to try and answer, but will instead offer a mix of ideas accepted in agriculture over the last two decades or more before commenting in passing.

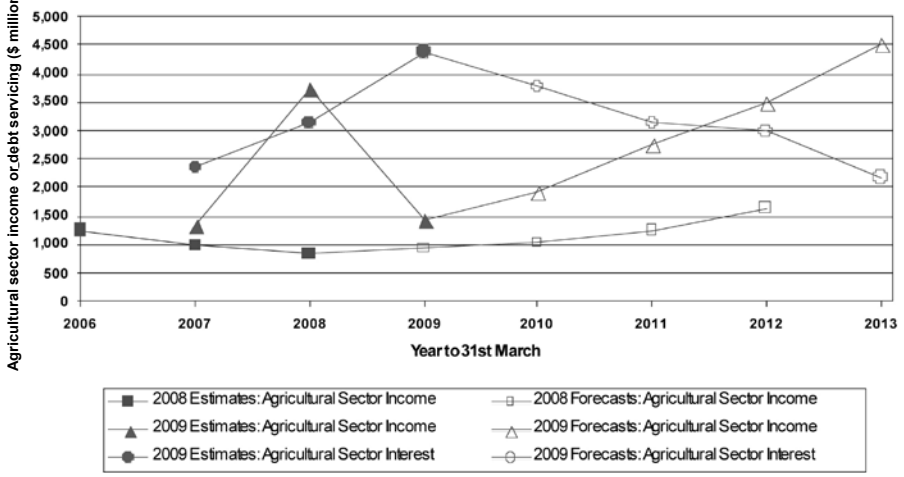
- In 1986 some in the agribusiness community were advising farmers to diversify away from farming by investing in the share market.
- By 1998 it was commonly accepted by those trading farms that any returns from farming would be from asset appreciation and not profit
- 2000 saw the dairy industry accept a mega co-op model against the better judgement of regulators, but with the Dairy Industry Restructuring Act ensuring easy access to milk supply for new entrants in high value manufacturing.
- New Zealand agriculture has always had booms and busts, sometimes multiple cycles are the order of the day. These include kiwifruit, exports of kiwifruit plants, wool, deer, ostriches, forestry, nashi pears, persimmons, goats, dairy, grapes and aspects of biotechnology.
- Around 2004 AgResearch adopted as its vision doubling New Zealand agricultural production by 2020
- The Golden Age of Agriculture became a common theme in 2007
- Success in agribusiness early in 2008 was defined as convincing an ageing but debt free dairy farmer to use the power of other people's money and purchase a second dairy farm. The thinking was not new.
- 2008 saw the then Minister of Agriculture touring New Zealand talking up investment in increasing dairy production.
- July 2009 saw farm asset values $30 to $40 billion below what they had been worth at their peak.
- In August 2009 Prime Minister John Key officially launched Food Innovation New Zealand at Massey's Manawatu campus. The key benefit to New Zealand is to be the value this adds to our traditional primary produce with an ambition to increase total food and beverage export returns to from $22.9 billion more than $40 billion in less than 10 years.

The focus is still supply rather than demand and is about improving commodity volume or prices. The thinking has not changed. Much of agriculture is still focused on attracting speculative investment money rather than making profits.

Adding value

Close to the centre of that agri-food hub and providing a contrast is New Zealand Pharmaceuticals (NZP). They add value to some food products but make their money manufacturing pharmaceuticals from animal by products. They are not promising

MAF forecasts and estimates of sector income and debt servicing costs



to add billions of dollars to existing New Zealand commodities – much of their raw material is imported.

NZP would provide a good contrast to Food Innovation New Zealand when deciding whether Treasury and the OECD are correct in their conclusions on the relative values of public and private sector returns to research and development. Where are the credible and information bases on which the likes of Food Innovation New Zealand make their decisions on investment in New Zealand agriculture?

In July 2009 MAF provided forecasts of farm incomes tripling over the next four years. This was in marked contrast to their 2008 projections that were still optimistic but realistic.

The rosy forecast is only achieved by forecasting using an exchange rate with the US dollar of 52 cents until 2013. Debt servicing costs are projected to more than halve over the period and make the biggest contribution to improving income projections. There are three ways that the projected level of debt servicing could be achieved by 2013 – widespread default, low interest rates or foreigners taking farm ownership or a combination of these.

Plan A or plan B

Opposing views exist on agriculture's future. The incumbent view I will call Plan A. It has taken New Zealand to the situation it finds itself in now, encompasses all the major institutional players, and supports the industry culture shown earlier. It is perhaps epitomised by the dairy industry's 2009 strategy – more of the same. In that strategy, debt only gets one mention in declaring that farm debt equity ratios have not changed since the 2004 strategy.

Plan A has a consistent message whose questioning is frowned upon. Public sector research and development and increasing agricultural production are revered. New Zealand agriculture has a positive future simply because we grow food. The world recession is to blame for most other ills.

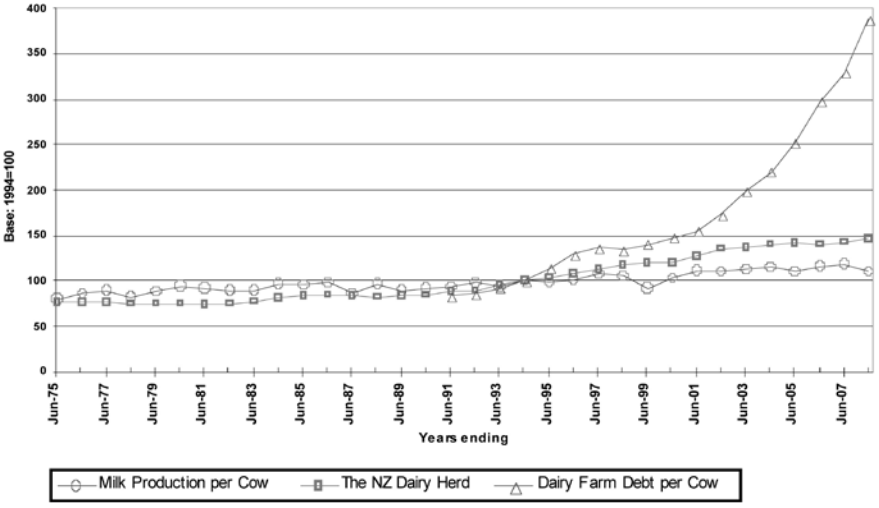
Plan B is an alternative view that lines up with the earlier selection of points from the OECD and will lead to greater competition and innovation. Its economics are resource rather than asset driven. This plan is pragmatic.

The New Zealand dairy industry

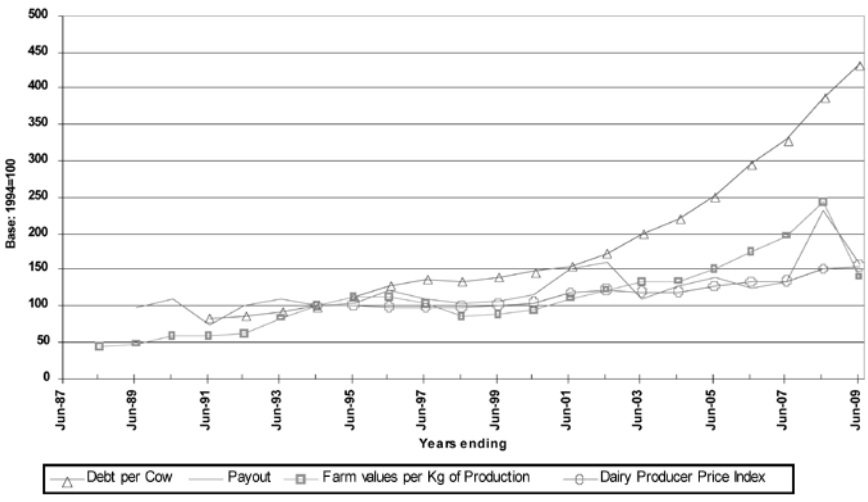
The New Zealand dairy industry has not responded constructively to the threats and opportunities presented by the restructuring that occurred with the formation of Fonterra. Some of that is a consequence of the Dairy Industry Restructuring Act and the mega-co-operative model which dominates the industry. The industry has in addition bought into its own hype.

The industry, led by the agribusiness community, has concentrated on farm asset growth, but has performed poorly in terms of productivity and farm management. The following graph is commonly presented without the debt to show the gains made in dairying, to argue for more investment into research and implies the industry's expansion strategy is working.

Average debt per cow



Debt, costs, asset values and payout



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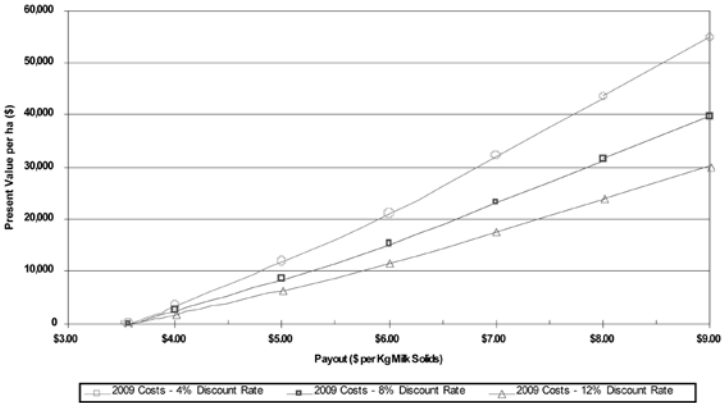
The effect of payout and interest rates on Waikato dairy farm



The debt adds another perspective. The graph shows the debt per cow increases by 288 per cent between 1994 and 2008. Milk production per cow is 10 per cent which is under the long term average annual gain of one per cent. The dislocation of debt per cow and milk production per cow is alarming.

At the moment debt defines the industry, but its distribution is fortunately is highly skewed. Dairy farm debt is causing banks considerable concern, and the free flow of money into the industry has dried up. Some dairy farmers are currently using their creditors as sources of finance.

From the graph at the bottom of the previous page it is obvious that debt has grown much faster than asset values particularly since the formation of Fonterra. The producer price index has risen in line with payout other than in 2008. From June 2008 debt continues to compound while asset values and payout have crashed. Growth in the dairy producer price index now exceeds that for payout and asset values. Worse is probably still to come from falling asset values and payouts well below the projected $5.20 for the 2009 season.

Since the formation of Fonterra the objectives of the industry have merged with the objectives of Fonterra. The dairy industry strategy is effectively synonymous with Fonterra's strategy. Fonterra's strategies have always been difficult to pinpoint with any precision, making it particularly hard to assess their success. What has been apparent is that strategy has been in a state of flux. It is possible to infer the major phases as –

- Market power and efficiency from scale as Fonterra has undergone almost continuous restructuring
- Growth mostly about getting bigger from acquisitions
- A shift to exploiting New Zealand dairy industry supply chain expertise by exporting it to other countries
- Survival, the current situation, with long-term strategy replaced by short-term focus on remaining viable.

Individual New Zealand dairy farms

Many factors contribute to the value of a farm, but recent economic circumstances have changed much. The question of asset values may be from the perspective of whether the farm owner has positive equity, or alternatively at what value does purchase make a sound investment. Three main factors affect the value – interest rates, profitability and any lifestyle premium. Lifestyle values only apply to some farms, and may not be bankable. That leaves profit as the main determinant of value followed by interest rates.

A disruptive consideration to farm values is the relationship of each farm's value to that farm's access to processing of raw milk product. Fonterra's formation caused a major upward revaluation of that access. The process is now working in reverse.

The present value of a farm is from the income stream that it generates. The value of this income stream is influenced by the discount rate – effectively the cost of finance.

Operating costs have a major influence on farm present values. Eventually increasing costs could mean a farm has no productive value, in other words you would not be able to make a profit even if the farm was free. This fact seems to be lost on both local and central government.

At this point we have to conclude that dairy farmers do not in the short term have any control over payout, and no control over some costs. We find we are back to considering many of the basics that concentrated farmers minds from the 1950s to the 1980s – the almost forgotten art of how to select the production system and level of production that maximises farm operating surplus.

This is where the best financial return to farmers for effort is to be found provided managers can get past a number of pre-conceived barriers. Work done for MAF policy in 2007 used a sophisticated bio-economic model. This identified national gains in dairy farm operating surplus of $250 million by selecting the correct stocking rate for the existing farm system.

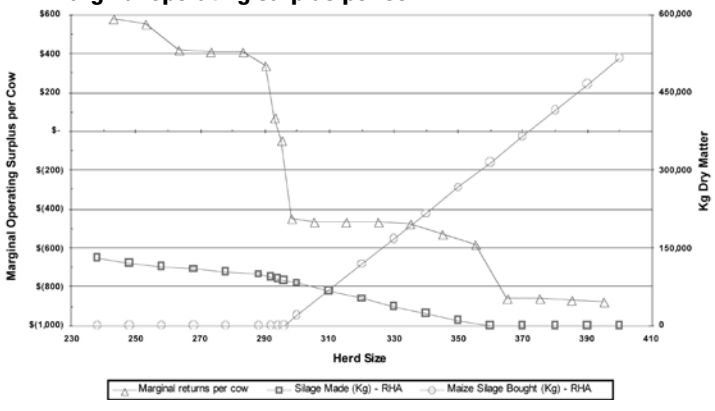
The concepts go far beyond correct stocking rate and are now critical. With the low payout expected for the current season, knowledge of that work and its application will be the difference between some farms surviving or not. Producing to where marginal cost equals marginal revenue is still poorly understood in agriculture. This blind spot is the cause of poor farm financial performance.

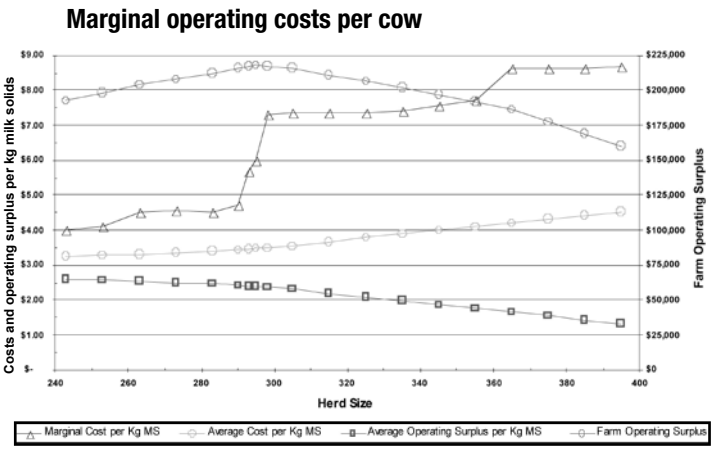
Marginal costs

Marginal costs and revenue must predominate over the current mantra of more production and holding external factors such as markets, exchange rates, tariffs or subsidies responsible for poor on farm profit performance. Every accountant, farm consultant, banker, land agent and most importantly each farmer needs at least to understand what their marginal costs look like.

The two graphs that follow should be considered as illustrating concepts. The data represented by the graphs is modeled with cows fed optimally and was precise for 2006. In 2006 this farm typically had a herd size exceeding 300 cows. Reducing its herd size would have improved the farm's operating surplus.

Marginal operating surplus per cow





Marginal operating surplus per cow is the amount each additional cow in the herd individually contributes to farm operating surplus. The graph shows that contribution switching from a positive contribution of $400 per cow to a negative effect of in excess of $400 a cow over a change in herd size of ten cows.

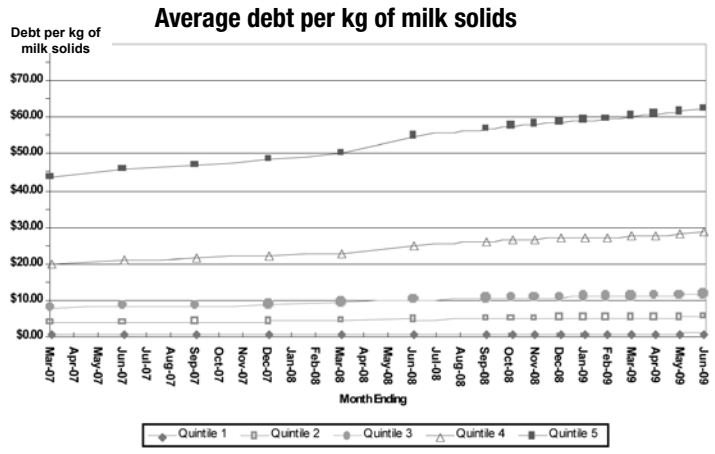
Who wants to milk additional cows when each of them is costing $400, $600 or $800 in farm operating surplus? The correct herd size matters. The point to take is that in pastoral farming marginal operating surplus can change quickly and dramatically. Each additional cow makes a negative contribution to farm operating surplus.

The second graph is for exactly the same farm, costs and production but presented in a different form. It shows costs per unit of production and average costs, average revenue and farm operating surplus.

In this graph operating surplus is maximised to where marginal revenue equals marginal costs. Payout is a good proxy for marginal revenue. Therefore, at a $5.50 payout, operating surplus should be maximised where marginal cost equals $5.50 per kilogram of milk solids. Average cost and revenue are changing, but neither can provide a clear indication of the level of production to maximise operating surplus.

Levels of debt for individual farms provide stark contrasts. It is clear from data on the distribution of dairy farm debt that many farms have little or no debt while others have levels of debt that can never be repaid. The data is complicated by sharemilking properties having two potential sources of debt – the farm owner and the sharemilker.

The lines in the graph plot averages, and as such there will be considerable individual farm variation about them especially for the higher debt quintiles. The data is a stark illustration of the problem some dairy farms have with debt, and how the problem is compounding. Those attempting to farm with debt levels in Quintile5 have almost certainly passed the point of no return. Debt levels are such that they cannot be serviced at any foreseeable combination of payout and interest rates meaning debt will only increase. In many cases the debt will need to be repudiated.



Debt should not be an issue for farms with debt in Quintiles 1 and 2 but access to new finance may be restricted and more costly than it would otherwise have been due to the finance industry's current adverse attitude towards agriculture. Prospects for farms with debt in Quintiles 3 and 4 will depend on the level of debt, the ownership structure, other sources of equity or income, and managerial ability in terms of maximising the operating surplus that can be generated.

Risk management

Risk management is not something that can be done after the event. The key times to have considered the risks to New Zealand agriculture were –

- During the Douglas reforms of the 1980s
- At the time the dairy industry moved to the mega co-op model
- After it was made clear in 2006 and 2007 that agriculture's dependence for viability on inflating asset values could not be sustained.

Despite it being too late in some cases to save farms, individuals should work towards acceptance of a very different environment from the past. In some cases responsibility for the situation a business finds itself in is personal. In others, farmers have been badly misled sometimes by systemic failures of their industry. There are two opposed perspectives on agriculture but only one is right.

Get involved and attempt to bring about industry changes. Production economics provide the best chance of a viable farm operation and will be reflected in farm asset valuations. Be wary of the status quo being rehashed as change such as merged or renamed institutions with the same people in control.

Industry is in much the same state as individual farmers, but with much greater need of fundamental change. While farmers individually are reasonably smart, their delegated decisions often are not. Turn the industry ethos upside down. The main pillars of that ethos are Agresearch, DairyNZ and Fonterra. New Zealand agriculture will not remain viable for long if any of the three pillars continue in any way recognisable as their current form. Central to reform will be changes to leadership. Regulators, research and research funding are problems far bigger than agriculture, but possibly equally or more in need of drastic restructuring. In these cases there are though far more stakeholders involved.

Individuals who are not farmers should reflect before choosing one side of the fence. Question, analyse, challenge and take care what you are seen to put your name to. Political and cultural leaders need to decide where they draw the line between their constituents and defending existing privilege. The latter, and especially any socialisation of private debt, will likely be judged harshly if not immediately.

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What is an appropriate basis for the valuation of farm land?

Bob Hargreaves and Iona McCarthy

The current credit crisis originated in United States as a result of permissive lending practices by bankers and other mortgage originators. The availability of low-cost credit without too much consideration of the borrower's ability to repay loans initially led to a boom in house prices.

The bust in US house prices occurred when large numbers of mortgagees began to default on their repayments and the market was flooded with forced sales. A similar boom was seen in both the housing and farmland markets in New Zealand with farm prices escalating on the back of increased demand for agricultural commodities, particularly milk protein products. The rural finance sector in New Zealand did factor payability into lending but there was an expectation of continued capital growth. This has now receded as the world recession deepens. To date the farmland market has proved to be more resilient than the housing market, but decreases in the payout for agriculture commodities has resulted in Federated Farmers spokesperson Bruce Wills being reported as predicting some New Zealand farms could lose 30 per cent of their value.

Valuation methods

Inevitably, valuation methodology has come under scrutiny and questions are being raised about the most appropriate basis for the valuation of farm land. Currently there are three standard approaches to the valuation of farmland. These are the comparable sales approach, the replacement cost less depreciation approach and the income approach. Normally valuers use at least two of the three approaches when compiling a rural valuation.

Comparable sales

The comparable sales approach is where like is compared with like and operates across many markets including farms, housing, the sharemarket, animal sales and plant and equipment sales. This works particularly well when there is plenty of recent sales information. The main difficulty with applying comparable sales to the valuation of farmland comes down to the heterogeneous nature of farms. No two farms are exactly alike and the rural market often has relatively few recent transactions. The skill of the rural valuer is in being able to make adjustments for the differences between sale properties and relate this back to the property being valued. Although valuation is an inexact science rural valuers do have the experience and judgement to make these adjustments.

Replacement cost

The second approach is the replacement cost less depreciation method. This involves calculating the added value of the improvements and adding this to the land value. The added value is estimated by calculating the replacement cost of each improvement and then the deducting an amount for depreciation.

There are strong market elements contained in the replacement cost less depreciation method because the historical cost of land is usually irrelevant and the current value has to be estimated from comparable sales of land exclusive of improvements. Similarly there are no textbooks available to assist a valuer with estimating how much depreciation to deduct, as the rate of depreciation is driven by the market and keeps changing.

Income or productive approach

The third approach is the income or productive approach. This requires the valuer to do a productive budget. The surplus brought from the budget is capitalised to arrive at the productive valuation. The linkage between the income from an asset and its value is the capitalisation rate, or yield.

After capitalising the income stream the valuer needs to adjust the valuation for the quality of both the locality and improvements. Farms closer to town typically sell for more than farms that are further away. Furthermore, improvements which may not add to the productivity of the farm can have an effect on the value. For example two farms may be identical in all respects except that one has a million-dollar house and the other one a house worth $100,000. The income approach also has some strong market elements. Unless the capitalisation rate used in the income approach is market related then the valuation may not relate to what is actually happening in the market place.

Ignore the income

The current reality is that valuers tend to rely on the comparable sales approach, use the cost less depreciation method as a backup method and for the most part ignore the traditional income approach to valuation. However, it is true that various gross income estimates are widely used by buyers and sellers as well as valuers.

For sheep and beef farms the price paid per stock unit is the typical gross income measurement. The equivalent for dairy farms is the price paid per kilogram of milk solids. Like many rules of thumb, gross income estimates present some real dangers when too much reliance is placed on this approach.

For example, consider two dairy farms with identical per hectare production. The first dairy farm may achieve this without the use of supplementary feeds and wintering off and make minimal use of nitrogen fertiliser. If the second farm makes use of wintering off and supplementary feed then the first farm would be expected to sell for more on a per hectare basis.

There is also the question of once-a-day milking. If once-a-day milking reduces production by 20 per cent then it is highly unlikely that the selling price per hectare will drop by 20 per cent. In fact it may not drop at all since the incoming purchaser can clearly raise production by simply milking twice a day.

Returns from farming

Having argued that market considerations drive the price of farmland, it is worth asking if land is worth what it will produce. Does the market get it right? Economics teaches us the present value of a farm is equal to its discounted future earnings.

It is necessary to define earnings from farming. Farmers typically see earnings from two sides of the business. Firstly, net cash flow from the business of farming and secondly cash flow from property investment, or land ownership.

Owning land

A problem with farming in New Zealand is that the business of owning land is far more profitable than the business of farming. For example, the capital gains from owning dairy farm land over the last 25 years have exceeded 10 per cent a year. During the same period the returns from the business of dairy farming have typically returned an annual two to three per cent.

This is not to say farming is inherently unprofitable, but simply the high price of farmland makes it difficult for owner operators to achieve annual cash flows beyond two or three per cent. The benchmark summaries for the 2006/2007 season from the Dairy New Zealand Dairy Base website shows the average owner operator made a 2.8 per cent return on dairy assets while for the same period the average sharemilker made an 8.3 per cent return.

The graph at the bottom of the page is taken from the Quotable Value dairy farm index over the period 1980 to 2007. Of particular interest from this chart is the fact that dairy farm values doubled over a five-year period from 2002 to 2007. This increase mirrors the period when the housing market was also showing dramatic increases in values.

Historical perspective

So what happens when it all gets out of hand? Can farming for capital gains continue indefinitely? Perhaps history can provide some guidance? Should the government intervene as it has in the past?

Under the State Advances Act 1935 the government-owned State Advances Corporation was instructed to value farm land on the basis of its productivity. Similarly, under the Mortgagors and Lessee's Rehabilitation Act 1936, the income approach to valuation was used to assess the debt servicing capacity of farmers. In some cases mortgagees had to write down the principal owing under the mortgage to meet the farmer's debt servicing ability.

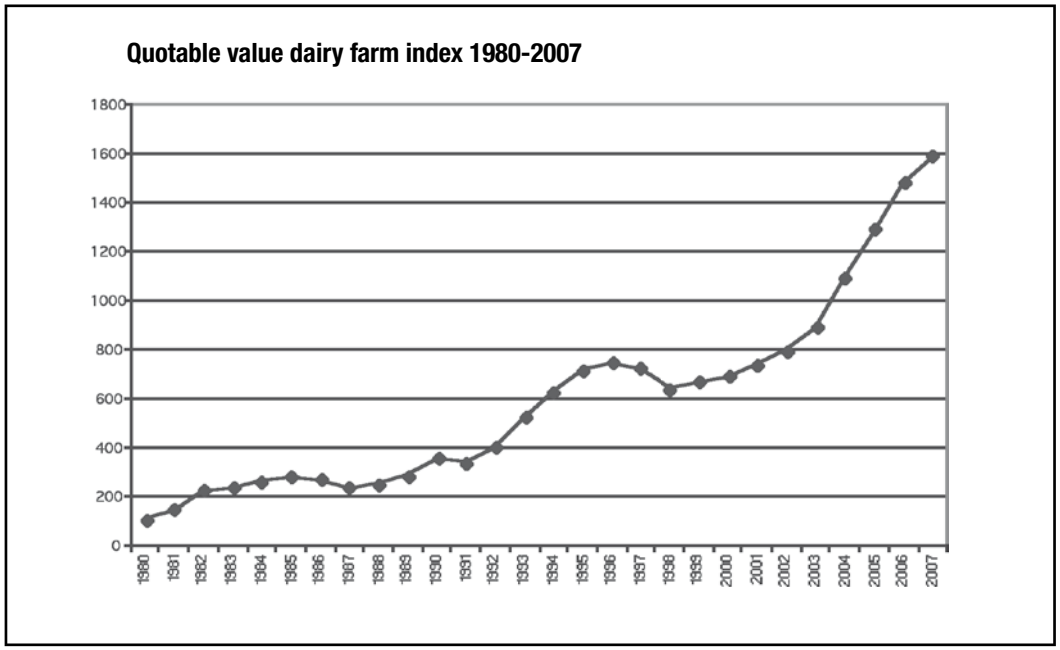
Of course this legislation was very unpopular with lenders and was soon repealed. The Servicemen Settlement and Land Sales Act 1943 fixed the price of farm land at 1942 values for about a decade. The rationale for the legislation was so the soldiers going away to World War II would not be disadvantaged by increases in land prices. Farm land transactions during this period had to be approved by the Land Sales Court on the basis of productive valuations using a capitalisation rate of 4.5 per cent and an agreed system of costs and pricing. This legislation bought valuers to prominence and stayed in force until the early 1950s.

Price falls

One of the problems with intervening in the market and controlling the price of land was that eventually the legislation had to be repealed and the market allowed to operate. Vendors were well aware that the price of land was likely to go up once the land sales era finished and so there were a number of circumstances where dodgy transactions were alleged to have occurred. There was the official price, as specified by the Land Sales Court, but often an additional illegal payment made to actually secure the vendor's signature.

The most dramatic reduction in rural land prices over the last 50 years occurred during the so-called 'Rogernomics' restructuring during the 1980s. At this time almost all farming subsidies were removed and price of hill country farms fell by up to 50 per cent in nominal terms during the downturn. Dairy farms were less affected because they were not subsidised to the same degree as sheep and beef farms. However, when inflation is taken into account the drop in the dairy farm index from 1984 to 1987 was 45 per cent in real terms.

Although the market usually gets it right in the end, in the short and medium term the market sometimes get things very wrong. An extreme example was reported in 1997. In Japan in 1988 at peak values, the Emperor's Palace in central Tokyo



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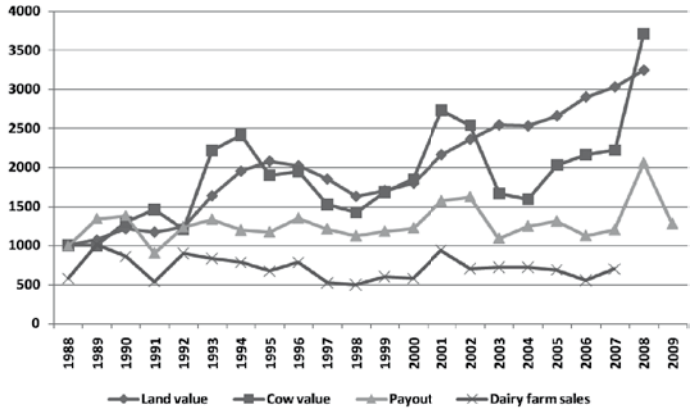
Farm Real Estate Cycles						
Factor	**Stage 1 Trough**	**Stage 2 Upturn**	**Stage 3 Boom**	**Stage 4 Peak**	**Stage 5 Downturn**	**Stage 6 Recession**
Farm Profitability	Weak, some losses	Improved overseas product prices	Continued improvement	Decline	Continued Decline	Losses are common
Sales Volume	Static, slow turnover	Increasing	Peaks	Decline	Continued decline	Volume low
Listing Time	Long listing time	Time to sell decreases	Listing time short	Longer listing time	Farms hard to sell	Long listing time
Farm Prices	Static	Increase	Rapid Increase	Vendors offer attractive financing to keep prices up	Decreasing	Continue to decrease
Lending Criteria	Finance hard to obtain	Relaxed slightly but relatively expensive	Easy credit at favourable rates	Credit tightens, interest rates increase	Credit continues to tighten	Credit difficult to obtain and expensive
Buyers Attitudes	Farms not seen as a good investment	Existing farmers can afford to expand	Rapid capital gains encourage more buyers into the market	High prices for farms and poor outlook reduce returns and buyer interest	Why purchase in a falling market?	Some bargains available for existing farmers
Sellers Attitudes	Most sellers still under financial pressure	Backlog of unsold farms decreases. New sellers have higher expectations	An excellent time to sell	Still a good time to sell	Strong vendors withdraw from the market	Financial pressure to sell on many vendors

was worth more than all of the land and developed property in California.

The land and gardens comprising the Emperor's palace consists of around 237 hectares and the State of California in the United States is 42 million hectares At the same time the total market capitalisation of Japanese shares exceeded the value of all of Wall Street by ratio of five to three at a time when Japanese economic output was only one third of that of the US. With the benefit of hindsight it is obvious the market got it badly wrong.

One of the current arguments in academia is between people who believe consumers act rationally – the efficient market hypothesis, and that the market price embodies all known information. On the other hand the behavioural school of economics and finance argue that people operating in markets do not always act rationally and there is a herd instinct leading to events such as property bubbles. In the case of the US housing market it seems the description of 'irrational exuberance and herd like behaviour' is correct since this market is now showing large declines.

Land value, cow value, payout and sales volume



Real estate cycles

The table above shows a stylised matrix developed by Hargreaves and McCarthy describing the six-stage rural real estate market and the various reasons for this market.

Farm profitability and sales volume consistently provide leading indications of changes in the real estate market. For dairy farms the most obvious indication that farm values are going to change are forecast changes in the payout. An expectation of an increase or decrease in payout is reflected in dairy farm sale prices and also reflected in the price paid for capital dairy stock. Volume of farm sales also provide an indication of change in price in the dairy farm market.

The length and magnitude of dairy farm real estate cycles is hard to predict but the graph on the left shows that the average length has been more than 10 years over the period from 1988 to 2009. The graph shows the relationship between the deflated QuotableValue dairy farm sale price, payout, cow sale prices and dairy farm sales volumes.

The key points that can be determined are that payout, cow prices and farm turnover lead real estate prices both on the upside and downside of the real estate cycle. Farms are getting bigger and the number of dairy units and volume of dairy farm sales is declining, but within this there are still cyclical turnover patterns. Increases in the dairy farm payout quickly get capitalised on to the price of land but decreases in payout take much longer to affect the land prices.

The revision of Fonterra's payout down from a forecast of $6.60 at the beginning of the 2008/2009 season to around five dollars is most likely to lead to a corresponding decrease, in real terms, of cow and land values. Early indications are that there has been a rapid reduction in the volume of dairy farm sales.

If it is true that there is a bubble with dairy farm values just as in the housing market, then it is likely that rural banker's will place an increasing emphasis on the productivity aspects of the farm and be less influenced by the likelihood of future capital gain. Indeed there may be capital losses in the short run. It is therefore worth reviewing some of the details of the traditional income approach to the valuation of farms. We should point out where the income valuation budget differs from a standard forecast budget prepared for management purposes.

More on the income approach

The income approach budget for valuation purposes puts the farm in a static or status quo budget position. This means the fertility of the farm remains constant as do the numbers and genetic merit of the animals. Improvements are maintained in their present state of repair and the costs and prices used in the budget will not necessarily be current market prices if it appears that these are out of line with long run prices.

This budget also uses the concept of the average efficient farmer. The average efficient farmer is not easy to define, but usually thought of as the average of the top 50 per cent of farmers. The reason for this is that the less successful operators are more likely to be exiting the industry. Conversely, if the valuer is valuing a farm where the current operator is achieving production of 10 per cent beyond what anyone else could achieve, then clearly this level of management could not be used in the budget because once this very efficient manager sells, the extra production would be lost.

The productive budget is not a cash forecast budget because it provides for depreciation in order to maintain improvements and plant and machinery in a steady state. The economic concept behind this approach is to reward all factors of production according to their marginal value product or market value. In the case of the reward for management this will not be the nominal amount that might be used by lending institution to calculate farmer's drawings, but would be the amount it would cost to hire an outside manager. If the management factor was under awarded and the surplus inflated by this amount, this would be capitalised into the value of the land and the result in over valuation. Similarly the contribution of the stock and plant is assessed by valuing these items and then charging interest, at a rate that reflects the higher risk, on this value against the budget.

Bid price

A derivative of the traditional productive approach is the bid price method. The bid price considers the valuation from the point of view of a potential purchaser. The bid price equals the productive value plus the investment value. One of the strengths of this method is that it is forward looking and forces potential buyers to consider the value of a farm on the basis of productivity. When entering a period when there is little capital gain and possible capital losses ahead, this seems like a prudent approach.

Therefore the first part of the bid price method is to ascertain the productive valuation using the budgetary concepts discussed above. In this case the capitalisation rate used is the real after tax of cost of capital weighted for the influence of equity and borrowing. For example, with a 50 per cent debt to equity, current debt funding at seven per cent and an after tax return to equity of three per cent, then the capitalisation rate is five per cent.

The investment value is calculated by discounting the likely selling price at the end of the holding period back to present values. In this case the discount rate will be the same as the capitalisation rate. In the current market care would have to be taken on assessing the likely selling price. Historically there has been a 10 per cent annual growth but values have decreased in the past in real terms when farm returns dropped.

Conclusions

As a result of tighter credit for farmers, bank managers are likely to pay much more attention to cash flow. The old sayings that cash flow is king and near cash flow is worth more than future cash flow will become particularly relevant. Budgets where bankers stretch the rules and factor in capital gain are likely to be a thing of the past. However, it is not all doom and gloom for investors. History shows that the rural property market is surprisingly resilient in periods of downturn.

Smart farmers can influence supply by delaying retirement and minimising the number of farms on the market during tough times. Such actions help to underpin the price of land. In addition, there is only a certain amount of land and strong operators continue to enlarge their operations and compete among themselves for land.

Other influences

The rural market is also influenced by the urban market. The demand for lifestyle blocks within commuting distance of towns and cities gives farmers the option of either selling their farm to another farmer, or subdividing and selling lifestyle blocks. There is also a ripple effect when the farmer close to town sells and buys another farm outside the commuting zone, injecting more capital into this market.

Then there is the question of highest and best use to other farm and horticultural endeavours. While dairy farming is currently the highest and best use of much of the better land in New Zealand this will not always be the case. With water shortages looming in the drier parts of the country it seems likely the most efficient use of this resource will be for sustainable horticultural and arable activities.

While the market approach to the valuation of farmland has stood the test of time and is upheld in the courts, it is essentially a backward looking approach. In volatile property markets it is also important to look ahead at future cash flows and likely changes in property values. The income approach to valuation and the bid price method are forward-looking approaches and these are the recommended approaches to be incorporated into buyer calculations and valuation reports.

The authors have used a number of sources in the preparation of this article. A full list of references is available from the editor.

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Do supplements reduce risk?

Rob Brazendale

We have all heard merchants and farmers claim that supplements protect farmers against adverse climatic events or future-proof the farm. Few would disagree that when adverse events strike, having supplements on-hand can mean getting through the event relatively unscathed. However supplements can expose a farm business to greater financial risk and when not used appropriately, can be a profit destroyer and put the business at risk.

There is no question that supplements have their place in profitable dairy systems. In seasonal dairy farming systems there are times of the year when grass growth is not enough to meet the feed demands of milking cows and bought in supplements can be profitably used to fill these feed gaps. The trick is to make sure the costs of these supplements does not exceed the return from feeding them.

Simple analysis

The profitability of supplements is often assessed in a very simplistic marginal analysis manner. For example –

- Purchase cost 23 cents per kilogram of dry matter
- Return 36 cents per kilogram of dry matter
- Profit margin 13cents per kilogram of dry matter

The problem is that grazing systems are not simple and there are other factors to consider, ranging from all the costs of actually getting the feed down the throat of the cow to the substitution from grass. These include storage and feed wastage, substitution, the direct costs of feeding and the infrastructure required.

Storage and feeding wastage

The table at the bottom of the page summarises the expected wastage rates for a range of feed options. It is possible to reduce wastage of feeds, such as silage, by feeding on feed pads and using bins, but this does add infrastructure costs and the overall cost may not be dissimilar. The table also gives an estimated cost of feeding supplements. It includes machinery running costs and depreciation but no allowance for labour.

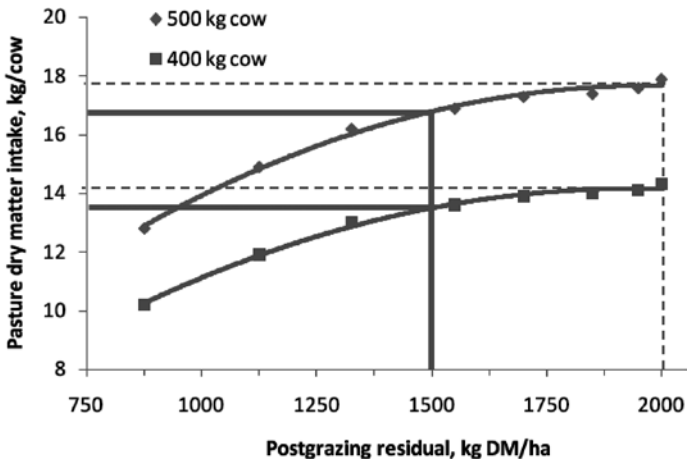
Substitution is the big hidden cost of supplements. This means wasting the cheapest form of feed available, the pasture, and replacing it with more expensive purchased supplement feeds. Substitution is minimised when there is a genuine feed deficit and milking cows are grazing below 1500 kg dry matter per hectare without supplementation.

The concept of fully feeding cows is fundamentally flawed when applied to New Zealand grazing systems. Under our grazing systems cows are required to forage for their feed, as opposed to the feed being brought to them under intensive northern hemisphere systems. This means the cow needs to be motivated to climb that sidling to eat those last one or two kilograms of dry matter of their daily intake. If they are not a little hungry why would they bother?

This was demonstrated in trial work in the 1980s. More recent work has been carried out by DairyNZ. This suggests that for every tonne of dry matter per hectare introduced, expect the amount of pasture eaten to decrease by between 400 and 600 kg dry matter per hectare. In other words the net increase in feed available to the cows is only 400 to 600 kg dry matter per hectare.

Supplements – estimated feeding out costs, wastage and other considerations

Supplement	Estimate feeding out costs	Megajoules of metabolisable energy per kg dry matter	Estimate wastage feeding out	Other
Meal	$10 per tonne	12.0 to 12.5	510%	High risk of acidosis. Need to introduce slowly and feed so individual cows cannot gorge.
Molasses	$10 per tonne	11.5	10-15%	High risk of acidosis. Maximum intake 1.0-1.5 kg dry matter per cow, introduce gradually.
Palm kernel	$10 per tonne	11	Feeding in bins 10-20%, feeding in paddock over 30%	Not very palatable. Needs to be available to cows when grazing to encourage intake when first introduced. Ideally no more than 30% of diet
Silage/baleage	$60 per tonne	9 to 11 Quality varies widely	Over 20%	Silage and baleage often not 10.5 ME and therefore not suitable as milking feed. Suitable feed for dry cows, or if no long-chop feed available for milkers
Maize silage	$60 per tonne	9 to11 Average 10.5 ME	Over 20%	Ideally no more than 30% of diet to avoid amino acid and protein deficiency, at high intakes require supplementation
Cereal silage	$60 per tonne	8 to 11	Over 20%	Like maize, not all regions in NZ suited to growing quality cereal silage, can get high wastage if poor quality.
Hay	$60 per tonne	8 to 9	Over 20%	Suitable feed for dry cows, or if no long-chop feed for milkers to reduce risk of acidosis.
Straw	$60 per tonne	6 to 8	Over 20%	Not suitable as milking cow feed but can make part of a dry cow ration, may be required in diet to meet fibre requirements.



Pasture-sparing is an advantage during periods of feed deficit. But it is problematic when feed supply is adequate to meet cow feeding demands because it adds to a surplus and is often wasted. Therefore the theoretical response to supplements is often quite different from what happens in practice. We have a good understanding of the on-farm circumstances that control the response rate to supplements. These industry agreed responses to supplements are summarised in the table at the bottom of the page. They allow for wastage and substitution for given grazing situations.

Purchase cost	2.2 cents per megajoule of metabolisable energy
Feeding out $60 per tonne	0.6 cents per megajoule of metabolisable energy
Total cost	2.8 cents per megajoule of metabolisable energy
Return – response 6.5g milk solids x $4.55 per kg milksolids	3.0 cents per megajoule of metabolisable energy
Profit	0.2 cents per megajoule of metabolisable energy

Profitable supplementary feeding is largely dependent on three factors –

- Sourcing feed at the right price, as a rule of thumb DairyNZ suggests five per cent of payout
- Minimising wastage
- Minimising substitution.

If these three factors are not achieved, feeding supplements is likely to reduce profitability and expose the farm business to greater financial risk. This increase in risk is amplified when supplementary feeding requires significant investment on infrastructure such as feeding pads, mixing wagons, additional tractors and expensive ration balancing additives.

Once this capital has been invested, it has a cost regardless of the margin for purchased feed. Therefore, even if the margin over cost of feed is insufficient to justify purchasing supplements, the capital cost still must be carried by the business.

The marginal analysis presented above should be re-worked to include all costs. This profit is equivalent to around 2.5 cents per kilogram of dry matter and assumes the cows would graze below 1,500 kilograms of dry matter per hectare if not supplemented and therefore minimal substitution is occurring. No allowance has been made for capital invested in infrastructure.

The reality is that, due to substitution and wastage, most commercial farms only achieve a response rate of 3.5 to 4.5g milksolids per megajoule of metabolisable energy from supplements and at these responses rates a net loss of one cent per megajoule of metabolisable energy is being generated.

Supplements have the potential to reduce risk, particularly when an adverse event occurs. However, they also have the potential to increase risk by eroding the underlying profitability of the farm business if used inappropriately. This risk is further amplified if the feeding of supplements requires capital investment to build infrastructure in order to feed the supplements.

Rob Brazendale is the DairyNZ development team leader

Response to supplement offered in spring

Response to feed offered grams per megajoule of metabolisable energy	Residuals and average pasture cover measure 1 click = 5 mm on rising platemeter	Supplement	Other
Negative to 3.0	Leaving over 9.5 clicks (1800 kg DM/ha) at or above target	Quality < 10.5 ME, Wastage over 30% fed in wet weather	Pasture quality in subsequent rotations poor and less pasture grown
3.5 to 5.0	8.0 to 9.5 clicks (1600-1800 kg DM/ha) stop feeding at target	Average quality 10.0-10.5 ME; Wastage 25% -30%	Supplement feeding stopped too late creating surplus feed
5.5 to 7.5	6.5 to 7.5 clicks (1350 - 1550 kg DM/ha) if supplement not fed, residuals 8.0 clicks when supplement fed.	Good quality 10.5 to 11.0 ME Wastage 20 per cent or less	Short term feed deficit under 10 days. supplement feeding stopped expecting target cover to be met.
8.0 to 12.0	Residuals less than 6 clicks (1350 kg DM/ha) if supplement not fed. When supplement fed 6 to 7 clicks (1350-1500 kg DM/ha); more than 300 kg DM/ha below target	Good quality greater than 10.5 ME, Low wastage 15% or less (feeding maize or PKE in bins/on feed pad)	Cows grazing to less than 6 clicks for more than 10 days, supplement feeding stopped. Responses increase of severe under-feeding (8.0g/ME response at least two weeks, response of 10g/ME 4 weeks)

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Financial pressures on the farming business and the human dimension

Neels Botha and Nico Mouton

Current on-farm financial pressures are beginning to create pressure on the family and people dynamics of farming operations.

The recent Reserve Bank of New Zealand stability report notes –

> 'Leverage in New Zealand's agricultural sector remains high following rapid growth in borrowing in recent years as commodity prices increased sharply, pushing up rural land prices. Bank lending to the sector more than doubled in dollar value between 2003 and 2008, and continues to grow more strongly than lending to other parts of the economy although growth rates have eased in recent months.
> Loans to agriculture currently account for 15 per cent of total bank lending in New Zealand, up from around 10 per cent earlier this decade. Rising agricultural debt has been accompanied by a trend increase in farmers debt-to-earnings and debt-servicing ratios. As noted in the May 2008 Report, the distribution of agricultural debt is highly skewed across the sector, with indebtedness generally greatest among dairy farms especially new entrants to the industry and farms that have expanded through leveraged land purchases in recent years.'

A large portion – 61.5 per cent – of the $43.5 billion rural debt is attributed to the dairy sector. With the current financial changes due to the credit crunch, some agricultural businesses are finding themselves under financial pressure. Lending institutions have used a series of financial parameters based on the funds that have been extended to farming businesses. Although these have not changed, in the previous four years the lending was much more free than is now the case and will likely be in future seasons. Sound financial management of a farming business is essential for its success and especially in the current environment.

Farm businesses now need to have a clear focus on financial management which is showing up weaknesses in some farm businesses and their systems. Lending institutions will be demanding more detailed financial record keeping and it will be the responsibility of farm operators to provide more detailed and clear financial positions rather than the annual financial accounts.

The human element

As financial pressure increases on individual farm businesses, the added dimensions of human reactions to financial pressure are beginning to show. All professionals dealing with farming businesses need to be clear about the handling of businesses under financial pressure and recognise the human factors.

Most farming operations have various advisors attached to them, such as their accountant, farm advisory services, friends and relations. However a farming business will not ask for help in all cases, or may not understand the position the business is in.

Some operators understand their position very clearly. They actively deal with the financial pressure when overdrafts and lending positions are outside the desirable parameters and have a plan to change. However there are also groups of operators who will be in denial and the lender will be frustrated by their behaviour in avoiding the issue and how to remedy the position. It is important that professionals working with farmers need to understand the process of dealing with people under pressure, and some guidelines are set out below.

Making changes

Pressure can come from many sources, such as finances, drought, a flood or severe storm or a pending divorce. This article is concerned more with financial pressure, but other pressures will have similar effects.

The current financial situation has forced many farmers to make changes. No two farmers are identical, but some have to make quite drastic changes quite quickly. Many are unsure of what to do and this increases the pressure and stress – the wear and tear of everyday life. This wear and tear takes its toll.

Many farmers need support to deal with and develop appropriate strategies to cope with the pressure. These strategies will be different for different people and range from dealing effectively with banks, making required farming system changes as well as dealing with staff, personal and family issues. This is not easy and the symptoms at a national level are clear – the pressure is becoming too high for some farmers, their families and workers.

Most professionals who work with farmers probably realise that counselling is a specialist field. Therefore when they are working with farmers who are under pressure, they should provide support but stay away from counselling unless they have had relevant training and or counselling experience. A good strategy is to suggest to affected individuals to get professional support and offer to link them to someone who can provide that.

Signs of stress

It is important to understand what happens to a person who comes under pressure and experiences stress. A very useful framework to help us understand this is the so-called Kubler-Ross grief cycle. It identifies the human emotional response to stress in a cycle that includes denial, anger, bargaining, depression and acceptance.

The ability to identify if and when someone is actually going through this cycle and which phase they are in, is important to help the farmer, and can ultimately strengthen the farmer-professional relationship. Most farmers who currently experience serious or even mild financial pressure will have emotional reactions simply because that is the way we are wired to respond. All of us have fight-or-flight responses. All human

have emotions, that woolly fuzzy stuff that may make some people feel uncomfortable, but is really important. Dealing with this becomes critical when pressure levels increase.

Not everyone goes through every stage of the so-called grief cycle. Some may get stuck in one particular stage, while others may pass through a stage so fast that they do not even notice it. There is no time limit for any of the stages.

Denial

The first stage is characterised by shock and denial. This is usually an initial response along the lines of – Things are going fine... this can't be happening to me. This stage is usually accompanied by initial shock at hearing the bad news.

A professional may be the bearer of the bad tidings. For example, when the outcome of financial analysis shows that the client is in serious trouble. Inaction then is not an option and serious and unavoidable action needs to be taken quickly. The farmer may not be ready to deal with the problem because of the state of shock, often accompanied by denial.

There are many coping strategies, but the professional should know that various forms of coping can be quite dysfunctional and contrary to behaviours the farmer should be exhibiting, such as excessive drinking or taking drugs. They also may become aggressive and unpredictable. People choose one or more of a range of coping strategies simply to deal with the situation, not to solve the problem

If in dealing with the problem you get wound up you should stop, get out and use any excuse to go somewhere and calm down. When a person is under pressure and severe stress, they tend not to be able to think straight and can be manipulated. Therefore if you provide a link to emotional support that you cannot offer, make a referral to someone who is a professional and will not take advantage of the situation.

Anger

When denial cannot continue, anger usually sets in. This often occurs in an explosion of emotion where bottled-up feelings are expelled in an outpouring of grief. You may want to stay out of the way at this stage, because whoever is in the way is likely to be blamed. Depending on the situation on a particular farm this could include farm staff, the farm manager, contractors, advisors or a partner who is responsible for administration and financial bookkeeping.

The question – Why me? may be repeated in an endless loop. Part of this anger is – Why not you? This fuels further anger at those who are not affected, or perhaps less seriously so. This may be also be characterised by questions and statements about it being not fair and how they were encouraged to take on more debt. The angry person may be angry with themselves for missing important signs or ignoring them and putting off that visit to the accountant, bank or professional.

The family

Family and staff and may also be angry at the person for what is happening or about to happen. Remember that when angry, most individuals can neither change their feelings nor those of others. But they need to know about this stage as it will help them to keep things in perspective and understand why hurtful comments may be made.

The anger and that of the family need not be logical or valid. So do not try to reason with them. This stage is a necessary part of grieving and once through it they will be ready to move on to do what must be done.

When a professional has to deal with clients who are angry, the best thing to do is give them space. But where anger becomes destructive it must be addressed directly. If the professional cannot avoid being with the angry individual, gently remind them of appropriate and inappropriate behaviour. Try to redirect their anger towards problem areas and ways to move forward. Do not get sucked into an argument because it may push them back into denial or cause later problems. Support them while they are angry and accept it, even let them be angry at you. The more the storm blows, the sooner it will blow itself out.

Bargaining

After the storm of anger, the next stage is about seeking ways to avoid the bad thing about to happen. It is a desperate round of bargaining, when people seek hope that the bad news is reversible. They hope they can postpone or delay the inevitable. They may even ask for a bit more time being allowed more time to finish. Staff may offer to work for less money or offer to do alternative work.

The individual may use things like loyalties, debts and dependants to bargain. They may bargain with the bank, you as the professional, their family, staff and others. 'If I promise to work harder can you find a way to help me?' Once individuals realise that nothing is going to change the facts, and the inevitable will happen, they are ready to move into the next stage.

When a person is bargaining, never offer any false hope. Sometimes there are things the professional can offer, such as support for change or new opportunities. Sometimes the best you can do at this stage is to point even more at the inevitable, even though this may well tip them into depression.

Inevitability

After denial, anger and bargaining, the inevitability of the news eventually sinks in and the person reluctantly accepts what is going to happen. After the active and more visible energetic phases of anger and bargaining, they almost crash into despondence.

In serious cases the depression can be deep, and then they see only a terrible end with nothing beyond it. They now turn towards themselves and in doing so turn away from any solution and any help that others can give them. A number of passive behaviours may be seen, like absenteeism from work, long lunch breaks, mediocre work performance and poor decision making.

But it could also be that the person is tearful, or may have gloomy episodes, where their main concern is focused on their own world. They may want to stay in bed all day, find it hard to function in social situations or find it difficult to complete normal day-to-day tasks. They may experience a detached feeling, and feelings of sadness, regret, fear and uncertainty are normal and common in this stage. It shows that the person has begun to accept the reality. Some people may not experience the depression stage, or it may pass in a few short hours.

They will fare better if they have good support, and are able to talk about it. People who are depressed feel very much alone and your company, even though it may not seem that way, is likely to be welcome.

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Keep moving

The second thing to do is to try to keep them moving on to the next stage. It is easy to get stuck in depression, and the longer they stay there, the deeper they are likely to slide. If it is possible, the professional should try to keep up a steady stream of support, for example by telephoning them. Show them that there is light ahead and encourage them to reach towards it. In the workplace in towns and cities, provision of professional coaching, counselling and other support can do a lot to help people recognise their depression and find a way to clamber out of the pit. This may not be possible on all farms, but there is a rural support network into which you may link the person for help.

Even in the pit of depressive despair, reality eventually starts to bite and the person realises that they cannot stay in that deep, dark hole for ever. They start looking for realistic things that they can do. When they reach out towards the road to acceptance, they are at last on their way out of the swamp.

Acceptance

They then move into the last stage – acceptance. They understand that it is going to be okay – 'I can't fight it, and so I may as well prepare for it.' It is important that they have as much control as possible as it gives them a lifeline of stability on which to pull themselves forward. Farm staff who have lost their jobs will be actively seeking new work, while farmers, if the situation is beyond repair, will be tidying up and getting ready to move on.

Acceptance is visible by people taking ownership both for themselves and their actions. They start to do things and take note of the results, and then changing their actions in response. They will appear increasingly happy and more content as they find their way forward. Finally they have reached the stage where they can plan with a clear mind. There may be regret, for what might have been, and for some their life will never be the same, nor will that of their families. But once they have reached acceptance they are in a position to move on and even help their families and others to acceptance too.

Some people may revisit some of the above stages more than once during the grieving process. When something new and challenging happens, or when things do not go as well as they expected, they can regress to an earlier stage as they process the changes. As the professional who took part in supporting a person when they went through the different phases, it will be good to congratulate them on getting through the change, and celebrate the completion of their transition.

Neels Botha is a science leader, Social Research Team for Agresearch and Nico Mouton is an agricultural consultant for Agfirst Waikato

Support during tough times

There are now Rural Support Trusts co-ordinated by MAF set up throughout New Zealand. MAF's interest was to have a network of locals able to help following a natural disaster, but many provide a vital source of totally confidential help for rural people in need for a variety of reasons.

The Waikato/Hauraki/Coromandel Rural Support Trust has taken many calls for help and the reasons are many and varied. They have come from farm staff, owners, sharemilkers and a few lifestyle blocks. Whether the problem is finance, feed shortages, stress of calving time, relationship worries or labour issues, the Rural Support Trust is a good place to start when looking for help.

Last year, there were many calls as a result of the drought, with farmers experiencing difficulties trying to source feed, and animal welfare being the major issues. Currently the dairy industry is facing challenging times. A lower forecast payout, tight cash flows and low pasture covers as a result of the previous season's droughts, along with continued increases in costs, mean many farm businesses are under significant financial pressure.

Like his 12 colleagues at the Rural Support Trust, chairman Neil Bateup has a rural background, and is trained to work alongside people experiencing difficulties, connecting them with a specialist if necessary. He says that if you can sit down and come up with a plan of how to deal with things, it relieves a huge amount of stress. People under stress often cannot make a decision, they just need someone to sit down and talk through things.

With professionals to call on ranging from farm advisors, WINZ and Victim Support, through to the Department of Labour and psychologists, there is a wealth of experience and expertise available to solve most problems unless things have been left too late.

Analysing risk in a farm business plan

William Brown and Marv Painter

This article deals with the problem of assessing the risks involved in a business plan. Business plans are popular for summarising and assessing the potential performance of a new or existing business. They present a plan for the business's operations, human resources, marketing and financial performance. The financial performance in particular can be difficult to assess.

Many think the financial plan should be very precise and try to predict what will happen financially in the future. This is next to impossible to accomplish. A more realistic approach is to plan for the future using reasonable estimates of what is most likely going to happen.

Once this reasonable financial plan has been completed, the task moves to the search and control of the risks associated with the business. The two main sources of risk are first, the risks stemming from the inherent nature of the business and the industry it is in and second, how and to what extent the business is financed by debt capital. The next step requires searching for and discovering what the few critical variables are in a business plan, their effect on the financial performance of the business, how they can be controlled and if uncontrollable, developing contingency plans.

What is a business plan?

A business plan is a document that outlines how a set of business goals are to be achieved. Typically the components of a business plan are the operations plan, the human resources plan, the marketing plan and the financial plan.

Operations

The operations plan provides a detailed description of the operations of the business. It describes the organisational structure and shows the site plan, including field maps, and any building and floor plans that the business may need. The operations plan also explains any technical processes and procedures, the work plan and flow of work used by the business.

A major part of the operations plan is the capital budget which lists the capital cost of all land, buildings, machinery and equipment that the business plans to purchase over the planning period. An estimate of the working capital which includes cash requirements, inventory, accounts receivable and accounts payable is also required.

Finally, the operations plan should also be the place for the initial estimation of cost of goods sold, and administration, marketing and general expenses for each year in the planning horizon. The bottom line is that the operations plan must provide the reader with a reasonably good understanding of how the business produces products, procures inputs and delivers the products and services to the customer.

Human resources and marketing

The human resources plan provides a detailed description of the human resource requirements of the business, including the total wage and salary costs as well as benefits. The bottom line is that the human resources plan must provide the reader with a clear idea of the human resources required and how those resources will be managed.

The marketing plan consists of two parts – a market analysis and a marketing strategy. The market analysis describes past performance, the market, the competition, the customers, the target markets, the match between the products and services, and the needs of the customers. The marketing strategy section includes clearly stated sales and profit objectives, and descriptions of the pricing policy, the target markets selected, the distribution strategy, the selling and advertising programme, and the marketing plan budget. The bottom line is the marketing plan clearly analyzes the market for the products/services provided and sets forth a marketing strategy.

Finance

The financial plan includes up to 10-year projections of net income and retained earnings statements, balance sheets, and cash flow statements. The financial projections are based on an economic forecast of expected inflation, interest rates for lending and borrowing, growth rates in sales, and growth rates in inputs and expenses. The financing budget determines the mix of short term debt, long term debt and equity financing needed by the business.

The overall financial performance of the business should also be assessed using net present value (NPV), internal rate of return (IRR) and external rate of return (ERR) calculations. The NPV uses a required rate of return on equity to calculate the present value of cash flows to equity for the planning horizon. The IRR represents the expected rate of return on the equity investment from the cash flows to equity over the planning period. The ERR represents the expected rate of return to the equity investors from the dividends paid to them over the planning period based on their original equity investment.

The bottom line is that the financial plan must demonstrate financial feasibility and clearly illustrate future expectations of income and cash flow. This should be based on the operations, human resources and marketing plans, as well as expected economic and financial variables.

Analysing the risks

Almost all variables in a business plan will fluctuate. Too much concentration on these fluctuations often stymies decision making. On the other extreme a wise person once said 'Those that don't know the risks involved are usually the most willing to take the chances'. So, how much analysis of the risks is appropriate to allow business planners to make decisions without analysing so much information that they are totally confused?

Conventional risk analysis begins by studying the probability of certain events occurring and measuring the resulting effect of these events on business profits. So conventional risk analysis needs some form of probability estimation. Historical data is often used for this purpose. Data on prices, consumer preferences, demand, supply, business cycles and weather can all be analysed to produce historically based probabilities and correlation coefficients. This results in probability distributions based on the past of certain events occurring in the future.

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Repetition

In order for these probabilities to be accurate for the future, history has to repeat itself precisely as it had occurred in the past. History has often repeated itself but not usually exactly as in the past. Often the temptation is there to adjust these historically based probabilities to better reflect what may happen in the future. This enters into the realm of subjective probabilities that are really educated guesses about what will happen in the future. Unfortunately once these guesses are written down they tend to be regarded as facts. Multiple guesses result in a myriad of statistical information that calculates the effects of these events occurring on business profits. This information includes means, standard deviations, coefficients of variation and correlation coefficients all in the name of helping the decision maker. In fact most of this information confuses and may hinder rather than help. The business planner then has to choose from a range of actions that could have different effects on business profits.

Of course if the probabilities or guesses are changed then different effects on business profits occur. The bottom line is the business planner either has little confidence in the results and is completely confused by the analysis. Either way, the analysis of the risks in this manner is of little benefit to practicing business planners.

Business and financial risk

A more realistic and beneficial way of analysing the risks in a business plan is to know and understand the two main sources of risk, that is business and financial risk. Business risk is the inherent risk in the business and depends on the nature of the industry in which the business is involved. Business risk deals with capital requirements, sales volumes and fluctuations, prices and the degree to which the business has control over prices, labour costs and availability, and a myriad of other industry-related variables.

Financial risk stems from how the business is financed and the effects of debt financing on potential profits. Financial leverage is the measure of the amount of debt capital relative to the amount of equity capital in the business and the resulting effect it has on the financial performance and financial risks faced by the business.

Financial risks and leverage

Often business planners do not realise how big a contributor financial leverage is to the risks faced by a business. The business plan should therefore reflect the true rate of return of the business, which is the IRR resulting from a business plan using only equity capital and no debt capital. The level of this true IRR is the rate of return the assets are generating without the leveraging effect of debt capital.

If the true IRR is less than the cost of debt, the resulting IRR when debt capital is borrowed will be lower than the true IRR and continue to drop when more debt capital is borrowed. If the true IRR is greater than the cost of debt, the resulting IRR when debt capital is borrowed will be higher than the true IRR and continue to rise when more debt capital is borrowed. Both of these results add financial risks to the business.

The dropping IRR with more debt capital is obviously detrimental to the business. However, the rising IRR can also be detrimental if planners forget that the increased returns are a result of financial leverage and not the inherent strength of the business. The business has the added risks of interest rate changes, changing terms of repayment, prepayment penalties, changes in service charges and other borrowing related risks. In addition the added financial risk of borrowing more debt capital magnifies the effects of the inherent business risks.

Business risks and critical variables

Analysing the inherent business risks in a business begins with searching for the critical variables. These come in at least two tiers. The first tier consists of parts of the business that have a relatively high probability of changing a significant amount. And if they do, the business will be severely affected.

Tier one

Planners usually know which variables are tier one critical variables and what needs to be done if the business is to be a success. Examples of common tier one critical variables are units of sales, growth in sales and prices for products in start-up businesses along with labour availability in certain other businesses. Managing tier one critical variables may mean trying to secure production and price contracts or making sure adequate labour is going to be available at all times. Not all businesses have tier one critical variables, but if they do they should be controlled as much as possible.

Tier two

Tier two critical variables are factors in the business that, if they change by a relatively small amount, will greatly change the financial performance of the business either positively or negatively. Tier two critical variable may include tier one critical variables as well as others. The search for tier two critical variables involves selecting an individual variable in the financial model and changing it slightly to see its effect on the financial performance of the business.

Examples of common tier two critical variables are –

- Units of sales
- Growth in units of sales
- Selling prices
- Unit labour costs
- Availability of skilled human resources
- Supply and cost of direct material inputs
- Amount of equity financing available.

There are usually only between one and six tier two critical variables in most businesses. Recognising tier two critical variables is a simple way of helping decision makers concentrate on the areas of the business that have the biggest financial effect.

Worst and best

An analysis of which are the worst and best case scenarios is the next step. All or most of the tier two critical variables move in a pessimistic direction for the worst case and in an optimistic direction in the best case. Both the worst case and best case scenarios should be realistic. These give a feel for how bad or how good things could be for the business if all the tier two critical variables move in the same direction at once.

The next part involves break-even levels on a cash flow, net income and economic basis which should be calculated for the most important tier two critical variable. The cash flow break-even indicates how poorly things could go before the business runs out of cash. Net income break even indicates how poorly

things could go before the business cannot make an accounting profit. The economic break-even sets the NPV to zero at the required rate of return and so indicates how poorly things could go before the required rate of return on equity investment is just met. The results are best displayed in tables or charts.

The final step in the risk analysis process is to formulate contingency plans. These plans come into effect when something happens that is out of the control of the business planner. These will counter adverse effects and take advantage of positive ones. Business planners cannot make contingency plans for every possible thing that could happen that is out of their control. However, developing plans for when the tier two critical variables move in adverse directions is possible.

The bottom line is that the risk analysis is meant to provide business planners with a much better feel for the risk level. In other words what the chances are that the business will be a success.

Risk analysis example

The example used here is a 1,417 hectare mixed farm in the dark brown soil zone of Saskatchewan, Canada. The farm has 1,214 hectares cultivated and sells wheat, canola, lentils and feed barley. It also has a 200 cow herd and sells weaned calves.

Financial risks

The base run of the financial model for the farm produced an IRR of 9.5 per cent using a mixture of debt and equity capital and assuming no inflation on asset values. The value of the farm assets including land, buildings, and machinery is CAD$2,900,000(Canadian dollars) and there is a CAD$500,000 long term debt outstanding. Therefore the farm as it is currently operated is quite profitable business and could use debt capital to its advantage.

The IRR rises to 12 per cent when an additional CAD$1,000,000 is borrowed at six per cent. The IRR rises to 14.6 per cent when CAD$1,500,000 is borrowed at six per cent. These increases in the IRR are caused by financial leverage and increase the financial risks faced by the business. In fact the IRR increases even faster as more debt is borrowed. Highly leveraged businesses can go bankrupt quickly if any one of a number of variables change, such as sales volumes, prices, direct material costs, or a number of borrowing risks including interest rate changes, changing terms of repayment, prepayment penalties or changes in service charges.

Business risks and critical variables

Sales volume and yields, is most likely to be a tier one critical variable for the mixed farm. Farm businesses, like the mixed farm, spread their risk of poor yields by having several different cropping enterprises and buying crop insurance. The addition of the cattle enterprise also helps to spread production risks.

Prices could also be a tier one critical variable in this case and again the risk of market fluctuations has been spread between

Tier two critical variables mixed farm

Variable	Base case NPV = $1,014,148	NPV = $0	Percentage change	Critical Ranking
Wheat sales tonnes	1200	2345	95%	**3**
Canola sales tonnes	465	1238	166%	
Lentils sales tonnes	375	937	150%	
Barley sales tonnes	770	2488	223%	
Calf sales head	180	908	404%	
Cull sales head	20	638	3090%	
All sales tonnes			**33%**	**1**
Wheat price dollars per tonne	$270	$527	95%	**3**
Canola rice dollars per tonne	$400	$1,065	166%	
Lentils rice dollars per tonne	$550	$1,375	150%	
Barley price dollars per tonne	$180	$582	223%	
Calf price dollars per head	$425	$2,140	404%	
Cull price dollars per head	$500	$15,950	3090%	
Average prices (dollars per tonne)			**33%**	**1**
Direct costs	$547,964	$118,039	-78%	**2**
Hired labour wage dollars per hour	$16.65	$(117.71)	-807%	
Management salary dollars per year	$45,000	$(281,763)	-726%	
Initial capital purchases	$2,900,000	$(13,184,889)	-210%	
Finished goods inventory days	50	(2,997)	-6094%	
Interest rate on long term debt	6%	-196%	-3373%	

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several crop enterprises and a livestock enterprise. In addition, the wheat and feed barley are marketed through the Canadian Wheat Board and prices are pooled amongst all the farmers who send their wheat to the Canadian Wheat Board. Finally, forward pricing contracts are also available for the canola, lentils and calves.

The next step is to examine the business for tier two critical variables. These variables are calculated by measuring the effect of changes in the variable in question on the NPV of the business, given a required rate of return of 20 per cent. If a small change in the variable results in an NPV of zero, then the variable is critical. If a large change in the variable is required to get the NPV to equal zero, then the variable is not critical.

As can be seen in the table on the previous page, the mixed farm has three tier two critical variables. Total sales and average prices are the most critical as they have to drop by about 33 per cent before NPV is equal to zero. By this stage, management should already have done something to control the level of sales and prices as they are tier one critical variables.

The direct cost for fertiliser, chemicals and fuel is the second most critical tier two variable as they have to rise 78 per cent before NPV is equal to zero. Finally the quantity of sales and price of wheat is the third tier two critical variable as they have to drop by 95 per cent before NPV is equal to zero. All the other variables tested are less critical than these three. The cut-off point between a critical and non-critical variable is somewhat arbitrary and will change from business-to-business.

Best case and worst case

The next table presents the results of a best case and worst case analysis for the organic mill. In this case the first and second ranked tier two critical variables – average sales, average prices, and direct costs – are all changed at once, a 10 per cent adverse change for the worst case and a 10 per cent beneficial change for the best case.

The results indicate that a 10 per cent adverse change in the first and second ranked tier two critical variables at once results in an IRR of 2.9 per cent. This is much lower than the base case of 9.5 per cent and the required rate of return of 20 per cent, but is still positive. A 10 per cent beneficial change in the first and second ranked tier two variables results in an IRR of 14.5 per cent. The results of the scenario analysis indicate the mixed farm can withstand a reasonable amount of fluctuation in the first and second ranked tier two critical variables.

Break even analysis

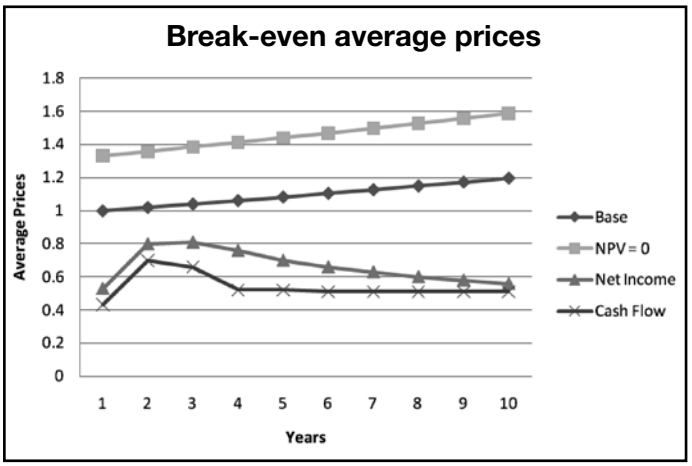
The graph presents the results of a break-even analysis using average prices as the tier two critical variable. Using average sales would result in a very similarly shaped chart. The four represent the base run, the economic break-even, the net income break even and the cash flow break-even. The base run represents the prices used inflating at two per cent a year.

The economic break-even is the price level needed throughout the 10 year planning horizon to get the NPV to equal zero with a required rate of return of 20 per cent and inflation still at two per cent. The economic break-even analysis is used to determine whether the business is likely to proceed at all. Can the business return enough to investors to make it worthwhile?

The net income break-even analysis is most critical for long-term viability and is the level of the critical variable that keeps the net income generated each year at zero. As can be seen it rises in the first couple of years and then falls, eventually coming very close to the cash flow break-even at the end of the planning horizon.

The final step is to make contingency plans for the most important critical variables. In this example, as in most mixed farms, the financial success hinges on prices, yields and direct costs. The farm is well diversified and can handle substantial negative change in any one enterprise. However, crop insurance and forward contracting of prices and costs should be seriously considered for at least some of the enterprises and costs.

Break-even analysis for an organic mill



Conclusions

Business planners have to make risky decisions all the time. It is important for them to do this in an organised and realistic way. The calculation of probability distributions, correlation coefficients and coefficients of variation on a number of variables, some of which are not critical to the financial performance

Continued on page 22

Scenario analysis for an organic mill

	Scenario analysis plus or minus 10%		
Critical variables	Worse Case	Base case	Best case
All crop sales tonnes	-10%	0	10%
Average crop prices dollars per tonne	-10%	0	10%
Direct costs	$ 471,064	$428,240	$ 385,416
NPV	$(1,567,383)	$(1,039,862)	$ (540,934)
IRR	2.9%	9.5%	14.5%

International Farm Management Association Congress, Illinois July 2009

Phil Everest

A strong contingent of New Zealanders attended the congress in Bloomington Illinois. The theme was food, fibre and energy for the future and we were not disappointed on either the programme or field day content.

Bloomington is approximately half way between Chicago and St Louis, right in the corn and soya production zone. The two cities Bloomington and Nomad are merged together with a combined population of around 160,000. The towns are the home of Illinois State University, where the conference was held. The full papers from the conference will be on the IFMA17 web site or from the link through the NZIPIM site. Two early sessions – 'The world in perspective' presented by Dr Robert Thompson and 'Toward world food security' presented by Gregory Traxler gave a good overview.

Some key points

The United States population is around 300 million. Of these two million are farmers with 85 per cent of the production coming from 15 per cent of the farmers.

Currently around half of the world's population live in cities and it is anticipated this could rise to 70 per cent by 2050. This will have the effect of moving food to cities away from backyard production. With the world population expected to increase from 6.8 billion to 9.1 billion by 2050, we will need both improvements in productivity and a greater area of land in production.

Biofuels

The energy story was interesting. The United States produces 44 per cent of its electricity from coal, 25 per cent from oil and gas, 15 per cent from nuclear power as well as 10 per cent from wind and six per cent from other renewable sources. They are aiming for 20 per cent renewable energy production by 2025.

Denis Magyar, North American Dupont Biofuels, presented a paper 'A look at biofuel technology'. In 2010 the United States will have the capacity to produce 14.7 billion gallons of ethanol which is around eight per cent of the fuel used. Corn based ethanol production is capped at 15 billion gallons by the government to protect food production. It was claimed that biofuels could drop the greenhouse gas emissions by up to 80 per cent compared to oil.

Is ethanol production profitable? We visited an ethanol plant that was a farmer co-operative. This had resulted from a sale yard co-operative who owned land and stock yards but with no stock to sell. The plant is not large by national standards but digests 5,000 tonnes of corn a day. Since the farmers started their investment three years ago they have had 130 per cent of their capital back – not a bad return on $63 million. They sell ethanol, dried distilled grain and carbon dioxide for fizzy drinks.

Tadeuz Patzek from the University of Texas gave an enlightening address on fuels. Cellulose ethanol is a less efficient fuel than corn ethanol when used in an internal combustion engine. However, using and improving cellulose technology will contribute to the energy balance. Bio butanol is currently being considered as it has a higher energy release than ethanol.

What else did we learn?

One of our field trips was to the Pioneer plant breeding station. Apart from the Roundup ready corn and soya they are now developing Dicamba ready soya and Gramoxone ready soya. Plant breeding has really made progress. A seed line from the year 1944 produces only 144 bushels an acre or nine tones a hectare, and seed from a recent selection now produces 250 bushels an acre or over 15 tonnes a hectare. On top of this they have doubled water use efficiency over the last 25 years. Currently selections are for a drought tolerant strain due for release next year.

Irrespective of where you farm in the world, land values rose 20 per cent to 40 per cent over two years but have recently fallen up to 20 per cent, depending on proximity to cities. Product prices have also shown volatility. Soya in May 2008 sold for $1,310 cents a bushel, in May 2009 it was 1,070 cents, an 18 per cent reduction in a year. Corn showed a 25 per cent drop, hogs a 20 per cent drop and milk a 30 per cent reduction over the same period.

There were some final thoughts of wisdom from Dr Lowell Catlett, New Mexico State University. What is a luxury in one generation becomes a necessity in the next. Farm sales are not related to the best place to farm but rather the closest place to recreational activities.

Analying risk in a farm business plan – continued from 21

of the business, does not provide the business planners with the information needed. In fact, it often confuses and stymies decision making.

A more realistic and practical approach is to know and understand that risks that arise from both business and financial sources. Managers need to know the effect of financial leverage on their business. Second, they need to know the tier one and two critical variables arising from the inherent risks faced by the business. Once these critical variables are known, worst and best case scenarios can be examined, their breakeven levels can be calculated and contingency plans made.

A longer version of this paper was presented at the 17th IFMA Congress 'Agriculture: Food, Fiber and Energy for the Future' held recently in Illinois, USA.

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Comparisons between organic and conventional pastoral dairy farming systems

Nicola Shadbolt, Terry Kelly, David Horne, Kerry Harrington, Peter Kemp, Alan Palmer and Alan Thatcher

Organic milk production in New Zealand has expanded in recent years in response to increasing global demand for organic products. Most comparisons between organic and conventional dairying available in the literature are from Europe or North America where the conventional systems are more intensive than those in New Zealand.

This article is a shortened version of a paper presented at the recent IFMA17 conference that compared the cost of production and profitability of certified organic and conventional dairy farming over five years of a Massey University system comparison trial.

Introduction

The food industry has been evolving into an array of diverse markets with consumers increasingly demanding healthy, nutritional and convenient food products. Organics is one of these markets offering perceived benefits over undifferentiated commodity goods.

Before the more rapid expansion of the last decade, the motivation for adopting organic practices was farmer concern about risk to their health and the environment from current conventional practices. In the 1990s food scares and the subsequent reaction of policy-makers and consumers had a strong effect on organic farming development. With demand growing at a faster rate than supply higher prices were achievable. The price premium over conventionally produced foods was also necessary due to higher production and distribution costs.

Methodology

In 2001, Massey University set up its Dairy Cattle Research Unit (DCRU) as a whole system comparison between organic and conventional pastoral dairy farming. The organic farm is not a closed system and can import fertiliser and feed in the form of grazing and silage from other organic farms. The DCRU began its organic conversion period on 1 August 2001, at which time the unit was split into two similar farms, one conventionally managed and the other organically managed.

The aim was to begin with two units of similar size, soil composition, fertility and herd composition. On 1 August 2003, the organic farm achieved its full AgriQuality organic certification. Being a systems trial, both farms have been managed individually according to best practice and no attempt is made to do the same thing on one farm as is done on the other farm.

Interactions

The long-term aim of this research is to understand organic dairy farming systems by investigating component interactions in these systems, and by determining how effects and interactions change as organic systems mature. Extensive monitoring continues to be carried out on both farms, and an inter-disciplinary approach has enabled the spectrum of soils, water, pastures and forage, animal production and health, and economics to be recorded and analysed.

The costs of production and profitability of the two-year conversion period and the first year as a certified organic farm were reported in 2005. As well as detailed annual reports provided to the funding body DairyNZ, there has been a range of academic and industry publications on such topics as mastitis management, weeds, animal production and environmental effects. The trials had to be designed in such a way as to not jeopardise the organic status or credibility of the systems trial.

This article reports on the comparative economic performance of the organic and conventional units over the five years that the organic unit has been fully certified between March 2004 and July 2008. The farm was chosen because of its research capability, but its small size of only 41.6 hectares and 88 cows has meant careful interpretation of economic performance is required.

Scale effects

Average levels of production for this farm, at 410 kg milksolids per cow and 935 kg milksolids per hectare, were above industry averages for the region. This phenomenon is typical with experimental farms and therefore one must be cautious about making comparisons between them and large-scale commercial units. Scale effects must be specifically allowed for in any comparisons.

The small scale of the farms, and the fact that they are university farms, also introduced costs that were not comparable to commercial farms. In the early years of the trial, all costs were recorded and it soon became obvious that it was the fixed costs that distorted the results the most. The costs per cow, such as animal health, breeding and feed, and costs per hectare such as fertiliser, pasture, forage and weeds, were useful to compare between the two systems and commercial farms.

Once fixed costs were included, such as labour, repairs, maintenance, vehicle costs and administration, the results were less comparable. The decision was made to provide whole farm results from a combination of the actual per cow and per hectare results from each system, combined with industry averages for fixed costs. Industry averages were also used to calculate the market value of land each year.

The data from the five years since the organic unit achieved full certification were used to compare the two farm systems. The two systems were also compared with the MAF monitor farm for this region. The monitor farm data is based each year on recorded conventional farm data that expert opinion then uses to create a representative data set for a typical farm.

Results and discussion

Production and returns have been variable, particularly for the organic farm, so it is misleading to extrapolate from the results of any one year's data. During the first year of certification, which was a very good dairy season in the Manawatu, the organic system consistently grew slightly less pasture than did the conventional system. Consequently it produced less milk – 10 per cent less per cow and 12 per cent less per hectare. However the organic system out-performed the MAF farm by 28 per cent more per cow and 16 per cent more per hectare. Production differences continued in the next season 2004/05, which was characterised by a cool wet spring and early summer followed by a warm and dry late summer-autumn period, resulting in reduced pasture growth and milk production levels from the previous season.

The 2005/06 season began well with excellent early spring conditions, but began to deteriorate in October with more variable conditions. A prolonged summer dry spell meant an early dry-off in March for the organic herd, resulting in marked differences in production between the two herds.

The 2006/07 season began badly with a cold wet winter and spring, but settled in to a good late summer/autumn so lactation lengths were an improvement on the previous season. Relative to the previous season, milk production was up for the organic herd and similar for the conventional herd.

In 2007/08 the climatic challenge was, once again, a dry summer that extended into autumn to produce extreme drought conditions throughout the region. This was the only season the conventional system did not out-perform the MAF farm per hectare. The organic system produced less per hectare than the MAF farm every year from 2004/05.

Learning curve

The inter-disciplinary team was on a steep learning curve during this time. They made a number of modifications to the organic system to enable it to better cope with the climatic variation without the usual props used by conventional farming. Purchasing in feed and grazing stock off-farm in times of low pasture growth were agreed strategies for the system as the aim was to maintain cows in milk as long as possible each season.

However the reality was that both organic feed and grazing were very difficult and expensive to source. By comparison, the conventional system could use nitrogen to boost pasture growth or purchase a range of feed supplements to fill any shortage. The modifications included delaying the start of calving in the spring by two weeks and reducing stocking rate. The aim was to run a stocking rate 10 per cent lower, but the reduction on average has only been three per cent. Most important was the need to confirm a source of feed for grazing young stock and dry cows and for grass silage and hay.

On the recommendation of an organic advisory group involved in the project, the farm doubled the area of its run-off, the land dedicated to supporting the dairy platform. All feed transferred from the run-off to the milking platform as silage, hay or as grazing, was charged a commercial rate per kilogram of dry matter to ensure the system was fully costed.

Value

Throughout this research we used the same MAF value per hectare for land and buildings each year for the two systems when calculating the return on assets. There are insufficient sales of organic land to determine whether it sells at the same value as conventionally farmed land or not.

Organic-conventional comparative systems data and MAF monitor farm data 2003/04-2007/08

	2003/04			2004/05			2005/06			2006/07			2007/08		
	Conv	**Org**	**MAF**	**Conv**	**Org**	**MAF**	**Conv**	**Org**	**MAF**	**Conv**	**Org**	**MAF**	**Conv**	**Org**	**MAF**
Cows milked	51	**46**	230	48	**43**	236	51	**45**	265	53	**47**	280	51	**47**	360
Area effective hectares	21.73	**19.92**	90	21.73	**20.14**	90	21.73	**20.14**	100	21.73	**20.14**	105	21.73	**20.14**	130
Stocking rate	2.4	**2.3**	2.6	2.2	**2.1**	2.6	2.4	**2.2**	2.6	2.4	**2.3**	2.7	2.4	**2.3**	2.8
Production kg milk solids per cow	457	**410**	320	401	**345**	320	406	**295**	336	392	**332**	336	360	**317**	315
Production kg milk solids per hectare	1073	**947**	817	885	**737**	840	953	**660**	890	956	**776**	895	846	**739**	873
Feed costs dollars per cow	206	**230**	194	432	**532**	205	353	**368**	221	344	**347**	252	435	**555**	369
Cost of milk dollars per kg milk solids	3.24	**3.66**	4.28	4.59	**5.70**	4.41	4.60	**6.24**	4.50	4.95	**5.94**	4.66	4.44	**5.60**	5.63
Operating profit dollars per hectare	1742	**1594**	656	456	**166**	637	667	**200**	788	350	**325**	654	3771	**3674**	2852
Return on assets	5.6%	**5.3%**	2.2%	1.5%	**0.6%**	2.1%	1.9%	**0.6%**	2.3%	0.9%	**0.9%**	1.8%	9.2%	**9.1%**	6.7%

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However if we were to value the land based on its production, as is common in New Zealand, then the asset value would be less. As a result the return on assets would be higher than that achieved by the conventional farm but the value of the land and buildings would have dropped by 18 per cent.

While the need to have fewer cooperative shares is justified as they are based on production level, not type of milk produced, it is debatable whether the value of organic land is less than conventional. Not only is the land producing milk of higher value but the potential of the land to produce at the higher levels under conventional farming is still there.

Over the five years, the average production per cow of the MAF farm is less than both trial systems – four per cent less than the organic and 19 per cent less than the conventional, as shown in the table. However the MAF farm production per hectare is 11 per cent higher than the organic system and eight per cent less than the conventional system. This comparison against the cluster of conventional farms gave a smaller difference between organic and conventional than the 18 per cent recorded between the two Massey systems.

Similarly the ARGOS farms' comparison over the first four of this five year period noted 23 per cent more milk per hectare from their conventional farms than their 'in conversion' organic farms. However the ARGOS farms began with an 11 per cent difference that progressively increased to a 29 per cent difference over four years, while the Massey systems in the same four years began with a 12 per cent difference that increased to a 19 per cent difference and then, in the fifth year, dropped back to 13 per cent.

Net livestock income is higher than the monitor farm in both trial systems. This is most likely due to the greater attention individual cows receive on these smaller units, a fact borne out by the higher amount spent on animal health in both units compared to the monitor farm.

The average gross farm income of both the organic and the conventional system exceeds the monitor farm average by five per cent and six per cent respectively. The organic system averaged 18 per cent better milk price as price premiums increased from 10 per cent in the first year to 16 per cent in the second and then 20 per cent from 2005/06.

However operating expenses on both units also exceed the MAF farm. They have been eight per cent higher in the organic system and three per cent higher in the conventional system. Animal health and feed costs are higher on both. The difference between the two research systems shows both animal health and weed and pest costs being lower on the organic unit, but feed and fertiliser being consistently higher.

Now that the run-off area for the organic system has been doubled, it is hoped that feed costs will be less variable, with limited spot market purchasing when organic feed is difficult to source and costly to purchase. Fertiliser costs have been consistently higher in the organic farmlet. It is hoped that current trials on various products will enable us to manage that cost down.

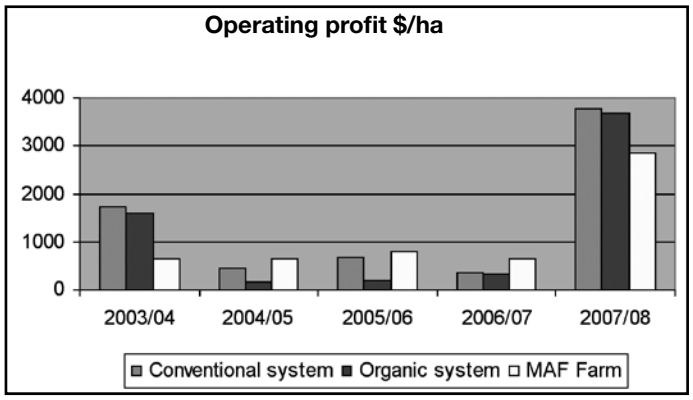
The difference in average returns from five years of data between the organic and conventional units and the MAF monitor farm 2003/04 to 2007/08)

	Organic unit versus conventional unit	Organic Unit versus MAF monitor farm	Conventional unit versus MAF monitor farm
Kg milksolids per cow	-16%	+4%	+19%
Kg milksolids per hectare	-18%	-11%	+8%
Milk price dollars per kg milksolids	+18%	+18%	0%
Milk income dollars per hectare	-3%	-0.1%	+3%
Net stock income dollars per hectare	+19%	+61%	+26%
Gross farm income dollars per hectare	**-1%**	**+5%**	**+6%**
Animal health dollars per hectare	-26%	+16%	+36%
Feed and grazing dollars per hectare	+11%	+34%	+17%
Fertiliser dollars per hectare	+34%	+5%	-27%
Weed and pest dollars per hectare	-71%	-79%	-38%
Operating expenses	**+4%**	**+8%**	**+3%**
Operating profit dollars per hectare	**-15%**	**-3%**	**12%**

Operating profit

The average operating profit of the conventional unit was $1,397 per hectare, which was 12 per cent higher than the MAF farm. The difference in the averages for the MAF farm of $1,232 per hectare and the organic system at $1,192 per hectare, was small. However, as illustrated in the graph, the variation in returns was greater in the organic system. The lower variability in the MAF farm could also reflect the ability of commercial farms to respond more quickly to changing climatic and market conditions than is possible in a university managed trial.

Operating profit on the MAF farm and for the organic and conventional systems



The return on assets is calculated each year as operating profit over opening assets, and the assets are re-valued each year. The average return on assets over five years of both the organic system and the MAF farm was 3.5 per cent, with the conventional system achieving four per cent. The return on assets for the organic system was 12 per cent lower than for the conventional system.

Over the five years as an organic unit, the lower milk yield has meant that the cost per kg of milksolids has been 23 per cent greater on average on the organic system than its conventional counterpart. In comparison with the MAF farm, the costs per kg of milksolids are only 13 per cent greater.

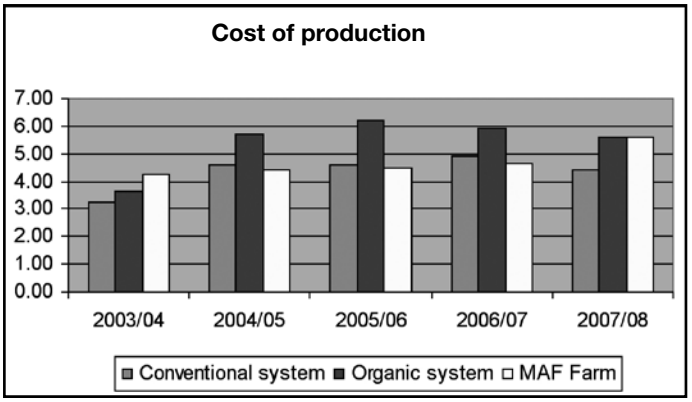
The conventional unit produces milk at a cost eight per cent less than the MAF farm. Again there is greater variability in costs in the organic system than in the MAF farm and the conventional system. However, improved management of feed costs by doubling of the run-off area for the organic system resulted in a decrease in the cost of production in 2007/08 despite extreme drought conditions.

Differences

In the ARGOS trial the difference in profitability is only available for the first two years. The difference between the paired farms was five per cent less for the converting organic farms in year one with 11 per cent less milk per hectare, and nine per cent less in year two with 23 per cent milk per hectare.

Published results from subsequent results are incomplete as only cash, the farm working expenses, was reported. The farm working expenses per kg of milksolids on the converting organic farms were three per cent and one per cent higher in 2005/06 and 2006/07 than their paired conventional farms. Farm working expenses were less by 25 per cent and 28 per cent respectively in those years but so also was milk production so the cash costs per kilogramme of milk produced increased.

Cost of production in dollars per kg milksolids on the MAF farm and for the organic and conventional systems



This trial has enabled us to make the comparison between half of the farm changing to organic production with the other half still being conventional. The conventional system was and still does perform above the MAF monitor farm; it is interesting to note that the organic system, whilst still in transition in some aspects, has delivered similar profitability to the MAF farm.

Conclusion

The effect of climatic variability on pasture production increases the vulnerability of organic systems that cannot use the props that are available to conventional systems. Significant modification to the organic system has taken place over the seven years since the trial began and the learning of the inter-disciplinary team has been considerable. The 23 per cent higher average cost of production recorded from this trial is consistent with other trials and is the result of 18 per cent lower production per hectare and higher feed and fertiliser costs.

The aim of the trial is to find ways to further modify the organic system so as to contain some of these costs. Until that is achieved the organic system lags behind the conventional system on profitability. Contrary results, which showed that organic dairy farms had slightly better returns than conventional farms, were obtained from countries with both price premiums and government support payments for organic farmers. In New Zealand organic farmers receive just the price premium for milk.

The method used to compare results is also important. If the method used for this trial had been that used by other published trials overseas, which was to compare the organic system with a cluster of conventional farms, the conclusion would have been that organic dairy farming has a higher cost of production but a similar profitability to conventional dairy farming. The more exact comparison used in this trial leads to a different conclusion and confirms the benefit of a long-term system comparison. The robustness of this approach also serves as a cautionary note for comparative studies using different methodology.

A full list of references used in the researching and writing of this article is available from the editor of Primary Industry Management *or directly from the author. A longer version of this paper was presented at the 17th IFMA Congress* 'Agriculture: Food, Fiber and Energy for the Future' *held recently in Illinois, USA.*

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Waste to wealth – biogas powering the pork industry

Elizabeth McGruddy

New Zealand Pork is exploring the feasibility of farm biogas systems to contribute to Green Circle pork production – crops to pigs, manure to crops, energy to power the farming infrastructure. Over the past two years, New Zealand Pork has researched the opportunity, convened a series of regional seminars, and commissioned a number of feasibility studies in collaboration with MAF and the Energy Efficiency and Conservation Authority.

The New Zealand pork industry comprises up to 250 commercial producers, supplying half the domestic market for pork products. Along with production of meat for domestic consumption, pig farms produce manure. The fertiliser values of pig manure are well-known and it is equally well-established internationally as a good substrate for biogas production.

Farm biogas systems

A significant proportion of the national pig herd is run outdoors or housed on deep-litter bedding which is less suited to biogas generation but makes excellent compost. Biogas offers an alternate treatment pathway for those producers using slurry or pond-based manure management systems.

A farm biogas system, in simple terms, provides for manure to be stored in an enclosed chamber for the digestion of organic material by anaerobic bacteria, either an in-ground covered pond or an above-ground enclosed tank. All that is needed is either manure or manure with other feed-stocks. Out of this you get biogas, which is approximately 70 per cent methane, and fertiliser in liquid and solid forms.

Remember car-less days

International interest in biogas spiked in the 1970s during the oil-shock period. Within New Zealand, a strong foundation for the sector was laid at that time with MAF and DSIR taking a lead role in research and development. A number of municipal biogas plants were established. Some of these, such as Bromley in Christchurch and Mangere, have now been operating for over 40 years. A wave of smaller-scale farm plants were set up, most of which ceased operation after a number of years.

New policy

Biogas is currently enjoying a resurgence of interest, principally as a result of the convergence of new environmental policy directives. The reasons behind this in New Zealand and internationally are –

- Providing manure storage for deferred irrigation reducing risks of nitrate leaching and nitrous oxide emissions
- Reducing methane emissions from open manure storage systems
- Diverting organic wastes away from landfills
- Developing renewable energy resources
- Improving security of energy supply including security of supply to rural areas.

For the New Zealand pork industry, the main reasons for using pork effluent for biogas is to –

- Reduce methane emissions
- Reduce on-farm energy costs which can be in excess of $100,000 a year
- Mitigate odour in storage and in spreading
- To add value to manure-based fertiliser products

Waste to wealth

In 2007, New Zealand Pork initiated a Sustainable Farming Fund project Waste to Wealth to research the opportunity for the industry. Under the auspices of that project New Zealand Pork –

- Reviewed international literature describing farm biogas systems across Europe, Britain, North America and Australia
- Identified critical factors facilitating or impeding uptake, and factors affecting the performance of farm biogas systems over the long-term
- Established contact with key players in the biogas sector and convened workshop presentations summarising the technology and the options at farm scale
- Organised field visits to a covered pond project being developed on a Waikato pig farm and a tank digester system under development on a dairy farm in Canterbury.

Main findings

Internationally, farm uptake of biogas systems has been strongest in Europe, but interest is accelerating in Britain, North America and Australasia. Pig manure is well-established as a substrate for biogas production, either in manure-only systems, or as base material in mixed feedstock systems. In Europe, biogas systems have developed in regions with high density livestock populations.

Capitalising on the opportunity in New Zealand requires attention to smaller, farm-scale systems and the development of primary sector clusters. European systems are mainly capital-intensive heated tank digesters. However there is a significant body of research under way in North America, Australia and New Zealand developing covered pond digester systems as a cost-effective alternative for temperate climates.

Critical success factors

The key parameters impacting on the establishment and operation of biogas facilities are common to all countries. In the 1970s, drivers for the adoption of biogas technology were the spiralling energy prices, supported in the US and Europe by significant government subsidies and guaranteed prices for the electricity produced. Many early plants subsequently closed and high costs and low returns are the reasons most frequently cited, together with –

- Inadequate design, for example in Germany only a few companies built more than one plant and only one built more than 10
- Designers and builders installed the wrong type of equipment
- Systems became too expensive to maintain and repair because of poor system design
- Farmers did not receive adequate training and technical support for their systems, with lack of operator training causing problems such as pipe blockages and equipment failure
- Lack of infrastructure for distribution and marketing.

In countries where farm-scale plants have successfully established, government investment has been a critical factor in supporting the viability of operations, principally by easing access to grid infrastructure. Currently Germany leads the way with farm-based plants and there are approximately 4,000 biogas units on farms with manure as the primary feedstock. Denmark leads the way with centralised anaerobic digestion facilities, with 20 of them sourcing manure from surrounding farms, supplemented with primary sector waste.

System options

In Europe, biogas plants have developed in regions where there is sufficient density of population to support activity and infrastructure linkages, as well as to minimise transportation and logistics. In the New Zealand context, options can be considered at three levels.

Independent farm systems

Independent farm systems will be appropriate, particularly where, as in New Zealand, most farms are relatively small and dispersed. A primary reason may be the opportunity to mitigate odour where this might be a problem. This would be supported by the opportunity to generate on-farm energy particularly where energy is a significant cost.

Covered ponds are likely to be the cheapest option, using manure as the feedstock. Manure is a relatively low-yielding feedstock, but the gas generated could substitute a significant

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proportion of on-farm energy use. The digested solids and liquid retain their nutrient values, but with reduced odour as most of the volatile organic compounds are digested. Key issues with farm systems are those relating to cost and maintenance. They need to be robust, low-cost construction with simple operation and maintenance.

Extended Farm Systems

Extended farm systems reach beyond the farm gate to bring in feedstock, such as other animal manures or food processing waste, and to export fertiliser and energy. This concept is very familiar to pork producers. The New Zealand pork industry is strongly integrated within mixed farming systems, with piggery operations most often managed as an intensive component within a broader pasture cropping system.

Larger farms may cycle manure and nutrients within the farm. Smaller operations commonly have long-standing relationships with their neighbours for spreading manure either using extended pipe irrigation systems or transported by truck. Beyond their immediate neighbours, New Zealand pork producers frequently have extended community networks for the supply of bedding materials, feed and for exporting solid fertilisers off farm. Biogas technology offers another layer of added value – heat and electricity – which may either be recycled on-farm, linked to neighbouring businesses or exported into the grid.

Centralised Facilities

Centralised facilities may be appropriate where there is a high density of intensive livestock production, but this is less common in New Zealand. Centralisation is also appropriate where a cluster of primary sector enterprises have a common interest in processing organic by-products such as manure. This is especially relevant where these can be matched with a local heat-seeking user such as greenhouses or swimming pools, and where a central facility can be located to minimise transportation of the liquid manure component.

Centralised facilities with mixed feedstocks will require more capital-intensive heated and stirred digester systems and higher levels of management. Key issues will include navigating planning and consent processes, in addition to those issues inherent in managing mixed feedstocks. Centralised facilities may be spun out as entities parallel to the main farming business, established as farmer co-operatives led by municipal authorities or utilities, or in a recent cases overseas, set up by corporate entrepreneurs capitalising on the new world of carbon trading.

Industry and government partnership

At the conclusion of the Sustainable Farming Fund 'Waste to Wealth' project a significant number of pork producers signalled their interest in undertaking more detailed assessments of the benefits, risks and financial viability of biogas installations. NZPork is now working in collaboration with MAF and EECA to support a programme of feasibility studies and technology transfer activities within and beyond the industry. While the pork industry is relatively small, it is strongly integrated within mixed farming systems, and well-positioned to serve as a pivot for wider primary sector uptake.

Six feasibility studies are under way at a range of scales, from medium-scale pig farms, through larger mixed pork and dairy operations, to a centralised hub concept being explored in collaboration with a number of parties.

Biogas technology is a valuable contribution to helping look after the environment. The results of these feasibility studies will show how it stacks up as an economic proposition, and areas where industry and government can continue to work together to support Green Circle pork production.

Elizabeth McGruddy is the Environment Officer for New Zealand Pork based at Massey University

Covered pond

Good effluent practice the ultimate goal

Mike Bramley and Debbie Care

Keeping effluent out of surface and groundwater is one of the dairy industry's ultimate goals.

Management of effluent can not only reduce the effect of a farming operation on the environment, but can add real value to the farmer's bottom line from its use as a nutrient source. Good practice involves knowing and meeting the rules and regulations applicable to the farming operation, then establishing a management system to back these up and provide benefits on-farm.

The dairy industry has been working alongside other organisations to address the issues of effluent management on-farm for a number of years. As awareness of the benefits of effluent has risen, along with increasing regional council compliance requirements, the uptake of better effluent management has improved markedly.

Heading

DairyNZ is heavily involved in running effluent management field days for dairy farmers, most recently in the Hawke's Bay and Waikato. These events have a practical focus for farmers and staff to gain knowledge around day-to-day system management, application rates, equipment and useful tips.

The potential equivalent fertiliser value of effluent is $30 a cow per year on an all-grass system or $55 a cow per year on a system using two tonnes of maize per hectare with a feed pad. To capture this value the effluent must be applied and kept in the root zone.

Other research shows that a kilogram of nitrogen from effluent is equivalent to a kilogram of nitrogen from urea, in terms of pasture production, composition and nitrate leaching. Therefore farm dairy effluent can produce a good pasture response, for example, up to 10 to 15 kg of dry matter per kilogram of nitrogen applied in the effluent in the right growing conditions. Potassium, calcium, magnesium and other nutrients in effluent are also available for pasture uptake.

Using effluent well has benefits to the farmer's bottom line, consent compliance and a farm's long term sustainability. For these reasons, more farmers are increasingly looking at effluent management options.

Land application

Collection and storage

All effluent should be collected in storage or holding ponds before it is applied to land – providing a number of advantages for dairy farmers. It enables greater flexibility for effluent to be applied at more suitable times, when it is more likely to meet plant nutrient and farm labour requirements. Applying effluent in wet weather should be avoided because if the soil is wet there will be a high rate of surface ponding and run-off. Storage also enables effluent to be applied when time is available to do the job properly and when it is most suitable for staff.

The required storage capacity depends on the number of cows, volume of water off the yard and dairy roof, volume of rain water falling on these surfaces and ponds, a stand-off feed pad and staff availability.

This system should also use a means to collect solids, for example a sand trap in a single pond system, or pump from the second pond in a two pond system. This will mean a low solids content flowing to the land applicator and fewer problems with pumps, pipe blockages and spray equipment.

Two pond systems

Ensure the effluent is contained in a sealed pond system and does not enter water bodies in an untreated state. In two pond systems effluent enters the first anaerobic pond where solids settle and are broken down by bacteria which thrive in the absence of oxygen. This reduces the level of nutrients flowing into the second pond. Anaerobic ponds should be at least three metres deep, although four to five metres is ideal.

A field day about managing effluent on farms

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The second or aerobic pond is shallower, allowing in sunlight and more aeration of the water by wind to maintain higher oxygen levels. In some cases second ponds have a bottom layer where there is no oxygen – these are more correctly called facultative ponds. Aerobic and facultative ponds are generally less than two metres deep.

Effluent leaving the second pond into a waterway is considered treated and must meet strict guidelines that will be set out in the resource consent. Councils may measure biological oxygen demand, nutrient levels and faecal bacteria test levels to ensure the discharge is not having significant effects on water quality.

Land application

Storage facilities must be sealed to ensure effluent does not leach into groundwater and groundwater cannot enter the pond. Sealing ponds can be as simple as using compacted clay and topsoil, if it is available and constructed correctly. Topsoil helps prevent the clay cracking. Otherwise artificial liners such as plastic, rubber or concrete can be used, and will definitely keep the ponds sealed. However specific engineering advice should be sought regarding its installation.

The ability to clean the solids collection pond is also vital, so ensure that the pond is not too wide or too deep to be cleaned with the equipment to be used in it. To benefit from effluent application and good plant growth you should have enough water in the soil. Soil consists of solids, water and air, with air and water competing for available pore space between the soil particles. This means over-application of effluent and poor drainage will cause too much pore space to be filled with effluent water, resulting in low aeration, affecting soil life and limiting plant growth and ponding of effluent on the surface. This will also influence the risk of leaching and contamination of water.

Keep the effluent in the root zone

Exceeding the maximum application depth will cause saturated conditions in the root zone, reduce pasture growth and may damage pasture due to excessive solids build-up. Ponding is a clear indicator of over-application. To avoid this, consideration must be made of the soil type, rooting depth of the plant species in the paddock and what the soil can hold in the root zone.

If an applicator applies five millimetres in one hour in one spot, that is equivalent to five millimetres application depth and a five millimetre rate. Applied over four hours that is a 20 millimetre depth of effluent at an application rate of five millimetres an hour. The recommended maximum application depth and rate is based on soil type.

Soil type	Max application depth	Maximum application rate
Sand, pumice	15 mm	32 mm per hour
Sandy loam	24 mm	20 mm per hour
Silt loam	24 mm	10 mm per hour
Clay loam	18 mm	13 mm per hour
Clay	18 mm	10 mm per hour
Peat	20 mm	17 mm per hour

Nutrient management

Ensure the annual nitrogen loading meets local rules. By doing several tests during the year, farmers will know the nitrogen content of the farm dairy effluent and can use that knowledge in the nutrient budget. The nitrogen content of effluent varies due to the type of animals and what they are fed, dilution by washdown water and length of storage of the effluent.

Effluent application nutrient loading can be calculated by using the nutrient content of the effluent in an Overseer nutrient budget which will calculate the nutrient loading per hectare from fertiliser and effluent. The nutrient budget will also calculate the amount of effluent application area needed to apply effluent over to meet local rules and help prevent nitrogen loss into waterways.

In any one application of effluent, do not apply excess nutrients. To get the best value from the fertiliser and reduce nutrient loss, the quantity of nutrients applied in the effluent should be closely matched to the nutrient uptake of the pasture or crop. It is a valuable fertiliser source and should be used as a fertiliser would be.

Soil type, pasture growth stage and composition, along with soil temperature and moisture, all affect nutrient uptake and availability to pasture. Applying at rates greater than plant uptake means the nitrogen and other nutrients are lost by leaching run-off, along with the opportunity of greater production when the nitrogen is not converted to pasture growth for cows.

Nutrient loadings

The area of the effluent block needs to be calculated based on nitrogen and potassium loadings in an Overseer nutrient budget. The size of an application area is determined by the volumes and nutrient content of the effluent, the soil and drainage characteristics of the land and the influence on natural waterways.

Allowing a reasonably large area of the property for effluent application is very important. It reduces nitrate leaching, prevents ponding and surface run-off, stops weed invasion of the treated area and makes best use of the nutrients for pasture growth. If there is not enough land, the excess effluent must be applied on suitable land elsewhere or have an alternative back-up effluent treatment system.

Generally applications of 150 kg of nitrogen per hectare per year is economically and environmentally optimal. Phosphorus loading from effluent is close to matching pasture requirements, however Olsen P levels must be monitored on effluent blocks to ensure they remain in the optimal range. If not, supplemental fertiliser may be required.

Often the potassium loading from effluent is greater than necessary for plant growth. Maintenance soil requirements are 70 to 80 kg potassium per hectare per year and effluent applications of potassium can be twice this amount.

This results in above-optimum potassium levels which will result in a higher risk of metabolic problems in cows such as inducing milk fever or grass staggers. Regular nutrient monitoring and nutrient budgeting is important to match effluent nutrient loading with pasture requirements. It will ensure potassium levels are kept at an optimum and that excessive applications do not result.

System management

The effluent system should be designed and installed by a qualified and experienced professional. A good system begins with a good design that is correctly installed and applies effluent with appropriate scheduling. System maintenance will ensure performance attains the optimum levels. Farmers should know the system they are using meets high performance standards and their management of it is appropriate to achieving these results. An effluent system should be selected by evaluating its manufacturer/designer, design suitability to on-farm conditions and changeability, along with its ability to balance capital and operating costs.

Performance indicators

An effluent system must cover all the legal and practical requirements for each specific farming system. Designers and installers should provide proposals which allow farmers to compare different proposals from different suppliers in a similar format. This should reduce confusion and give standards that the system should conform in order to produce good results on the farm.

The following points should be discussed with effluent system designers and suppliers –

- Compliance with food safety regulations
- Compliance with Resource Management Act including regional plans, permitted activity rules and consent conditions
- Hydrological design including storage, flood risk, maximum application rate and annual nutrient loading
- System performance including minimum and maximum effluent applied depth, number of days storage, flow speeds and energy demand
- Operating requirements such as daily run-time at peak demand, daily labour and equipment use, staff training needs, maintenance schedule and costs
- Investment such as capital cost, return on investment, system life and annual operating costs.

An effluent management plan

Maintaining an effluent management plan will help farmers manage an effluent system. It will help their approach to effluent management, machinery and equipment maintenance, contingency planning, nutrient management and staff training.

As well as how to operate the system, staff should be informed about why the plan is important. The nutrient value of effluent should be emphasised, along with the importance of protecting surface water and groundwater for the good of the environment and people, as part of a responsible industry.

There should also be a record of who is responsible for maintaining the system and when maintenance was done. There should be a contingency plan to cover not being able to irrigate when soil is waterlogged from wet weather and when there is an equipment breakdown or power cut. Contingency measures include having enough storage to cope with pump failure or prolonged wet periods. Holding pond storage is one option to provide flexibility so that you do not have to apply effluent when it is wet but also gives back-up capacity in the case of pump failure.

Application map

An application plan will help identify suitable areas of the farm for effluent application and is beneficial for on-farm staff to see and keep accurate records. A plan or farm map will identify waterways, natural drainage patterns, prevailing wind direction and neighbours' dwellings, soil types and sub-surface drainage. It will also mark out the ideal area for effluent application, noting irrigator runs for each paddock and colour-coded risk zones such as mole or tile drainage areas, very wet soils or very free-draining areas with underlying gravels and accessible groundwater.

Areas for no application should be marked in red. This should include all land within 20 metres of a drain, waterway or bore, or the boundary of a neighbouring property.

Rules and regulations

Finding the balance between successful dairy production and its impact on water, air and soil is a pivotal issue when determining sustainable dairying. Natural resource management is overseen by regional, district or city councils. Unitary authorities, such as Gisborne, Nelson, Marlborough and Tasman, combine the functions of regional and district councils.

Farmers should be aware of the effect councils have on day-to-day operation. Regional councils manage water use such as damming, taking or diverting water and discharging contaminants into water, while district councils have control over land use such as subdivision and development. Regional councils may control some activities on land if they will affect natural resources.

Regional councils establish rules in their regional plans to ensure the sustainable management of water. If a farming activity does not comply with a rule, that is a breach of the Resource Management Act and is breaking the law. Regional council responsibilities which may affect farmers include the sustainable use of resources, clean air, clean water, secure land, waste disposal and environmental awareness.

Overall good practice

In summary, good practice involves complying with all rules and regulations and –

- Collecting all effluent prior to treatment and having appropriate sealed storage facilities
- Ensuring the effluent is contained in a sealed pond system and does not enter water bodies in an untreated state
- Ensuring the applied effluent does not result in ponding or run-off and keeping the applied effluent in the root zone
- Making sure the annual nitrogen loading on the effluent block meets local rules, in any one application of effluent do not apply excess nutrients and calculate area of the effluent block based on nitrogen and potassium loadings from Overseer nutrient budget
- Having the effluent system designed and installed by a qualified and experienced professional with an effluent management plan and a contingency plan in case of system break-down or wet soils.

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Balancing governance and management in family farming businesses

Kate Butson and Jack Cocks

Traditionally a good day's work on a farm involves going outside, getting your hands dirty and coming home weary at the end of the day. Or does it? With the growth of farming businesses it is imperative that farmers are working on their businesses as well as in them.

But what should the balance of governance and management be? What is the difference between the two? What are the key elements of governance and management that we need to ensure are present in farming businesses to ensure growth and sustainability? How, as practitioners in the rural sector, can we help our clients' understanding of governance and management and how they best balance them to meet their goals?

Relevance

The average size of farms in New Zealand has increased steadily. This increase in size has frequently been accompanied by an increase in the complexity of the farming business, both from a physical and a business perspective. The growth in farm business size has occurred for many reasons including succession planning, perceived economies of scale, capital availability, innovative ownership structures, use of technology and superior management techniques.

As a consequence of this growth farmers have faced an important issue. How much time should be spent working on the business versus how much time should be spent working in the business. What should the balance between governance and management be? Traditionally farmers have worked in the business, completing day-to-day tasks on the farm. As the size and complexity of their business increases other demands on their time such as staff management, strategic planning, financial planning, buying and selling decisions, along with policy and compliance issues become much more demanding and time-consuming. Farmers often have difficulty distinguishing between governance and management and consequently the balance of the two can become disproportionate.

Definitions

How do we define governance and management? Governance has been defined as 'a system of processes and structures to direct, control and account for the business at the highest level'. Simplified as it relates to farming businesses we will define it as working on the business, the strategic level, including long-term planning and direction of the business, scenario planning, processes and frameworks, business vision, business renewal and policy setting.

Management has been defined as 'getting things done in organisations through other people'. Management is interacting with others to achieve outcomes for the business. For the purpose of farming businesses, management will be defined as working in the business, the operational level, day-to-day activities, including tasks such as staff management, physical farm work, cash flow management and short-term planning.

The research

Because there was a limited understanding of the critical success factors required for effectively balancing governance and management in farming businesses a grounded theory methodological approach was used. Barney Glaser, a US researcher, proposed that what most differentiates grounded theory from much other research is that it is explicitly emergent. It does not test a hypothesis. It sets out to find out what theory accounts for the research situation as it stands. Constant comparison of the data that is collected for use in the formation of themes is at the heart of the process. The theory is emergent, and it is discovered in the data.

Glaser suggests two main criteria for judging the adequacy of the emerging theory –

- That it fits the situation
- That it works and helps people to make sense of their experience and to manage the situation better.

Qualitative data was collected using case studies of six very successful farming businesses throughout the South Island. Participants were sheep, beef or dairy farmers or a combination, and they were all involved in a family-owned business that farmed three or more properties. These case studies sought to understand how these businesses understood and implemented governance and management activities.

The grounded theory approach revealed six emerging themes amongst the participants. Of these, four are governance based while two are management based. Governance based themes included strategic planning, structure in the business, personal reasons and family and community goals. Management based themes were human resource management and communication along with operational decision making and processes.

These themes were closely interlinked and appeared to function at optimal levels when all were present and balanced within the business. In some cases realisation of the presence of these themes in the business only became apparent to the participants during the interview process. Some of these were actions or practices that were subconsciously performed to a high level. The importance placed on each of these themes varied from case-to-case, depending on circumstances such as age and stage, personal opinions, size of business and family succession.

Best practices

Whatever the right balance for a business the same best practices drawn from the conceptual model will apply. The time and effort applied to each will vary depending on the present state of the business. However all are important if optimal performance is to be achieved. Personal reasons provide energy for challenges and new ideas, strategic planning tells you where you want to go and why.

Structure identifies the roles that will be required to get there. Operational decision making and processes and human resource management and communication ensure that the right people are there to help you implement the plan. Family and community goals provide balance and alignment of your personal and family values with your business ethos. The best practices are summarised for each of the six themes.

Personal reasons
- Enjoy challenges and changes in the business
- Value non-physical work
- Money is a means to an end not the end goal

Strategic planning
- Have a strategic business plan or vision
- In the plan understand where you want to go and why
- Link the plan to the operational activities of the business

Structure in the business
- Identify key roles and responsibilities in the business
- Prioritise your activities and manage your time
- Understand the limitations of your structure and when it needs to be reviewed

Operational decision making and processes
- Develop processes that allow day-to-day physical work to be completed by others
- Processes allow successful practices to be replicated
- Operational decision making has to reduce to allow time to be spent on governance

Human resource management and communication
- Assist employees to develop and progress
- Regular, open communication, both formal and informal
- If you are not interested in helping your employees achieve their goals, why would they be interested in helping you?

Family and community goals
- Differentiate between family and business goals
- Do not pressure children to join the business
- Be prepared to share knowledge and skills with others in the community or industry

These key themes can be classified and linked together in diagrammatic form. Of the four triangles in the model, the lower triangle is management based with the three upper triangles being governance based principles. A chronological order can be used to explain the model.

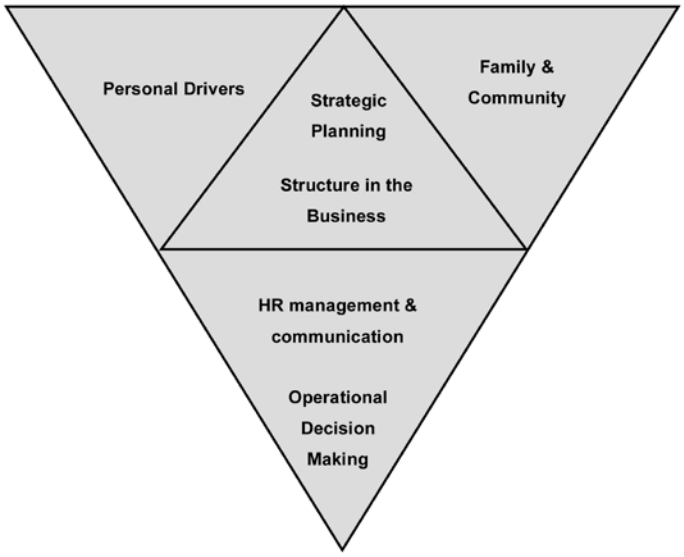
First a sound functional base is required to build the business from. This base is the operational activities of the business. If human resource management and communication processes are well developed then time becomes available for the business owner to widen their focus to include more aspects of governance as well as management.

Secondly, having time available to spend on business goals allows the strategy and structure of the business to develop. This enables and encourages growth and provides capacity to manage and govern the business as a multiple property.

Thirdly, supporting and guiding the business goals are the personal goals and family goals. These act as a guide for the business goals and ensure that the business matches the individual and family values and principles.

Finally, the element of balance, the shape of the conceptual model mimics the requirements of a real business to balance governance and management. Spending too much time on either governance or management unbalances the business and hinders performance, growth and satisfaction. Focusing entirely on

Balancing governance and management



governance but placing no emphasis on management may result in loss of focus on operational management activities which are the building blocks of a strong business. For example, purchasing properties that fit with future strategy but cannot be operated under the existing management structure.

The exact balance of how much time should be spent on governance and management activities will vary from business-to-business. They will depend on factors such as the size of the business, the number of properties, other business interests, complexity due to different type of properties owned, and the number of people involved in the business.

Practical applications

So how can we use the findings from this research to help our clients understand and balance governance and management within their business? As with any important meeting it is vital that the right people are present for the conversation, this ideally includes all key decision makers for the business.

Finding the correct balance for a particular business requires a thorough examination of the current governance and management activities. Ideally this will occur with reference to the best practice questions described for each of the six emerging themes. Once a good understanding of the existing business practice is gained it should become clear which of the conceptual model best practices are absent or under-represented.

Similarly it may become apparent that there is an over-representation in some areas limiting the time available for other activities. From here the conceptual model best practices should be used as a guide to build on the strengths and mitigate the weaknesses, until a balance is reached.

Every business is unique so there no 'out of the box' solution or silver bullet answer for the right balance of governance and management. It is important to revisit the roles of governance and management in the business at regular intervals. As the business changes so too may the balance of governance and management required to keep it functioning both successfully and sustainably.

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Managing grass weeds

Trevor James

At a recent series of workshops, Trevor James of AgResearch provided hands-on training on best weed management practices for grass weeds in the arable sector. This included grass weed identification, control methods and the results from the weed management trials.

Grass weeds, in particular annual summer growing grasses, are of increasing concern in the arable sector. Maize and sweet corn growers especially are finding that grass weeds are becoming more of a problem and that failure to adequately control them is limiting production and causing problems with harvesting equipment.

Why grass weeds cause trouble

There are three main reasons why grass weeds are causing so much trouble of late.

Abundance

The first is a matter of abundance. There are five commonly occurring summer annual grass weeds –

- Summer grass, *Digitaria sanguinalis,* is the most common and widespread, being found throughout the North Island and northern half of the South Island.
- Rough bristle grass, *Setaria verticillata,* has been one of the most troublesome as it is tall growing and its bristly seed head can entangle and jam up machinery. It is less widespread but very predominant in Poverty Bay with more localised infestations in the Waikato, Bay of Plenty and Marlborough.
- Barnyard grass, *Echinochloa crus-galli,* is another tall growing grass weed which can compete with tall growing crops. It is also found throughout the North Island and Marlborough region but infestations tend to be localised.
- Smooth witch grass, *Panicum dichotomiflorum,* has a more prostrate growth habit and is mostly limited to the northern half of the North Island.
- Broom corn millet, *Panicum miliaceum*, is a new grass weed in New Zealand and although it is still only locally abundant, it is causing serious problems. Broom corn millet is a tall growing, broad-leaved grass which sets copious quantities of large black seeds. So not only is it extremely competitive, due to its large growth habit, but its large seed allows it to germinate and grow very rapidly making pre-emergence control difficult. Although only first observed in crops about 25 years ago it is now widespread in Poverty Bay, Hawkes Bay and Marlborough, where it has probably been spread by sweet corn harvesters.

Although there is no accurate documentation of the spread of these grass weeds, experience over the years suggests that they are becoming more plentiful and their distribution is increasing. This is certainly the case for broom corn millet.

Earlier planting dates

The second reason for grass weeds becoming more abundant relates to earlier planting dates. In the 1970s most maize crops were planted at the end of October. Now many are planted as early as the first week of September.

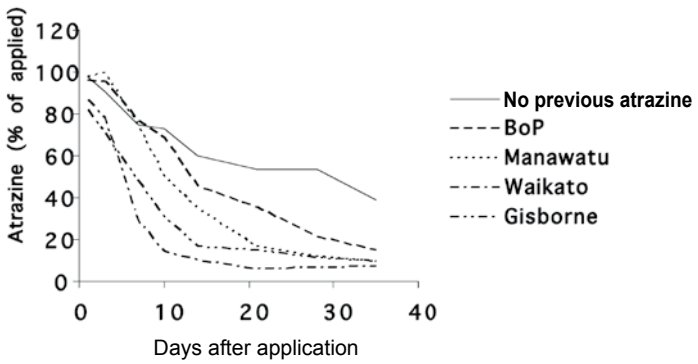
All of the grass weeds mentioned above have a C4 photosynthetic pathway. This simply means that they grow in response to temperature and usually have quite high threshold temperatures below which they will not germinate. These threshold temperatures are usually not reached until November and December.

When maize was planted in late October or early November, this frequently coincided with soil temperatures which allowed the grass weeds to germinate and were well controlled by the pre-emergence herbicides applied for that purpose. However, when the maize is planted much earlier, the grass weeds are still going to germinate at their natural time, so sufficient residual activity from the herbicide must persist for six to eight weeks to control the grass weeds when they grow. This is a big ask and some herbicide applications fall short allowing grass weeds to get growing before the crop attains canopy closure.

Herbicide degradation

The third reason relates more directly with herbicides failing to adequately control grass weeds. It has long been known that certain soil characteristics have a major effect on herbicide behaviour. Soil properties such as organic matter, pH and per cent clay can all affect the overall efficacy of a herbicide. This is frequently identified on the product label, with a higher rate recommended for heavier soils or those high in organic matter.

We have recently demonstrated that herbicides can also be less effective in soils that have a long history of herbicide use. This is due to enhanced degradation whereby the soil microbes degrade the active ingredient of the herbicide at a faster than normal rate. This factor can also result in reduced residual activity and problems with grass weeds prematurely escaping control. Recent studies have shown that the degradation of atrazine in several soils with a long history of atrazine use, was up to five times faster compared to a soil where atrazine had not been used previously.



Degradation of atrazine in soils with a long history of atrazine use compared to a soil with no previous exposure to atrazine

Weed management best practice

Another aspect of controlling grass weeds is that sometimes we are not using the most appropriate herbicide for the weed. Choosing the best herbicides for managing weeds is not a straightforward task and many factors need to be considered to obtain maximum

efficacy. The influence of various soil properties has already been discussed, but added to that are timing, rainfall, pre- and post-crop management and the weed species present.

Timing, as previously mentioned, can affect herbicide efficacy so it is important to know what the predominant weeds are. If they are cool climate weeds with a C3 photosynthetic pathway, then they will mostly germinate in response to the soil disturbance of cultivation. Pre-emergence herbicide application in this case should be timed from this event, not the planting date, to ensure the herbicide is applied and activated with water before weed seedlings emerge.

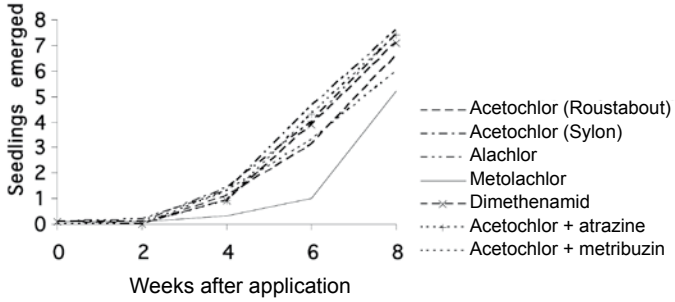
Rain and temperature

If the predominant weeds present are warm climate or summer annuals with a C4 photosynthetic pathway, then they will usually emerge later and in response to increasing soil temperature. Strategies must be in place to control these weeds if the pre-emergence herbicide fails to do so, with the most common strategy being the use of an appropriate post-emergence herbicide such as nicosulfuron.

Predicting rainfall is impossible, so planning for it is equally difficult. Nevertheless an understanding of the effect of rainfall is important. Too much rain can hasten the dissipation of a soil acting herbicide, while too little rain can slow it down. Quicker than expected herbicide dissipation can lead to reduced residual control of weeds, but if slower could lead to herbicide carry-over and damage to subsequent crops.

Pre-crop management can be used to eliminate troublesome perennial weeds by cultivation or use of a non-selective herbicide such as glyphosate. Post-crop management can be employed to reduce herbicide carryover.

Weed species present are possibly the most important factor in achieving effective weed control. Our experiments, carried out over the past two years, have shown that some herbicides are better for controlling certain grass weeds. For example, metolachlor (Dual Gold) gave better control of summer grass than other grass herbicides, which were very similar, when tested in seven different soils.



Number of summer grass seedlings emerged from the 10 seeds planted at two week intervals

In this study, pots were filled with the different soils and sprayed with different herbicides. Then every two weeks 10 grass weed seeds were planted into pots and the number which emerged were counted two weeks later.

First there is the need to determine if there are problem perennial weeds present because they are often best dealt with pre- and post- crop management. For example, rhizomatous weeds can be managed with extra cultivation which brings the root fragments to the surface to dry. Winter active weeds such as buttercups and docks can be left undisturbed, then treated with a non-selective herbicide prior to final cultivation. However, other perennial weeds may have to be controlled with a specific herbicide.

Then there are the annual weeds, and we have to know whether they are predominantly C3 or C4 weeds. If they are mainly C3 weeds then the standard practice of a combination grass and broadleaf herbicide mix is likely to be sufficient. However if any herbicide-resistant weeds are present, such as atrazine-resistant fathen, then special measures may need to be taken to manage such a problem.

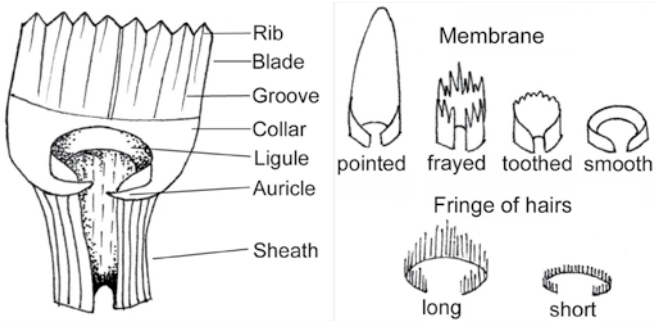
Identification

It is important to note that if there are C4 grass weeds present, they may not be completely controlled easily and if not addressed, their numbers could build-up. It is the growing problem of the C4 annual grass weeds in our crops that is causing real concern.

Some of these grass weeds are still of limited distribution and effective management for them requires positive identification. Most of these grass weeds are easy to identify when in the seed head stage but by then it is too late for good management. The Foundation for Arable Research (FAR) has sponsored both a small booklet *Grass weeds of arable crops – the ute guide*, and a series of workshops around New Zealand aimed at training people to identify grass weeds at the seedling stage.

The identification of grass weeds at this stage is based on a dichotomous key which asks a series of questions such as – Does it have auricles? Does it have a ligule? Is the ligule membranous or hairy?

The workshops help with naming and identifying parts of the plant which are often quite small, and then a practical exercise where several seedling plants need to be identified.



Parts of a grass leaf and examples of ligule types

With the ability to correctly identify problem weeds early and a better understanding of how soil acting herbicides work, farmers will be better equipped to get the best performance out of their herbicides as well as being able to minimise their environmental effect. Farmers will be better placed to deal with new weed infestations and any changing conditions that climate change may throw at them.

Dr Trevor James is a senior weed scientist with AgResearch, based at Ruakura Research Centre (Hamilton). Over the past 35 years Trevor has conducted much of the research for the cropping industry and plays an active role in extension.

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Forestry in the hill country Sustainability and survival

Vivienne McLean

This article first appeared in the* Tree Grower*, the magazine of the NZ Farm Forestry Association. It is one of a series of articles on a selection of farm foresters throughout New Zealand.
Dugald and Mandy Rutherford farm in the high country of the South Island at Melrose, 20 km from Hawardene. They have been farming this 3,500 hectare property since 1975 and over the years have been planting trees for many reasons, but mainly to diversify the business. They wanted cash flow from something other than stock. Every year their real income has gone down and just continuing to increase the stock units was not an option. In many places trees are the only sustainable solution as they exploit the minerals in the subsoil and are less susceptible to extreme weather.

Melrose experiences all the extremes of inland Canterbury weather – droughts, snow, frost and gales. However the major climate challenge to farming in this area is snow. Dugald says his grandfather twice faced five feet of snow overnight which is potentially devastating for a sheep farmer.

From sheep and cattle, Mandy and Dugald have diversified into deer farming, tourism and forestry, and currently farm some 5,250 sheep, 310 cattle, and 300 deer and have 200 hectares of planted forests. Forestry and trees are inextricably entwined with Mandy and Dugald's farm management. They share each other's enthusiasm for trees. As former Husqvarna South Island Farm Foresters of the Year they exemplify the way forestry and thoughtful land use go hand-in-hand.

They have three main reasons for planting trees, apart from their obvious pleasure in growing them. The primary one is to spread their financial risk as trees continue to grow even when extreme weather affects their income from farming. They also plant trees because on some parts of Melrose forestry is a more sustainable, productive use of land than extensive grazing. The third reason is for succession planning and to create a retirement income. Agro-forestry blocks also provide vital shelter for stock in summer sun and snow storms alike.

Melrose background

The home block of Melrose straddles the headwaters of three flow-sensitive catchments – the Waipara 764 hectares, Okuku 2,500 hectares and Waitohi 213 hectares.

Since the original Horsley Downs Estate subdivision in the early 1900s Melrose has had a number of owners, most of whom lost money. The property was also owned for some years by the BNZ who rented it out. Land use was traditionally fine wool sheep grazing and the only land management tool was burning on an approximately three-year cycle.

Dugald's father bought the property in 1948 and from the 1950s, with the use of top dressing, fencing and tracking, was able to make a profit. He introduced cattle in the 1960s. In the 1960s and 1970s the practice of burning was curtailed and a much more conservative approach was taken to soil health. This has lead to an increase in scrub cover in general.

In subsequent years they purchased Haystacks, moderate hill country in the Waitohi Catchment, 332 hectares of bare land six kilometres further up Virginia Road. In 2000 they purchased 126 hectares of cultivated flat land at the bottom of Virginia Road.

Land description

The three properties range in altitude from 330 metres to 1,300 metres above sea level. The predominant soil type is greywacke-based and is mainly Hurunui Hill or Hurunui Steepland, depending on topography.

The original land cover was forest and Melrose has deep forest soils as a result. However most of these forests were gone before European settlement. As one of the original settlers in the area, Dugald's grandfather witnessed many further changes in the vegetation cover as first deer and then possums arrived. There were also several rabbit plagues. However Dugald says it is good country in that they do not have noxious weeds. The current land cover also includes 145 hectares of beech forest.

Melrose experiences all the extremes of inland Canterbury weather. The thermometer under cover on the back door veranda has recorded temperatures ranging from -16°C to 38°C.

Rainfall records have been kept from 1948 at Melrose and are recorded for NIWA, with a long term average of 960 mm. However the major climate challenge to farming in this area is snow.

The roles of trees at Melrose

Forestry and trees are inextricably entwined with Mandy and Dugald's farm management. However Dugald's knowledge of and involvement in forestry goes well beyond that of most farmers with a passion for trees.

He graduated with a bachelor's degree in Forestry Science in 1971. He is a past president of the NZFFA, is currently president of the North Canterbury branch, chairman of the Anglican Schools Forestry Trust and co-founder and chairman of Warren Forestry. He does not know where his love of trees came from, but it is obviously something of a family tradition. His grandfather had his own nursery when he first came and settled next door, when the farms were initially broken up. He planted trees initially because there was no firewood and they used to have to go long distances over the hill to get fuel.

When Dugald was still at school his father planted some trees behind the house. Dugald started pruning them, although he still does not quite know why, recalling it was actually before Wink Sutton was doing his research. He went off to Canterbury University intending to start first year training to be a vet, but when the forestry course was announced, straight away he just knew that was for him.

'When my father retired he got really enthusiastic about planting trees. A lot of people only get that interest later in life, but if you have it when you're young then you can really enjoy it all the way through.'

Melrose in 1959...

...and in 2004

Sheep farming in the snow at 1,300 metres

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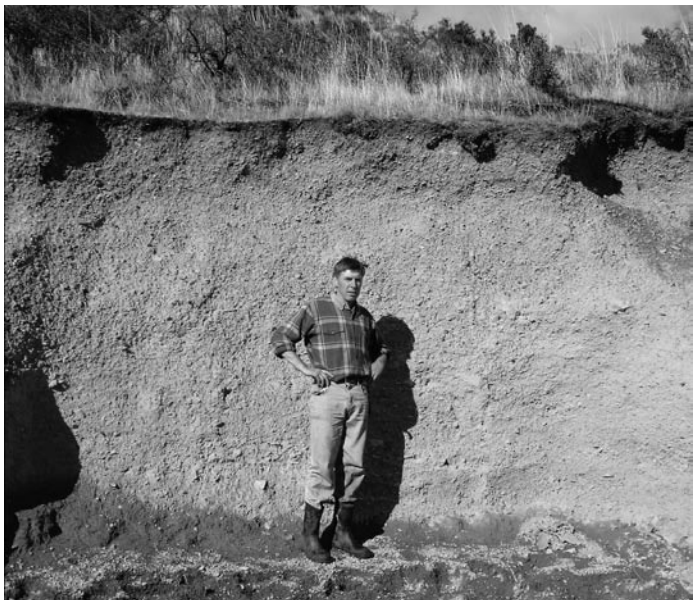
Why forestry?

Planting began on Melrose in 1975, with two aims. The first was the intention of planting a block every year so that in the future there would be an annual cash flow from something other than stock.

He says forest product values have kept ahead of inflation for the past 100 years and he believes this trend will continue, for a number of reasons. As access to logs from natural forests becomes more difficult due to environmental pressures, or the available forest becomes more remote, then the real price of wood will continue to increase. The majority of clear-felled forests in the tropical areas are being converted to agriculture or palm oil plantations and there appear to be few future competitors in wood production for a plantation owner in New Zealand.

This contrasts markedly with agriculture where he has faced a three per cent decline in values annually. In fact farming here is not really a sensible thing to be doing. Every year that Dugald has been on the place their real income has gone down. They have had to double stock units just to stand still. What options will the next generation have?

Dugald is concerned that simply continuing to increase stocking rates on marginal hill country is not a sustainable or realistic option. It will have a number of negative effects.



Very thin soils

One of these would be more stock movements through waterways, to the detriment of water quality. He says there is no economic solution to combat this problem on their class of country. An increase in fertiliser use will also put pressure on water quality but this may create a further problem. As the price of phosphate rock and elemental sulphur rises and agricultural returns diminish, the first place phosphate application will be cut is on Class VI country. It will leave a modified environment in a vulnerable state and in turn encourage the spread of hieracium.

Another negative effect is the removal of woody vegetation to grow more grass, pushing grazing into more marginal areas. This will reduce biodiversity, above-ground stored carbon and reduce low-level shelter for stock. Areas left bare by spraying, burning and intense grazing are then vulnerable to soil erosion if stressed by drought, rabbit invasion or stopping fertiliser use.

Shingle where trees do better than sheep

A forest owner on a farm has other revenue generating options to consider. These include carbon sequestration and the establishment of the forests under the Permanent Forest Sinks Initiative. Other possibilities could be bioenergy or biochar depending on local scale.

The biological imperative

The second reason for forestry at Melrose is that the Rutherfords believe there is a compelling biological reason for planting trees in their area. On some parts of Melrose, forestry is a more sustainable and productive use of land not suitable for more intensive grazing. It would be much more profitable in trees.

On their better country, where they can get a return from fertiliser and keep on top of scrub reversion, pastoral farming will probably prevail. However on undeveloped country, which they describe as having suffered 150 years of burning and grazing, continuing these practices is not a sustainable option. Some of this land is more remote, so it is significantly more expensive to fly fertiliser on to. Other areas have a depleted or very thin A-horizon within the soil profile, so they see forestry as the only sustainable solution.

Trees can exploit the mineral in the subsoil that grass and clover cannot, and the only mineral that needs to be added for good growth is boron for radiata pine. Forests also have positive effects such as reducing soil erosion and improving water quality. Where forests replace stock, stock movements through waterways are reduced, lowering both faecal matter and fertiliser in the waterways.

'A lot of our country is almost bare shingle, but you can put a crop of trees on and they will do extremely well,' says Dugald. 'It just seems to make sense to put trees in a place like this. Maybe this land has been burnt too often throughout its history so that topsoil has been eroded, but we've still got that good sub soil.'

With their deep root systems, forests are less susceptible to climatic variations. After once hearing the comment that trees stop growing during Canterbury droughts, Dugald thought he should find out for himself. He set off to find a tree whose annual growth rings could be matched against rainfall, as well as extreme weather such as heavy snow, extreme droughts and extreme frost, to demonstrate the minimal effect local climatic variation has on tree growth.

The result is shown on the graph on the next page. Despite tremendous variations in rainfall and other weather the growth of a radiata pine tree planted in 1975 and harvested in 2005 remains extremely consistent. All of those events have an effect on the property's income from agriculture but the trees are able to 'just plod on.'

Planning for retirement

The third reason for planting forests concerns retirement and inheritance planning. As part of their succession strategy, the 200 hectares of pines progressively planted will, when harvested as each woodlot matures, generate income from some 4,000 tonnes of logs annually, allowing them to move off the farm.

Dugald explains that forests can grow into large capital assets with a good cash flow and will give them and the next generation more options. Pure pastoralism usually generates too small a cash flow to allow the retirement of one generation and the succession of the next without crippling debt.

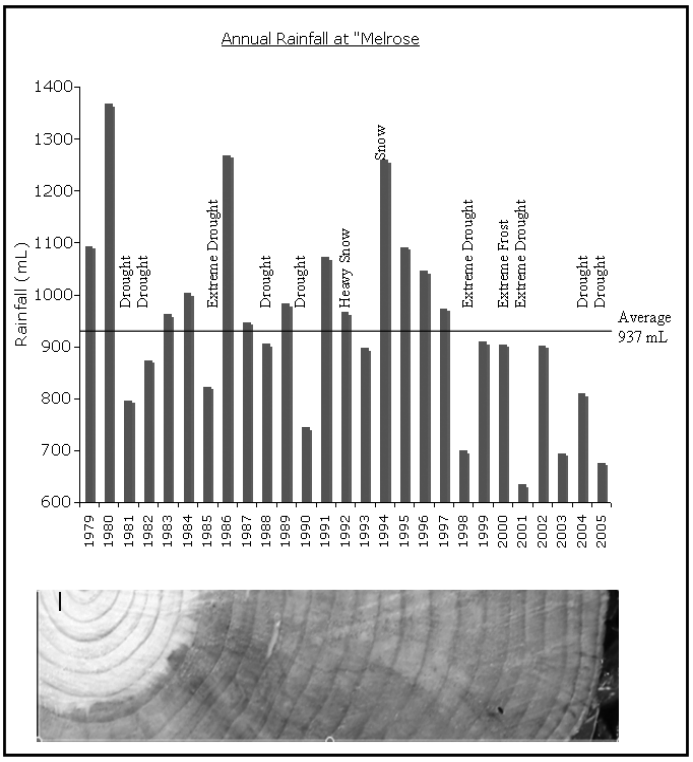
'Because we have 200 hectares of forestry we now have the potential to fund our retirement in perpetuity, which creates greater flexibility in terms of succession planning. In the future I see all these reasons for planting becoming more relevant as the next generation looks to make a living off Melrose. Around 2,000 hectares of our property is unsuitable for any exotic forestry planting because of the high risk of wilding spread unless sterile trees are developed. Of the remainder of the land up to 1,000 hectares would be suitable for tree planting.'

What trees and why?

The initial planting used the Forestry Encouragement Grant, and as cash was tight, the areas planted were the minimum two hectares, in corners that required little fencing. Regimes followed Forest Service standards and involved radiata pine, Douglas fir and *Eucalyptus delegatensis*.

After the grant scheme finished the Rutherfords began fencing for deer. In the process they took advantage of the new fencing and the old sheep fences to plant a number of blocks that have since either ended up in the deer farm or are on the boundary of it. The deer love conifer forests even though they have native cover in all their paddocks.

Radiata pine under their conditions have performed well under the agro-forestry regime. Dugald thinks they will revisit this regime now they have seen how the crop has developed. The last agro-forestry block was planted in 1991. The 1992 planting involved a series of small woodlots over a block, placing them for shelter and on spots that grew little grass.



Growth rings and rainfall

Douglas fir and other species

Douglas fir has been planted on the higher, colder and steeper country. These higher volume crops will have to be harvested by hauler. All plantings have been planned with access to the logging road in mind. The property is long and narrow and the main Douglas fir planting is around six kilometres from the county road.

Dugald notes they have ideal road making material only a blade depth below the surface. Some areas of macrocarpa, larch, *Pinus nigra* and *E. nitens* have been planted, all of which do well if sited correctly. One area of *P. nigra* was established using aerial seeding, which after a slow start is now well established. The key to its success was little or no grass completion.

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Tree management

A key to good radiata growth in the area is boron. The Rutherfords have found that on soil types with little or no organic matter and without an application of boron, trees were little better than gooseberry bushes. As a result all radiata receives boron shortly after planting.

Most of the radiata has been pruned to six metres. Pruned wood has proved to be of good quality with few defects. On the other hand because of the altitude and latitude, their radiata will always be of low density which is a negative for structural grades. Pruned stocking per hectare varies between 150 and 300 stems per hectare. In the agro-forestry blocks all unpruned trees are thinned, otherwise mustering is impossible.

Douglas fir is planted at 1,200 to 1,400 stems per hectare and thinned to 800 at 16 metres height. In areas with good access further commercial thinnings are planned to produce a final stocking of 450 stems per hectare.

Macrocarpa has been planted at 800 stems per hectare, with pruning up to six metres on up to 300 stems per hectare. Canker has become an issue on the harder sites. In the past there was no sign of the disease but it has appeared in recent times, causing malformation and some deaths on the colder, more exposed sites where the trees are not doing so well.

E. nitens does very well, as long as it is kept up out of the frost pockets. Form is immaculate and with pruning up to eight metres they are a magnificent sight, although 15 metre high trees have been killed outright by frost during a period when 16°C frosts were experienced for a week.

In recent times the Rutherfords have reduced their plantings while they coped with the silviculture of the planted areas and educated their four children. Planting has now moved into a new phase with the children establishing 10 hectares of radiata. Things have come full circle.

A range of sites

'Nurserymen must rub their hands together when they see us coming,' says Dugald. Over the years they have tried hundreds of species and found most of them unsuitable. One thing they have learnt is that a true trial for a new species requires trying it over a range of sites. A 1989 roadside planting of *E. nitens* has been very successful, although another block did not survive the frost in 2000 that struck shortly after high pruning.

Species such as Douglas fir and Lawson cypress are well adapted to snow, drooping their branches so it falls off, while *E. delegatensis* actually repels the snow so it does not stick at all. These grow at high altitude in New South Wales and are well adapted to snow.

Agro-forestry block

Coping with the snow

Ponderosa pine put in a very windy spot, has proved to be successful at combating the wind. On the other hand trials of redwoods and stringy bark eucalypts have proved less than successful in the harsh conditions, and Mexican oaks planted two springs ago were set back by frost. Nevertheless the Rutherfords continue to experiment with different species, including a 10-hectare trial of radiata cuttings and controlled pollinated seedlings all pegged and tagged with six replications.

Agro-forestry

In the mid 1980s the Rutherfords began their agroforestry plantings. Radiata pine was used on the easier contour country where ground based logging will be possible for what will be a low volume crop. The planting pattern was normally in double rows with 10 to 15 metres between rows. These blocks provided sheltered grazing for up to 17 years although there were periods when thinning and pruning debris was hazardous for new born lambs. These blocks were especially valuable during heavy snow and frost periods for cattle and deer.

A lot of the plantations are open, and especially with the cattle on a hot summer's day they use the shade in the plantation. The shelter is appreciated in the winter as well, when it is really cold weather.

While the popularity of agro-forestry has waned, the Rutherfords say it is still valid for their particular situation. It is often difficult to achieve good tree form in an agro-forestry block because of the wider tree spacings. However because pine trees do not grow very fast at Melrose, even though they are planted at wide spacings, the branches are still fine, unlike other parts of the country.

Enhancing biodiversity

In many cases a forestry planting has given the Rutherfords the opportunity to protect a bush remnant or other natural feature from grazing by including these areas within the plantation boundaries. Most of their plantings end up with a patch of bush or a wetland included and fenced off. The reward is seeing the resurgence of beech and red tussock in the protected areas.

The profitability of improving lambing percentages

Cameron Ludemann and G Trafford

Increasing ewe lambing percentages has the potential to improve farm profitability. However this depends on the level of fertility already being achieved by the ewes, the level of survival of the lambs as well as the lamb selling strategy that is implemented. Farmers need to carefully consider the implications of whether or not to focus on improving ewe fertility further.

Since the removal of subsidies in 1984 New Zealand farmers have increased productivity in an attempt to maintain or enhance the economic viability of their operations. For example the average number of lambs tailed per ewe mated in New Zealand has increased from 98 per cent in 1984 to 126 per cent in 2006.

Costs of ewe fertility

Increasing lambing percentage can come at a cost. Higher ewe fertility in general will increase ewe pregnancy and lactational energy requirements. For example an extra lamb for a ewe requires an extra 20 kilograms of dry matter for pregnancy and an extra 100 kilograms for lactation. This may require a reduction in the number of ewes carried on a farm.

At higher flock lambing percentages, the proportion of triplets and quadruplets increases. The average proportion of singles in a litter can halve from survival to sale lambing percentage of 125 per cent to 150 per cent. This is made up for by an increase in twin and triplet lambs.

Triplets and quadruplets can have over 20 per cent lower survival rates from birth to weaning which contributes to the costs of higher ewe fertility. Many farmers also find the management involved with triplets and quadruplets more difficult. On the positive side, increasing lambing percentages may allow for more of the spring surplus to be consumed by stock allowing for higher pasture quality and reducing the requirement for costly hay or silage making. The question of whether increasing lambing percentages makes economic sense then becomes an issue to consider.

Computer modelling

Simply comparing the profitability of farms with various lambing percentages may not lead to an accurate depiction of the relationship between lambing percentages and farm profitability. There are many variables that can differ between farm systems that could make it difficult for a reliable comparison to be made. Climatic variation and differences in management practices between farms are such examples of variability that can render analysis between real farms unreliable.

Computer models can be used to ascertain whether increasing lambing percentages produces greater profits to farmers. A computer model that simulated a typical Canterbury dry land sheep and beef farm was developed as part of a masters degree. The model involved a linear programme which was designed to obtain an optimal solution. In this case the linear programme changed the number of stock on the farm to maximise farm profits. At several levels of ewe fertility the model was used to calculate the maximum possible net profit the farm could make, taking into account the farm's finite feed availability throughout the year.

There are many different measures of lambing percentage used by farmers, consultants and researchers. For example, researchers often use the term ewe prolificacy or number of lambs born per ewe lambing, but farmers may find this hard to relate to. The number of lambs sold and retained for replacements per ewe mated is a lambing percentage measure that most farmers and consultants are familiar with. This will be the measure that is referred to in this article.

Model farm

A Canterbury/Marlborough dry land sheep and beef farm similar to that described in MAF monitoring reports was used as a basis for the farm model. Farm parameters included –

- 378 hectares of effective area
- Winchmore unirrigated pasture growth
- Average South Island monthly pasture quality
- 10 hectares of swedes and 10 hectares of kale yielding 6,000 kg dry matter per hectare for winter feed
- Cattle numbers set to around seven per cent of the number of ewes
- Ewes producing four kilograms of clean wool a year at four dollars a kilogram
- $57.33 average lamb price with a 17 kg carcass
- $40 cull ewes
- One stock unit was equivalent to a 6,000 MJME energy requirement.

The farm net profit was calculated by adding the returns from the lamb, ewe, cattle and wool sales and subtracting from this the sum of variable costs. These costs were based on the number of stock units on the farm, as well as the fixed costs that were in proportion to the total area of the farm. Feeding and genetics of the ewes at mating time in April set the lambing percentages for the model. There is a positive relationship between the weight of ewes at mating time and their subsequent ovulation rates. However this relationship plateaus at approximately 67 kg.

To alter the level of ewe fertility a multiplier was used to increase or decrease the relationship between ewe live weight at mating and their ovulation rates. This multiplier simulated genetic variation in fertility that occurs naturally between flocks. When the fertility was altered, so did their feed requirements.

Lamb live weight gains were differentiated between the single at 156 grams per day, twin at 130 grams a day, triplet at 104 grams a day and quadruplet 83 grams a day. A fixed proportion of the lambs available for sale were sold prime each month from November to June. The proportions sold each month varied from 10 per cent of lambs available in November, to 20 per cent in December, 30 per cent in January, 20 per cent in February with the remainder sold from March to June.

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Lambing percentages and performance on farm profits

The base trend line in the graph shows how farm profitability relates to lambing percentage when average levels of lamb survival and live weight gain performance are achieved. It shows an increasing trend in profitability when lambing percentages increase from 100 per cent to approximately 150 per cent.

A greater number of lambs available for sale is a major reason for this increase. As the lambing percentage increases, a smaller proportion of the total lamb drop needs to be retained as replacements. Therefore most farmers in the 100 per cent to 150 per cent range will likely benefit from improving ewe fertility.

Above the 150 per cent mark, farm profitability reduced. A rise in the proportion of triplets and quadruplets was the most significant factor contributing to the negative trend. While ewes are scanned at higher percentages, a higher proportion of lambs did not survive from scanning to sale. All feed that went into the ewe for pregnancy and lactation for lambs that eventually died before slaughter was effectively being wasted.

The ewes still needed to be allocated the extra feed for the higher lambing percentage, which required a reduction in stocking rate as lambing percentage increased. For example from a lambing percentage of 124 per cent to 180 per cent the model estimated a reduction in the total number of sheep by 53 stock units in order to balance the supply and demand of feed. The table indicates the numbers of livestock over a range of lambing percentages. As is shown, more lambs born are produced from fewer ewes at higher lambing percentages.

Stock numbers estimated by the linear programme model over a range of lambing percentages

Parameter	New Zealand average			
Ewe profligacy percentage	152%	190%	252%	280%
Survival to sale percentage	124%	153%	180%	192%
Number of ewes	1789	1661	1478	1410
Number of hoggets	335	311	277	264
Number of lambs born	2720	3154	3731	3955
Lambs born actually sold	81%	80%	71%	68%
Stocking rate stock units per hectare	9.10	9.09	8.96	8.91

However, the table also shows that the average proportion of lambs that survived from birth to weaning dropped from 81 per cent to 71 per cent when lambing percentages increased from the New Zealand average of 124 per cent to 180 per cent. This means that more feed will be wasted on ewe pregnancy and lactational requirements for lambs that do not get to a selling age. Farmers who are close to the 150 per cent mark therefore may need to look closely into alternative ways of improving profitability to see how they compare with further improvements in ewe fertility.

Another way of measuring the level of ewe fertility is by scanning percentages. These percentages give farmers an idea of ewe fertility before lambs have been born. This can help farmers make management decisions to suit the respective level of fertility. The optimal ewe fertility that the model calculated is equivalent to 200 to 210 per cent at scanning.

Lamb survival and profitability

The first graph shows how much of an effect survival of triplet and quadruplet lambs have on profits. If these lambs were able to achieve survival rates equal to twins, the decline in profitability above the 150 per cent optimum would be slowed substantially, but not halted. In practice, achieving triplet survival rates that are the same as twins would be very difficult.

Triplet and quadruplet survival rates defined as the proportion of lambs that survive from birth to weaning would have to increase from 65 per cent and 55 per cent respectively to the 85 per cent survival rate of a twin lamb. A major limitation to improvements in triplet and quadruplet lamb survival is the physiological limitation of the ewe. Lamb survival is often influenced by birth weight, with larger lambs suffering from birthing difficulties, while smaller lambs with their high surface area to volume ratio and lower fat reserves are more vulnerable to climatic challenges. The optimal birth weight is generally regarded as being around 4.5 kg.

Ewe nutrition can be manipulated to increase lamb birth weights. However, ewes with many lambs may not be able to physically consume enough feed, nor have sufficient uterine space to grow the lambs to the desired birth weight.

An alternative way of improving the average survival rates of lambs would be to increase the proportion of twins in ewe litters relative to the level of fertility. As ewe fertility increases so does the proportion of triplets that are present in the ewe litter. This comes at the cost of having fewer single and twin lambs that have higher survival rates. However, the heritability of the trait for ewes that have higher fertility with fewer triplet and more twin lambs is low.

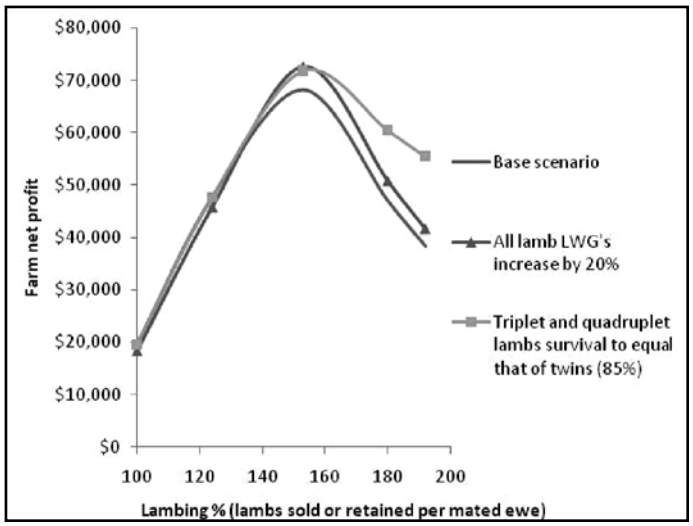
However as a long term breeding programme objective the benefits could accumulate and allow it to be a helpful way of improving the average survival rates of lambs. The fact that improving the triplet survival rates to that of twins did not halt the decline in profitability would suggest that other factors also contributed to the decline in profitability above 150 per cent.

Lamb live weight gains and profitability

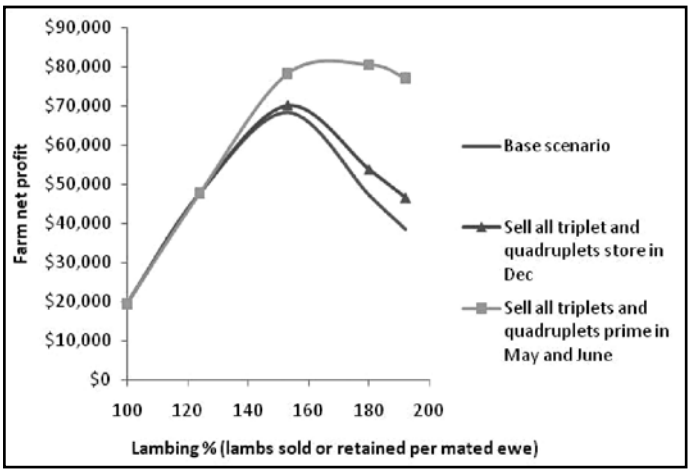
The average weight of triplets and quadruplets are lower at any given age owing to lower birth weights and lower live weight gains compared to single and twin lambs. At the optimal lambing percentage of around 150 per cent, increasing lamb live weight gains by 20 per cent produced a similar profit as increasing the survival rates of triplet and quadruplet lambs. Given that it is likely to be easier for a farmer to achieve 20 per cent higher lamb live weight gains compared to 20 per cent increases in lamb survival rates, it may be better for a farmer who is sitting near the optimal lambing percentage to look towards improving lamb growth rates.

Increasing ewe fertility above the optimal made lamb survival more important as a factor for improving profits. This was due to the fact that at higher ewe fertility more triplets and quadruplets were present meaning the increase in lamb survival would affect more lambs. However, at those lambing percentages the farmer may actually be better off reducing ewe fertility to allow for a higher stocking rate rather than trying to improve triplet and quadruplet survival.

Farm profitability in relation to lambing percentage, with variation in lamb live weight gain and survival



Farm profitability in relation to lambing percentage, with variation in lamb sales strategies



Lambing percentages and sales strategies

Triplet and quadruplet lambs will generally have lower carcass weights at any set age compared to their single and twin born counterparts. The model disadvantaged the triplets and quadruplets as it sold a set proportion of the singles, twins, triplets and quadruplets as prime each month. Triplet lambs that were under-weight at sale were doubly disadvantaged in that they were sold at a lower price per kilogram according to the schedule.

Therefore, a scenario which aimed to counteract the problem of lower prices for triplet and quadruplet lambs was included in the analysis. In particular the sales strategy of keeping the triplet and quadruplet lambs on later was implemented as is shown in the graph. Compared to the base scenario, holding off the sales of triplet and quadruplet lambs until May and June when there is generally a lift in lamb prices allowed farm profits to be maintained even at above optimum lambing percentages.

This indicates that profits when lambing above 150 per cent can potentially be maintained so long as the right sales strategy is put in place. An important word of caution is that while selling the triplet and quadruplet lambs later can help stop the decline in profits, there is risk involved in this strategy which was not accounted for in the model.

A significant risk involved in keeping the multiple lambs on until May and June is drought. This is especially important in a Canterbury dry land situation, but may be of lesser concern in summer safe areas such as in parts of Southland. Either way there will be a cost involved with keeping on the lambs until later in the season. Even in a summer safe environment there could be a cost in the form of possibly lower ewe performance in the next year. For example using autumn feed for lamb finishing may do so at the expense of ewe nutrition at a pivotal time of the year. This could have a bearing on ewe ovulation rates and subsequent fertility in the next year.

Selling the triplets and quadruplets as stores early on in the season allowed for a slightly higher profitability at and above optimal lambing percentages. However, the risk would reduce significantly when implementing this policy. Selling the lambs as stores still did not halt the decline in profitability brought about by a higher proportion of lighter triplet and quadruplet lambs with lower survival rates though. The benefits of selling stores or finishing lambs later must be balanced against the risk of drought.

Summary

Issues to consider when considering whether to focus on increasing ewe fertility or not, include –

- Increasing lambing percentages comes at a cost in the form of additional feed requirements as well as a greater proportion of lambs with lower survival rates and live weight gains. There may be a requirement for a reduction in stocking rates.
- When average lamb survival rates, live weight gains and ewe performance measures are being achieved the optimal lambing percentage was calculated as being around 150 per cent lambs sold or retained per mated ewe for a typical Canterbury dry land farm. This is equivalent to a ewe scanning percentage of 200 per cent to 210 per cent.
- The actual optimal lambing percentage will vary between farms according to the proportion of triplets in the ewe litters, and average lamb survival rates.
- Improvements in lamb survival and live weight gains could help increase the optimal lambing percentage. Farms with above average shelter or a breeding/nutrition programme focussed on lamb survival could have a higher optimal lambing percentage than was described.
- Improvements in triplet and quadruplet lamb survival showed the greatest promise of improving profitability at above optimum lambing percentages. However it is likely that it would be relatively easier to increase lamb growth rates, than to increase lamb survival described in this research.
- If a farmer is close to the optimal lambing percentage it may be better to focus instead on lamb growth rates.
- Selling policies can have a big impact on the profitability of farms at high lambing percentages. Selling triplet and quadruplet lambs later on in the season when prices rise may improve profitability. However, these policies can carry additional risks, especially in the event of drought or if they impact on subsequent ewe performance.

Cameron Ludemann is an Agricultural Consultant at AbacusBio Limited

Fruit and vegetables win with health and climate change

Chris Ward

It is not hard to appreciate that most people in the western world eat more than they need. Just think about shape of many of the people starring in American sitcoms. People like eating, even with the credit crunch for many of us food purchases are only a small proportion of disposable income, and it is for many, one of the few remaining pleasures in life.

I remember well two economics lecturers at Lincoln who were very keen horse race gamblers. Often I would see them at Addington, victims to their own theory 'that you continue betting as you get greater satisfaction from your winnings than dissatisfaction from your loses'. So it is with meat consumption. The pleasure of eating more than is needed more than offsets any obesity or climate change concerns.

Too much meat

Most of us consume a diet that has far too much meat in it, compounding obesity and the resulting health problems. In May 2008 a large Cambridge university study looked at all studies worldwide which examined meat consumption and rates of cancer incidence. Their conclusion is that if you want to lessen the chance of getting cancer, keep your meat consumption to less than 500 grams a week or about 25 kilograms a year.

Cambridge was more recently joined by Australian academics who have called for people to eat no more than 90 grams of meat a day, 33 kilograms a year, for water conservation and for improved health reasons.

Most developed nations consume a lot more. For New Zealand, consumption sits at about 100 kilograms per person each year. So we can reduce our meat consumption to only a quarter of our current meat consumption with better health outcomes.

Looking at it in a world perspective, if all the citizens of the world ate only 25 kilograms of meat a year then the world would need to produce about 70 million tonnes less meat. This includes bringing developing countries per head consumption up to 25 kilograms of meat as well as cutting back consumption in developed nations.

Potatoes looking good

Eating less meat is desirable from a health perspective for most of us living in developed countries. When production of meat is examined from a carbon emissions perspective the argument for eating less meat becomes even more compelling. Recently Nathan Fiala wrote an article in *Scientific American*. In it he examined the energy needed for beef and pig production in the United States and compared this with the energy needed to grow potatoes and asparagus. In the article he says that producing a pound of beef in a feedlot generates the equivalent of 14.8 pounds of carbon dioxide, for pork 3.8 pounds and chicken 1.1 pounds. The equivalent for asparagus is 0.4 pounds. Potatoes fare even better at 0.25 pounds. This means that, weight for weight, producing beef creates 60 times the carbon dioxide that potatoes do and almost 40 times as much as asparagus does.

The article goes on to say that worldwide meat production – beef, chicken and pork – emits more atmospheric gases than do all forms of global transportation. Production of meat makes up 18 per cent of all greenhouse gas emissions.

So you have to ask yourself would you not prefer to eat less meat and still travel where you want to go. The answer may be a bit of each, eat less meat and travel less or more efficiently. That way you are at least in a very practical, sensible way improving the outlook for our future climate.

Energy hungry

I am not suggesting that New Zealand should produce less meat as we are an efficient producer on a world scale with our all grass feeding system. Inefficient energy hungry systems such as US feed lotting needs examination of its energy use. The fact that grain is grown with all the associated energy on the farm and transporting it to the feedlot makes it energy hungry. This is before you even start to calculate the emissions from the cattle themselves.

This brings me on to life cycle analysis and the fast developing research and measuring industry that will go with it at significant cost. Why are supermarkets in Britain and Europe worrying about obtaining the carbon footprint of most products they stock. It is a bit like asking all motorcycle drivers to justify their fuel consumption whilst you can still buy a gas-guzzling car and use it for the same purpose. Individually there is a lot we can do to lower our carbon own carbon footprints. Diet modification is needed, not carbon labels on every product.

Lifestyle changes

There is plenty of behaviour modification and lifestyle changes we could adopt before we rush in and measure every products footprint. Why are we not educated on which products have low carbon footprints? Scientists know this. We do not need all the detail, but it is useful to have some idea of the comparative energy that goes into the food items we decide to buy. If meat production systems such as intensive feed lotting is so bad, should all consumers not know this and buy more carbon frugally.

Mankind cannot live off fruit and vegetables alone in a balanced diet, but with a few possible exceptions horticultural products stand to be on the ascendancy. Meat production may be descending from the most energy intensive production systems. It has to if we are just a little bit serious about reducing emissions.

Meat production in the future will perhaps be linked more to the production of a co-product such as milk and eggs. Producing meat and hides only in a production process is perhaps a luxury, and incompatible with the globally stated goal that we must lower global greenhouse emissions. So think on this as you contemplate what to buy when you do the supermarket shopping. Intrinsically New Zealand food producers are well positioned for the food revolution.

Chris Ward works for Horticulture New Zealand.

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