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Agricultural productivity and Environmental Sustainability Are we going to throw the baby out with the bathwater?

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Agricultural productivity and Environmental Sustainability
Are we going to throw the baby out with the bathwater?[1]
(NZARES Conference, Nelson, 30 August 2012)

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Abstract

Among the green lobby and the general public there is urgency for agriculture to clean up its act on environmental issues. Increased intensification of land use and in particular dairying has led to environmental spill-overs that the public is no longer willing to tolerate. Agriculture is in danger of losing its public license to operate. Polices to ensure degraded waterways are put on a path to improvement are currently being formulated. These have the potential to rob New Zealand of its international competitive advantage in agricultural production if not implemented wisely. This paper uses two case studies to illustrate the costs and the timeframes inherent in environmental improvement for pastoral agriculture and makes recommendation on policies to ensure New Zealand has good environmental outcomes and retains its international competitive advantage.

Introduction

My presentation today is about a classic wicked economic problem – the dynamically complex, ill-structured public problem of how to ensure that agriculture can continue to grow while meeting public expectations on the sector's environmental performance. There is a danger we will throw the baby out with the bath water - the baby is our internationally competitive agriculture and the bathwater is the dirty dairy label.

I have a positive view of the future and see great opportunities for New Zealand if we can successfully manage our way through this wicked problem.

Outline

First I'm going to introduce the policy challenge - how to ensure the policy framework is conducive to a flourishing agriculture while ensuring public perceptions on the sector's environmental performance are met. Then I'll touch on 2 case studies in sensitive catchments that provide pointers

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[1] An earlier version of this paper was presented at the Ministry of Science and Innovation Te Punaha Seminar Series on 21 June 2012. This presentation may be viewed on UTube at: http://www.youtube.com/watch?v=mtXMniklHng&feature=youtube_gdata_player

[2] Nimmo-Bell contributes to teams providing policy advice to government, industry and communities on natural resource management issues. I would like to acknowledge the contributions of my colleagues in NIWA, Beca, AgResearch, GNS Science, Diffuse Sources Limited, Tipa and Associates, Enveco and Market Economics for their roles in the case studies I will refer to. Nimmo-Bell's primary role in these studies is to quantify the market and non-market costs and benefits of different policy options. I would also like to acknowledge my colleagues in Nimmo-Bell, in particular Charlotte Cudby now with MPI and Michael Yap. The sections on policy towards the end of the papers have benefitted from discussions with DairyNZ's Dr Rick Pridmore and Simon Tucker. Errors and omissions are the responsibility of the author.

on the approach being taken and where we are heading. This will include a discussion on how well science and economics is utilised in policy decision making. And then building on all of this, I'll set out some high level principles that will give us a better chance of achieving our goals as a society over the four well beings: cultural, economic, environmental and social.

The policy challenge

> The risk is that in trying to achieve public perceptions of acceptable environmental standards over unachievable timeframes we will lose not only our international competitive advantage in food production, but reduce our ability to fund the education, healthcare and welfare services we all expect and demand.

Agriculture is in danger of losing its public licence to operate. New Zealand can't afford this to happen. Good things are happening, but we don't hear enough about them.

A whole farm system change is required. This will take time and more time than many people want.

Public perceptions on acceptable environmental standards are formed largely through a media that often shows scan regard for objectivity and balance. Headlines scream dirty dairy at every opportunity. I've recently seen on TV beef cows shown as dairy cows and docked cows in pictures that must be ten years old. At best this is sloppy journalism and at worst disingenuous (i.e. not straightforward or candid; insincere or calculating: "an ambitious, disingenuous, philistine, and hypocritical operator”).

Agriculture's license to operate is based on these public perceptions – Positive public perceptions are good for growth. Negative public perceptions limit growth. If growth stalls or worse still stops or even contracts, the dairy industry will increasingly loose its best people overseas.

There is a danger that focusing on the easy target – dairy, we do not also address in a like manner other major problem areas – in particular urban issues such as sewerage spills and storm water discharges which deserve equal scrutiny and regulatory response as contributors to the problem.

The good things are drowned out by headline grabbing negatives.

Pure Advanage (2012) points out that NZ rates highly as an efficient food producer – it's our comparative advantage as a nation. We are doing some things right:

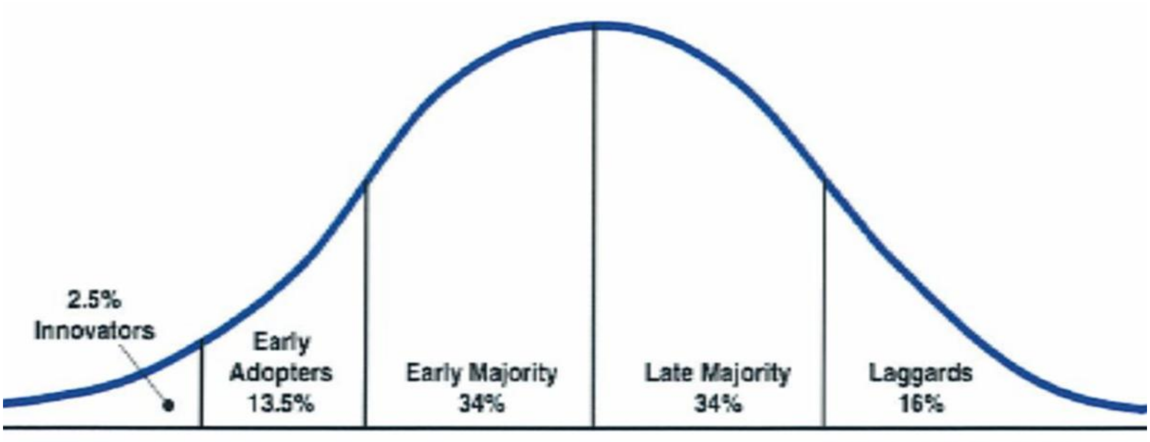
- Fonterra's investment in innovation in NZ, Singapore, Australia and China: forage and bovine genetics, nutrition, flavours, texturants and packaging
- NZ's leadership in GHG methane emissions research PGHGR Consortium and AgGHGR Centre – particularly in the area of solutions to ruminant emissions
- Growth in Bioactives – colostrum, manuka honey, antioxidants from blackcurrants, supercritical extracts – for their antinflammatory, antifungal, antimicrobial properties
- High tech advances in water & soil management – precision agriculture – automated smart irrigation systems, minimum tillage cropping, targeted fertiliser application

But PureAdvantage acknowledges that a lack of targets on nutrient flows is holding back solutions on nutrient discharges – which in my view is the major environmental issue.

Whole system changes take time and resources to implement – adoption of new technology and in particular, complex system changes follow a normal distribution and typically take around 20 years for full adoption to occur.

Figure 1 shows the typical adoption distribution. We are probably at the innovators and early adopter stage for diffuse nutrient discharges which means up to 16% of farmers are likely to be on board. The challenge lies with middle 68% of farmers – the early and late majority. The laggards in the tail are unlikely to change and farm ownership change will be the way to make progress here.

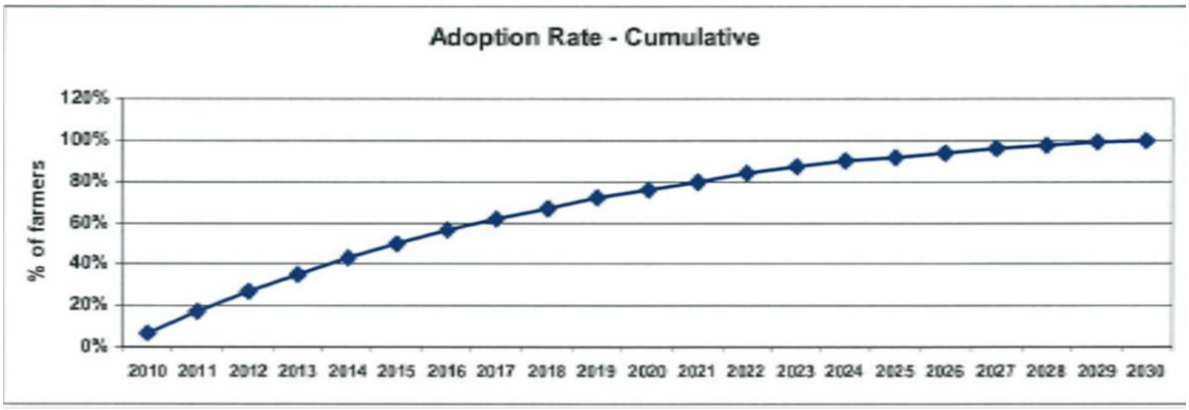
Figure 1. Adoption distribution of complex management systems



Source: Journeaux, Schischka and Phillips 2011

The time horizon for the adoption of complex management systems is of the order of 25-30 years as shown in figure 2. An intensive effort will be required to reduce this time period to 20 years, with a 50% adoption in 5 years a major achievement. We can't expect this sort of progress without some critical prerequisites being met – and these are not yet in place.

Figure 2. Cumulative adoption rate



Source: Journeaux, Schischka and Phillips 2011

Farmers will do the minimum to avoid penalties, but we have to go way beyond that to a place with incentives to do better. On nutrient flows farmers need to know the limits – measurable limits to target. I'm not talking about input restrictions like cows/ha, but output targets like kg nitrogen leached (NL)/ha. How this is managed will make a huge difference to farmers' response and performance.

I am now going to review what is actually happening on policy to clean up degraded water systems using two case studies. The first is the Waikato River. Nimmo-Bell was contracted to undertake the economic analysis for the Waikato River Independent Scoping Study (NIWA, 2010). This study made recommendations to clean up the Waikato River and has major implications for agriculture in that region.

Waikato River Co-management

The aspirations are for a healthy and well river that is swimmable and where food can be gathered over the entire length: the river of life - each curve more beautiful than the last. Figure 3 shows a vista along the magnificent Waikato River. Note the absence of a riparian strip along the left bank with opportunity for animals to graze right down to the water.

Figure 3. Waikato River

Source: NIWA 2010

The scoping study, led by NIWA, was based on a new approach to catchment co-management between the Crown and river iwi to restore and protect the health and wellbeing of the Waikato River for future generations. As such it took on a quite different approach to anything I have been involved in before. Maori aspirations and approach to analysis of the issues had equal weight to that of western thinking.

Three scenarios were analysed:

S1. Current policy no extra CAPEX

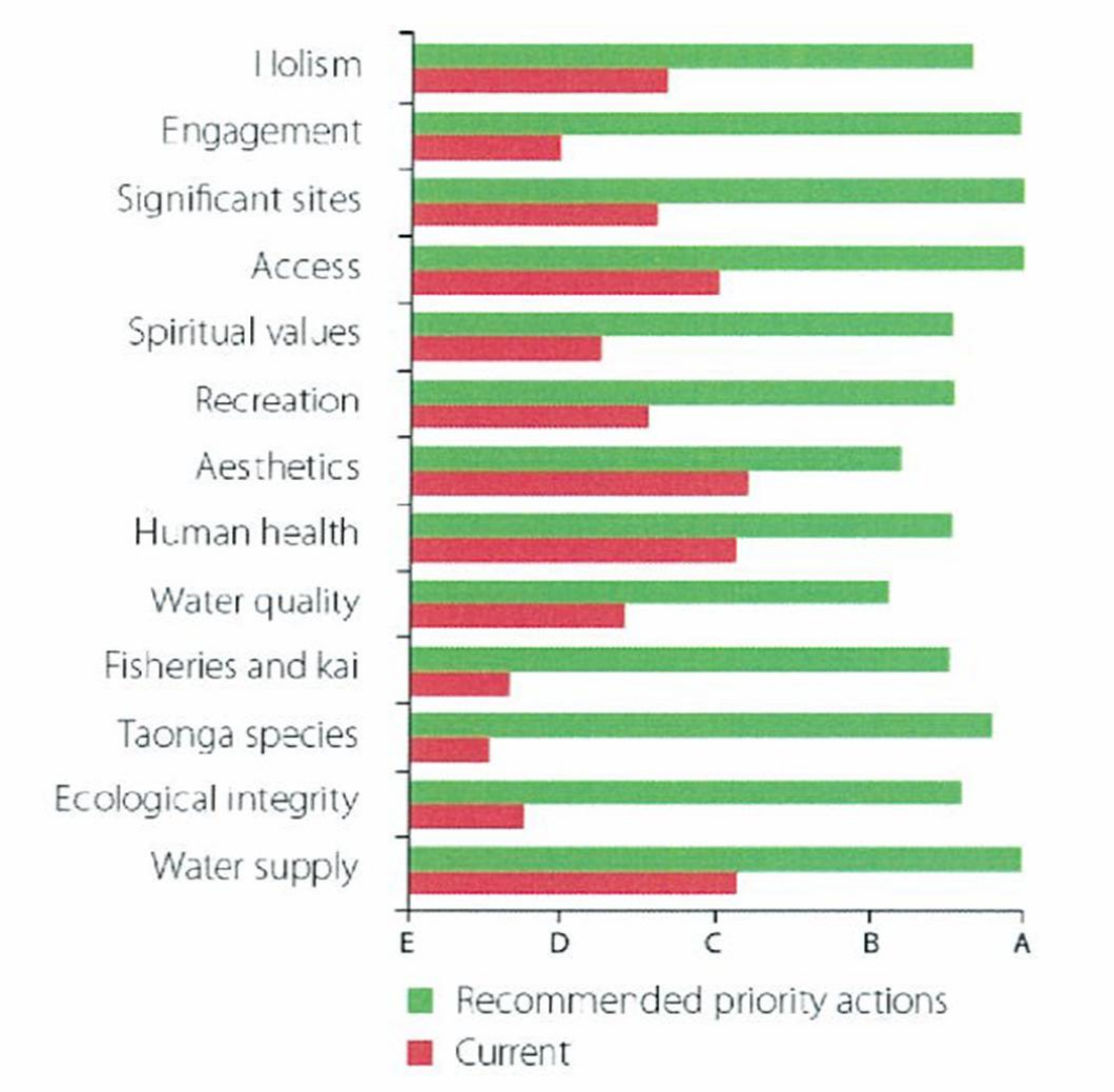
S2. An optimised package of restoration of low risk and high potential B/C ratio

S3. S2 plus actions, with additional benefits of not well proven and/or lower B/C ratio activities.

Aspirations for the river

Arising from this analysis a number of priority actions were chosen, which were derived from Scenario 2 plus some of Scenario 3 activities. Adoption of the priority actions are expected to result in the following progress on aspirations for the river (see Figure 4):

Figure 4. Progress on aspirations for the Waikato River from adoption of priority actions



Source: NIWA 2010

On the scale E is the minimum standard and A is the standard fully net. Currently the river scores a D- to a C whereas the aspiration is for a B+ to an A. Note that agriculture does not feature, but it influences water quality which is expected to move from D+ to B+ as a result of the recommended actions.

Note also that these aspirations are for the river and do not directly equate to the four well beings which are the aspirations of the community. Economic well being is not something that the river has, but the community does. The economic analysis recognises this by attempting to quantify all the costs and benefits associated with cleaning up the river.

Having a Maori / Western science approach integral to the process added a new dimension to the analysis. For all that there was a remarkable co-incidence of views about objectives for the river. My experience in being part of the process opened my eyes to the common purpose. Most of the concerns around aspirations are due to poor communication. The more we work together on issues the less mistrust there will be and the result will be a more cohesive society.

The results of the economic analysis of market related costs and benefits are shown in Table 1. There will be a net cost of $1.4 billion in Present Value terms over the 30 year life of the analysis, with total costs of $1.9 billion and benefits of $570 million. Half the Net Cost is expected to be borne by agriculture due to actions that will result in less nutrient, effluent and sediment reaching the river. Some benefits do accrue to agriculture through the adoption of best management practices with consequent increases in efficiency gains.

Table 1. Results of Recommended actions

Market Costs and Benefits (PVs discounted @ 8% over 30 years)	
Costs	-$1,930m
Benefits	+$570m
Net Cost (PV)	-$1,400m
Cumulative Jobs	
Waikato	+1,590
Rest of NZ	-21,160
Total	-19,570

Source: NIWA 2010

Non-market Benefits

An assessment was also made of the non-market benefits and costs. These fall into categories of active, such as ecosystem services (kai moana and access) and passive including aesthetics and biodiversity. The study conclusions were that the net non-market benefits i.e. taking the river from D-/C to B+/A are likely to be in the same order as the market costs.

Agriculture's contribution

The cost to the agriculture sector of priority actions in Present Value terms are Dairy $259 million and dry stock $441 million, giving a total of $700 million. Dairy costs relate to action required on nutrient and effluent management, diversion of runoff away from waterways, wetland construction, planting riparian buffers and use of N inhibitors. For dry stock farmers the main actions required are fencing streams, planting riparian buffers, changing land use from pastoral farming to forestry, erosion control, establishing forest buffers along waterways.

The main cost for dairy farmers will be in upgrading effluent management systems through better effluent storage and effluent irrigation systems. There will also be a significant loss of productivity due to land use change. Drystock farm costs will increase through fencing of streams, riparian planting and land use change to forestry.

Many farmers will need professional advice to make the whole system changes required to achieve the objectives. It will take time to change and more time to see the results. For example, the target set for dairy on free draining soils is for a 40% reductions in nitrogen leached from the base of 44kg to 25 kg (under Scenario 2), with herd shelter to 15kg under Scenario 3.

The focus of this analysis was on determining what is needed to clean up the river and what will it cost. Clean-up activities involved much more than improving the quality of the water. A significant proportion of the cost pertained to allied components such as restoration of habitat for Taonga species including tuna (eels), whitebait and other kai. Science dominated the analysis with the result that there was not enough funding to undertake such work as a primary survey to estimate the non-market benefits. Unfortunately, when the lead contractor has a science bias economics gets tends to get squeezed. In this scoping study economic efficiency was not a primary concern so the contribution of economics was not as much as could have been. Now that the clean-up has been scoped the focus should turn to efficiency issues as the budget to implement the policy will inevitably be less than the costs identified.

I will now turn to the Rotorua Lakes catchment

Rotorua Lakes land use?

Like the Waikato River, Lake Rotorua has become significantly degraded. Although most of the point source discharges have been dealt to, the main problem continues to be diffuse source nutrients from pastoral farming. The objective is to improve water quality in Lake Rotorua using the Trophic level Index[3] as the indicator, reducing it from 4.8 to 4.2 (Beca 2011). This will require a reduction in nitrogen from the current load entering the lake of 725 tonne per annum to a sustainable load of 435 tonne of nitrogen per annum, a reduction of 300 tonne.

Scientists estimate pstoral farming contributes 72% of the nitrogen and 43% of the phosphate entering the lake and the scale of reduction in nitrogen requires a change in land use to lower the amount of these nutrients. Three scenarios were agreed between the Council and the lead contractor to achieve this over three timeframes (10, 25 and 50 years) compared to the base land use (see Table 2).

Scenario 1, which has a halving of land in dairying falls short of the required reduction in N by 17%. Scenario 3 achieves the target, but requires all land in dairy to change to a lower leaching activity. Scenario 2 achieves the target and allows some dairying to be retained (see Table 3). Under the proposed scenarios most of the reduction in N comes from changed land use – between 78% and 90%.

[3] Trophic level Index, a measure of water quality

Table 2. Proposed land use change in Rotorua Lakes Catchment

Land use change				
('000 ha)	**Base**	**Sc 1**	**Sc 2**	**Sc 3**
Dairy	5.1	2.5	0.0	1.1
Dry stock	15.1	9.0	12.7	9.0
Forestry	21.2	28.2	27.1	30.0
Life style	1.1	2.6	2.6	2.6
Total	54.6	54.6	54.6	54.6

Source: Beca 2011

Table 3. N reduction under 3 scenarios

N reduction t/yr			
	Sc 1	**Sc 2**	**Sc 3**
Land use change	195	284	272
Land mgt change	55	20	31
Total	250	304	303

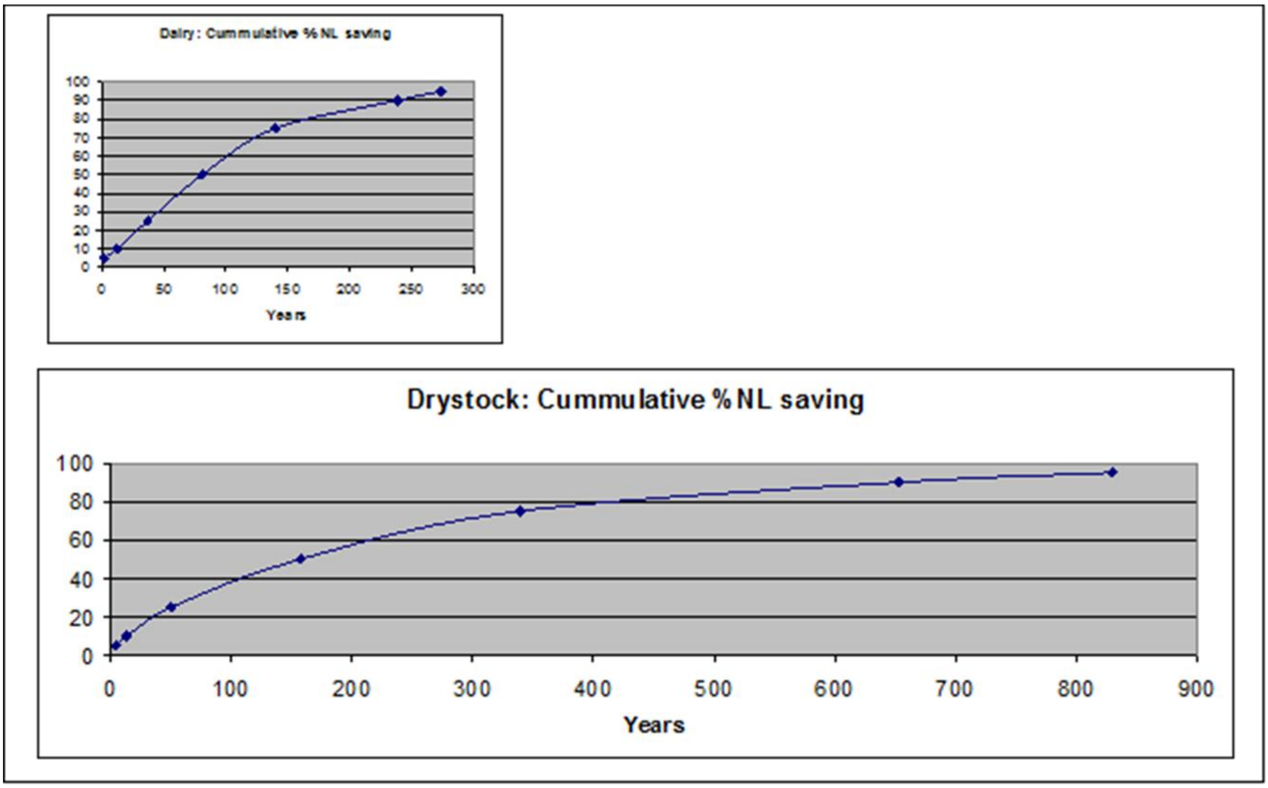
Source: Beca 2011

Even with the proposed changes in land use the reduction in nitrogen entering the lake will take decades to occur. This is because less than 10% of land currently in dairy lies within 10 year contour for the time it takes nitrogen to enter the lake via ground water and 68% lies beyond the 50 year contour. For dry stock the timeframes are much longer with 75% of land lying beyond the beyond 50 year contour. According to GNS Science (Beca 2011) around 50% of NL will arrive at the lake within a year and the other 50% which will travel via deep water aquifers will take much longer (see Figure 5).

For dairy, GNS Science estimate it will take 100 years for 60% of the deep water N to arrive and for drystock 100 years will see only 40% arriving. No matter what is done there will be a substantial lag between action taken and benefits fully received – in fact several generations. Thus the time between implementation and measurable results has an economic drag. This delay between implementation and measurable results is reflected in the economic model – the shorter the implementation timeframe the higher the cost, but it really won't do much to change the benefits in the short to medium term

The main land use change is forestry which increases by 33%, 28% and 42% from 21,200 hectares under the three scenarios. While forestry has a much lower economic return compared with dairy it also results in a loss of regional income over the period that the forest is growing, a period of 26 to 30 years. Furthermore it may or may not have a lower return compared with dry stock farming depending on whether the Emissions Trading Scheme (ETS) actually delivers real returns.

Figure 5. Prediction of N travel times via deep aquifers for Dairy and Drystock farming



Source: adapted by Nimmo-Bell from GNS Science (Beca 2011)

Selling carbon credits is risky

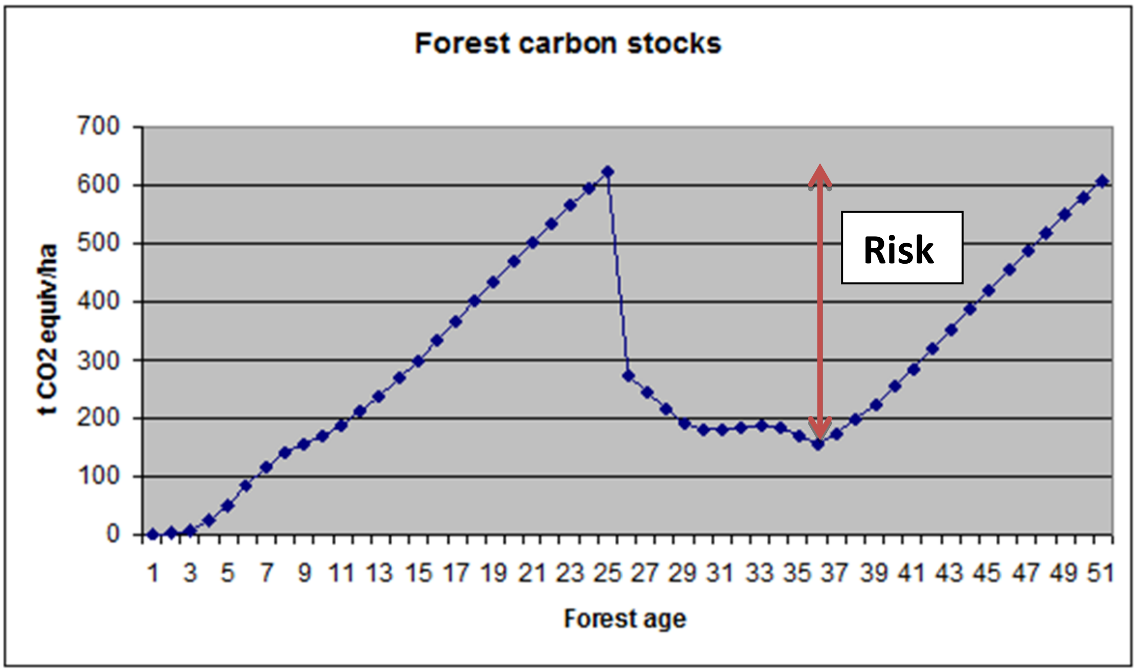
From a forester's viewpoint carbon credits are not all they're cracked up to be. If all the credits gained are sold – two thirds have to be bought back at harvest (see Figure 6).

This exposes the forest owner to significant financial risk – in the space of a year the price of credits have gone from $20 to $6/tonne CO_2. What will they be in 2040? If sold at $25/t, the breakeven buyback price is around $50/t at a discount rate of 8% due to the time value of money. Only a third of the credits are risk free. But these credits can only be claimed in the first rotation. So once in the scheme there is a huge cost of getting out. It is a lock up situation, with dubious returns beyond the first rotation.

NPV of benefits

The least cost scenario is Sc1at $15.3 million - with carbon credits and implemented over 50 years (see Table 4). Without carbon credits forestry is not competitive with drystock. This has the effect of increasing the net cost of the policy by 43% for Sc1. The difference between With and Without carbon is greatest with implementation over 10 years, because of discounting and 50 year project life. Not only is there an economic cost of changing land use to forestry in PV terms there is also the cashflow implications imposing up- front costs and delaying the receipt of income to the end of the rotation. If carbon credits are a reality then the annual return during the rotation is better than the annual returns from drystock farming, but there is also the financial risk of carbon price change. If not, then a change in land use to forestry must be funded with significant cashflow implications for land owners.

Figure 6. Cumulative CO_2 in a typical radiata pine forest



Source: adapted from MAF 2010

Table 4. PV of Net Costs ($m, 8% discount rate)

With Carbon Credits			
Years	**Sc 1**	**Sc 2**	**Sc 3**
10	42.6	72.6	62.2
25	27.1	46.2	39.6
50	15.3	26.2	22.5
Without Carbon Credits			
10	60.7	87.8	84.1
25	38.7	55.9	53.6
50	21.9	31.7	30.4

Source: Beca 2011

The cost effectiveness of various land use changes with carbon credits varies from -$1/kg NL converting drystock to forestry to $41/kg converting dairy to low N drystock (see Table 5).

Table 5. Cost effectiveness /kg NL (with carbon credits)

Conversion of –	
Drystock to forestry	-$1/kg
Dairy to new lifestyle	$5/kg
Drystock to new lifestyle	$6/kg
Dairy to low N loss dairy	$13/kg
Drystock to low N drystock	$24/kg
Dairy to forestry	$32/kg
Dairy to low N drystock	$41/kg

Source: Beca 2011

While changing land use from dairy to forestry is a high cost option it is considered essential to achieve the 300 tN/yr target for the lake. This analysis does not take into account the potential gains from innovation. How the policy to reduce the N load going into the lake is implemented will have major implications for agriculture.

Present Worth of N: Cost effectiveness over time

If society has the same discount rate for N as for $ then timeframe is not significant. But there are significant differences between options with Sc1at $34/kg N loss, Sc2 at $48/kg and Sc3 at $41/kg. If the discount rate for N is lower than $ this will favour a longer implementation. If the discount rate for N is higher than $ this will favour a shorter implementation. A high discount rate implies near to benefits and costs are relatively more important than those further away.

Non-market value of improved water quality

Based on an updated 2004 contingent valuation survey (Bell and Yap 2004) the non-market benefits of improved water quality in Lake Rotorua for Residents is $47.2m. In addition, Non-resident anglers have a value of $12.5m, which gives a Total Benefit of $59.7m and thus the Benefits exceed Costs for Sc3 over 100 years.

Discussion

The CBA results assume current technology. No allowance is made for innovation. It is my view that once limits are set for environmental spillovers farmers will find ways to live within them. It is unlikely that the land use change assumed in the study will occur if farmers are set realistic targets and given the freedom to choose the way to achieve them. History has shown that farmers are very adaptable and respond well to changing circumstances. This arises from dealing with the seasonal variation that is inherent to farming in New Zealand. Season to season variation through drought and flood are high and the changes required on average in farming systems is likely to be significantly less, but none the less daunting to many farmers. It will require a whole farming system change to adjust and this will take time to implement.

Currently, uncertainty over limits demotivates farmer response. Farmers have been adopting a wait and see attitude. It does not make sense to make major changes to farming operations when the details of environmental policy have yet to be worked out. The tactic that has been adopted by the farming sector has been to defend the status quo, but this is now changing with a significant change in approach from farming leadership towards the acceptance that change is necessary.

Significant progress will be made by getting rid of the tail of the adoption distribution. Those farmers who can't or won't change either because they are at that part of the life cycle that it is too hard or that is just not the will there. The pressure on these farmers will come from peer pressure and ultimately from the regulators. Eventually, they will sell out and a new generation of farmers will take over. These farmers will have their heads in the right space and make the adjustments that are necessary.

Innovation is likely to lead to significantly lower economic cost than modelled. It is very hard to see how this is likely to unfold without knowledge of how the policy change will be implemented, which is currently an unknown.

Conclusions from Rotorua study

Most farmers are in the catchment are in a caretaker mode. They are waiting to see how the policy changes will be presented before making expensive changes to their farming systems. Depending on circumstances achieving targets could range from financially positive to viability threatening. Whole farm system change is needed. Most farmers will need professional advice to achieve targets efficiently. Science has shown the extent of the problem and given the tools to fix it. The economics highlights the benefits of innovation as there are many ways to achieve the desired goals and in order to minimise the economic cost farmers need to have the freedom to choose their own path to achieving the desired results. Policy makers have the scientific and economic information needed to formulate sound policies. We have yet to see how they will use this information.

Policy environment

In my view, agriculture has been in a national policy vacuum for diffuse source nutrient flows with ad hoc regional regulation being implemented without an overall national policy framework. However, there is a common interest among the major stakeholders including agriculture, regional authorities, environmentalists and urban dwellers. The clean and green culture that was established with the younger generation in the 1980s and 1990s is now imbedded in New Zealand's psych.

The Land and Water Forum has created a platform (L&WF 2012) for positive change by bringing together the parties in a non-confrontational process that is leading to a consensus on a sustainable way forward. This must not be allowed to result in an overly bureaucratic nightmare for farmers when it comes to implementation.

For many years agricultural industry leadership has been in defensive mode on environmental issues, largely I think, because they could not see a way forward that protected the economic position of farming while improving environmental conditions. The current leadership appears now to have moved beyond that position. Effective agricultural leadership is forestalling unnecessarily stringent regulation.

Progress is being made on key environmental issues. Serious non-compliance for unlawful discharges as shown by prosecutions is down 65% to 9.5% over the last 3 years. This is being achieved through investment in hardware e.g. professionally planned and constructed effluent ponds and software e.g. training and up-skilling (Simon Tucker DairyNZ, pers com, 2012).

Agricultural initiatives

Farmers need targets that will fix the issues as a package. This will include CO_2, may not be N, could be P or Urban sewerage etc. There is a danger in regulators rushing to limit nitrogen when the limiting factor may be something else such as phosphorous. Industry good organisations such as DairyNZ, the CRIs and private sector research providers all have vital roles to play. It is essential that the regulations are based on good science. As an example, DairyNZ's Dr Rick Pridmore has provided the target levels of N for Lake Rotorua, which form the basis of the policy to return this water way to a socially acceptable quality.

Prescriptive input restrictions will stifle initiative and result in farmers doing the minimum necessary to meet the regulations.

Farmers need outcome based targets to encourage innovative solutions. It is a classic case of many small decisions leading to the best solution rather than relying on one major one. Farmers learn from each other and quickly take up ideas that save them time and money. The targets must be under pinned by a regulatory framework that includes penalties of a sufficient harshness to deter the laggards, yet not unduly penalise genuine mistakes.

The issues are catchment specific and need to be dealt with on that basis within a national policy framework.

Framework for a whole system collaborative process

1. Set the objectives
2. Define the limits
3. Determine the contributors to the problem
4. Divide up the required actions among the contributors - Agriculture/Industry/ Urban
5. Monitor, evaluate and refine.

Setting objectives relates to the 4 well beings: cultural, economic, environmental and social – the balance depends on societies' appetite for risk. For example, placing too much emphasis on the environment would have a high risk of economic stagnation in rural areas and eventually for the whole economy. Conversely, too much emphasis on economic returns puts at jeopardy New Zealand's clean green image and risks devaluing the way of life enjoyed by being a New Zealander.

The rush to set limits is a real issue as the consequences of getting it wrong are potentially immense e.g. setting a low nitrogen target of 26kg NL/ha/year when the current average is 56 could make many dairy farms uneconomic. If milk production suffers the losers are not only the dairy farmers, but the regional (and national economy if taken up nationally). The flow on effects could result in less jobs, less export income and less money available for public expenditure on education, health and welfare programmes etc.

There is a prevailing perception that the major problem is N, but it may be P – most New Zealand rivers are P limiting, if so riparian strips to reduce P run off rather than targeting management to reduce N leaching should be the focus. The Commissioner for the Environment (2012) report on understanding the science of environmental improvement provides a helpful introduction to this subject for the lay reader.

Limits should be set on the basis of good science not social perceptions. A return to pristine water is not a reality. There is no public outcry about the water quality in Lake Karapiro yet it has a much higher recreational use than Lake Taupo despite having a significantly lower level of water quality. The target water quality level for particular water ways should be the result of balancing society's net gains based on the four well beings. There will be different water quality levels in different parts of a catchment and this does not necessarily mean water quality will be lower at the end of the pipeline to the sea.

Each component of the targets must be location specific, measurable and time bound e.g. waste water temperature from dairy factories in the catchment reduced by x degrees by 201_, urban storm water effluent reduced by y tonnes by 201_.

Policy response

Policies should ensure that Good Management Practice is rolled out by catchment in stages:

Year 1 - benchmark data

Year 2 - develop win win solutions

Year 3 on – adoption

Year 4 on – monitor, evaluate and refine

Many farmers will require one on one advice as well as group advice and national coordination. Farmers will inevitably carry most of the burden of adjustment. As the benefits accrue to both the local and national economy rate payers and tax payers should also bear a proportion of the cost.

My feeling is that the bridges between science, economics and policy have been created. The next decade or so should see a gradual improvement in environmental outcomes. In striving to improve economic performance in a tough international marketplace agriculture has taken its eye off the environment al ball. As a consequence New Zealand has slipped down international rankings on the environment. If policy makers heed the advice of scientists and economists specialising in natural resource management then the bridges will be strengthened and the pathway to a better place can be attained. The alternative is further deterioration in the four well beings as stakeholder groups pursue narrow self-interest at the expense of balanced profress.

Summing up

Agriculture is what we do best

Environmental sustainability is a given

If we are not to throw the baby out with the bathwater it will take:

- Leadership
- Collaborative communication and management
- Innovation
- whole farm systems change
- a phased approach.

We need to focus more on the positives and measure and publicise progress on outcomes.

We need agricultural leadership that embraces the view that agricultural productivity increases must go hand in hand with improved environmental outcomes.

We need collaborative management that targets the major sources of problems in an even handed manner, one that doesn't rush in before the problems are fully understood.

We need a policy framework that is outcomes based, encourages innovation and steers clear of prescriptive input management.

We need to recognise that farmers have to make whole system changes and plan for a phased approach to achieving targets.

By doing these things we have a chance of maintaining our position as an internationally efficient food producer and enjoy the wellbeing we all expect in the future.

The policy challenge

I would like to leave you with the policy challenge I opened with:

> The risk is that in trying to achieve public perceptions of acceptable environmental standards over unachievable timeframes we will lose not only our international competitive advantage in food production, but reduce our ability to fund the education, healthcare and welfare services we all expect and demand.

Thank you for your attention. I am happy to take questions and comments.

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