

**NEW ZEALAND:**

**AGRICULTURE and the ENVIRONMENT**

*Toitu te whenua, whatua ngarongaro te tangata*  
People come and go, the land remains

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This report is based on a six week study tour of the North and South  
Islands undertaken in July/August 2006

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## ***THE ELEVENTH COMMANDMENT***

***“Thou shalt inherit the holy Earth as a steward conserving the resources and productivity from generation to generation. Thou shalt safeguard thy fields from soil erosion; thy living waters from drying up; thy forests from desolation; and protect thy hills from over-grazing by the herds, that thy descendants may have abundance forever.”***

*From: L.W. McCaskill (1973) “Hold This Land”*

***‘Sometimes a whole hillside will wrinkle and slide like snow melting off a roof, its huge corrugations smothering and smashing the wretched sheep, half or wholly burying them in every posture.’***

*Herbert Guthrie-Smith (1969)*

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## SUMMARY

### Introduction

The UK is currently experiencing huge changes to farming and the countryside. The Water Framework Directive is forcing us to address processes and interactions on a catchment scale, whilst CAP reform has placed greater emphasis on environmental management through GAEC, LMCs and an expanded programme of agri-environment schemes. One of the consequences of the changes will be a redressing of the balance between production and a fully functioning, clean environment.

New Zealand already has the reputation for producing good, healthy food in a clean and environmentally benign manner, indeed much of its marketing and overseas export success relies upon this perception. A recent study showed that New Zealand dairy farmers typically benefit by around NZ\$30,000 (~£10,500) per year from its green image.

<i>Some facts: comparing Scotland with New Zealand</i>		
	<b>Scotland</b>	<b>New Zealand</b>
Land Area	78,000 km <sup>2</sup> (UK 244, 000 km <sup>2</sup> )	268,000 km <sup>2</sup>
Population	5m	4.1m
Distribution	Urban (71% on 11% of area)	Urban (92% on 14% of area)
Rainfall	600 – 3000 mm	300 - 8000 mm
Topography	49% > 200m	75% > 200m
% workforce in agriculture	2.8	8
% of GDP	1.3%	4.5%
Sheep	8m	40m

But does reality stand up to impressions, and what are New Zealanders doing to ensure that agriculture is not damaging soil or water resources? Are there any lessons we can learn from New Zealand that could help us adapt to the new regime in UK agriculture?

## Agriculture in New Zealand

Traditionally, New Zealand agriculture has been dominated by sheep farming based on grass-clover swards. This is a low input, low output, low *environmental impact* system. But times, and agricultural practices, are changing. Since the 1980s sheep numbers have halved to around 40m, dairy cattle have increased by over 2m (to 5.1m), and deer farming has increased by 300% (to 2m head). The industry is also being increasingly intensified.



**Fig 1: Extensive sheep production in Waikato**

## Intensification of agriculture

Dairy farming in particular is becoming more intensive but other sectors, including sheep and beef, are also stepping up their inputs and sales. Fertiliser, for instance, is rapidly replacing clover in supplying nitrogen: between 1996 and 2002, N inputs increased by 670% in the sheep and beef sector, and 160% on dairy land.

With an increase in fodder production comes an increase in stock density. Increased stock density results in higher nutrient loads, greater release of faecal indicator coliforms and other animal pathogens, more erosion and more “pugging” (poaching).

In addition, more stock farmers are importing supplementary feed and irrigation has increased by 55% every decade since the ‘60s. The area under irrigation in the Canterbury Region (the east coast of the South Island centred around Christchurch) has doubled in the last 20 years. Both irrigation and supplementary feeds are also increasing stock density.

## Horticulture

One of the greatest changes, and great success stories in New Zealand, has been the stimulation of the horticulture sector. In 1980 the export value of horticultural products (including fruit, vegetables and wine) was NZ\$ 115m; in 2005 the industry had grown to NZ\$ 2.3 billion.

Why has there been such a sea change in the country’s agriculture over the last two decades? One of the main reasons was the removal of subsidies in 1984. New Zealand farmers had to adapt to survive, and if there’s one generalisation you can make about New Zealand farmers it’s that they are characterised by a willingness, even eagerness, to innovate and to adopt new practices.

It is said that New Zealand has the highest rate of land use change in the world; their ability to respond to rapidly changing conditions, and to identify and exploit new market niches is the main reason behind the success of the industry. This is an

enormous source of pride in the country, but it also contributes to the problems increasingly besetting the environment.

### Environmental Quality

There is increasing evidence that environmental quality is decreasing and, in various ways, is costing the country millions of dollars a year.



**Fig 2: Stream bank erosion and siltation of waterways in Wairarapa, east side of the North Island**

### Examples of environmental degradation

- Soil erosion costs a conservative NZ\$ 127m p.a. due to the 300m tonnes of sediment blocking rivers, disrupting infrastructure, and reducing soil fertility
- Water quality is poor in the lowlands: one study showed that campylobacter was found in more than 60% of lake water samples<sup>1</sup>
- 80% of the bathing waters monitored by the regional council in the Waikato area (located in west coast of the North Island) failed to meet the required standards
- All lowland rivers in Waikato are polluted
- In Canterbury, rivers regularly go dry for prolonged periods during the summer due to over-allocation (including irrigation) and misuse of supplies
- 10-40% of lakes are nutrient enriched

Mathematical models<sup>2</sup> produced by the Crown Research Institutes strongly indicate that nutrients derived from agriculture will seriously compromise potable water quality in major population centres in the next few decades.

### Action in New Zealand

A major report, “Growing for Good”, published in 2004 by the Parliamentary Commissioner for the Environment, highlighted the ever-increasing negative influence of intensive farming on the environment. It was a clarion call for action.

Since the publication of the report, many excellent projects and initiatives have been set up in New Zealand. For example, the “Dairy Clean Streams Accord” aims to reduce stock access to water bodies; nitrification inhibitors and “denitrification walls” are being used to reduce nitrate pollution; increased regulation is helping to control land use and land management in some areas; and many organisations (such as the Landcare Trust and the Ministry of Agriculture and Forestry (MAF)) are bringing communities together for collective action.

<sup>1</sup> New Zealand has the highest incidence of *Campylobacter* food poisoning in the developed world – 3x higher than England and Wales

<sup>2</sup> such as the Integrated Aquifer Research Protection programme (IRAP)

### The Dairy Clean Streams Accord

Several factors combine to make dairying a serious risk to the environment: high stock density, lack of winter housing, strip grazing of winter fodder crops, poor irrigation management, and the increasing import of supplementary feeds.



The Clean Streams Accord attempts to address some of the problems caused by intensive dairying. The Accord is a statement of intent and a framework of action as agreed by government, regional councils, Fonterra<sup>3</sup> and farmers. The main thrust of the Accord is aimed at reducing stock impacts on waterways through good riparian management.

Fencing of waterways is the main method of controlling stock damage to waterways. The Accord aims to fence off 90% of streams by 2012.

**Fig 3: Strip grazing of winter forage crops and fencing of streams**

In addition, 90% percent of regular crossing points should have bridges or culverts by 2012. Also, farms have to have in place nutrient management plans and plans for effective management of parlour effluent. At the moment few farms take into account the nutrient content of effluent and a significant number of farms have inadequate storage or land application facilities.

### Nutrient management

Nutrient budgeting software programs (e.g. “Overseer”) are becoming more widely used, and nutrient management plans are now a requirement in some regions (e.g. Environment Waikato).

Much research has been invested in reducing nitrate leaching through the use of nitrification inhibitors. Lincoln University (in conjunction with Ravensdown Fertiliser Co-operative) has developed a product called “Eco-N” which contains the inhibitor “Didin” (or DCD<sup>4</sup>). The product is applied twice, as a suspension, directly to paddocks that are being grazed over winter. Results to date have generally been very impressive: for an outlay of around £20 / ha both nitrate leaching has been reduced

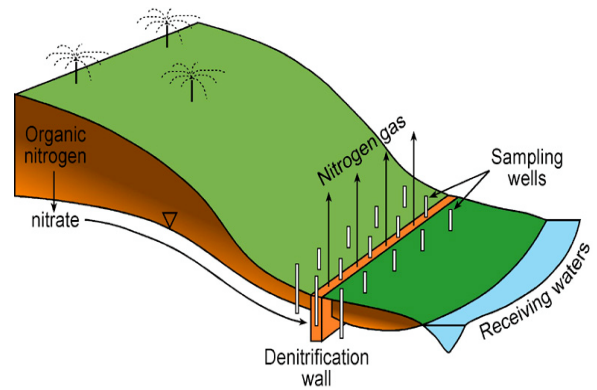
<sup>3</sup> Fonterra is the largest co-operative in New Zealand agriculture. It is owned by 11,600 New Zealand dairy farmers and it is the world's largest exporter of dairy products, exporting 95 percent of their production.

<sup>4</sup> Dicyandiamide. The inhibitors slow down the conversion of ammonium to nitrate. Nitrate is far more mobile and prone to leaching than ammonium.

and grass yields have been increased. At the same time, N<sub>2</sub>O gas (a potent greenhouse gas) emissions have also reduced.

#### **Fig 4: Denitrification Walls**

Yet another method for reducing nitrate pollution has been developed by Louis Schipper at Waikato University. His “denitrification walls” consist of trenches filled with sawdust, placed across the base of slopes alongside watercourses. Drainage water, charged with nitrates, flows downhill into the trenches whereupon anaerobic bacteria reduce the nitrates to NO<sub>x</sub> gases. The system is simple, cheap and long-lasting.



#### **Community Involvement**

Lake Taupo, situated in the centre of the North Island, is New Zealand’s largest freshwater lake. It is an iconic symbol in the country for both the Maoris and for the *Pakaha* (white people). At present it is virtually pristine, but risk assessment studies have indicated that there is a growing threat from farm runoff. The recent conversion of more than 27,000 ha of forestry to dairy land has compounded this threat.

In 2000, following an initial benchmarking exercise by the Regional Council, Environment Waikato, the “2020 Taupo-nui-a-Tia” project was established. A major feature of the project was the engagement of the local community including members of the 2020 Forum, the local Maori Trust Board, the Lakes and Waterways Action Group, and local and central government. By involving these groups a plan to manage the catchment was agreed much quicker and more easily than would have been the case if it was dictated by government, and the scheme stands a much greater chance of succeeding.

#### **Fig. 5: Arthur’s Pass, South Island**

Declining water quality and conflicting requirements between different land uses (HEP generation, recreation, tourism, and agriculture) are common problems occurring throughout New Zealand.



Another interesting project, run by the Landcare Trust and supported by the Sustainable Farming Fund, was centred around Lake Brunner on the west coast of South Island.

Farmers in this catchment are voluntarily implementing measures to prevent pollution of the lake. 25 farms agreed to participate in the project and consultations were held with them to decide on appropriate measures. By 2006, 52% of the agreed works had been completed (well ahead of schedule) and it's projected that a further 30% will be completed on time.

### **Fig 6 : Lake Brunner**

The Lake Brunner catchment contains over 30 dairy, sheep and beef farms, and intensification has raised several issues relating to water quality, ecology and tourism.

A group led by a local farmer and co-ordinated by the Landcare Trust, was set up to investigate on-farm best management practices designed to prevent further deterioration of the lake's health.



### Conclusion

New Zealand is a young country; Polynesians arrived somewhere around 800 AD, and Europeans first began colonising only 200 years ago. Land use and biodiversity change have been a feature of the islands ever since the first human set foot on their shores. Before the *Pakahe* arrived the moa were driven to extinction; in the last 100 years pasture has increased from around 2m ha to the present 10m ha at the expense of native vegetation; and indigenous forest birds have been decimated by imported predators and loss of habitat. And now, with increasing intensification of agriculture, the country is facing a new wave of environmental problems.

Many people recognise the growing threats to their environment and are investing a huge amount of effort to try and prevent further damage. For example, Fonterra, understanding the importance of overseas markets and the value of a “green image”, have been key players in the establishment and success of the “Dairy and Clean Streams Accord”. The government, especially since the publication of the seminal report, “Growing for Good”, have placed much greater emphasis on relevant, practical research and, via the Sustainable Farming Fund, community involvement. A lot of very good work is being carried out by the Landcare Trust and the Regional Councils in engaging the community and implementing changes in land management.

Much has already been done to address the problems, but much more still needs to be achieved before the situation can safely be said to be under control. However, one thing is for certain, if anyone can rapidly turn an oil tanker around it's the Kiwis.

## **RESEARCHERS**

- There are 9 Crown Research Institutes in NZ<sup>5</sup>, 5 of which are directly concerned with land use.
- The CRIs have no base-funding: all research monies are allocated on a competitive basis. Employment depends on securing these research grants.
- In recent years there has been increasing collaboration between the CRIs which has led to greater sharing of data, information, ideas, and expertise, and more efficient research.

*Jeremy Cuff, soil scientist, Environment Canterbury, Timaru*

- The Parliamentary Commission for the Environment reports on a permanent basis. Morgan William's keynote address, "Growing for Good", was published in 2004 and it questioned the environmental record of farming. The report noted that there are many problems caused by farming and yet the emphasis within the country is still very much on production.
- The soils in the Canterbury Plains (the most agriculturally-intensive part of the region, if not NZ) consist mainly of alluvial gravels covered by loess of a silt loam texture. Over the last 10 years there has been a great movement away from clover-fed sheep to fertiliser-fed dairy cows. Grass is irrigated wherever possible (and that's mostly all over the Plains). Livestock are not housed over winter. The high stocking density necessitates the use of sacrificial paddocks which are generally reseeded in the spring. Some arable farmers contract out their land to neighbouring dairy farmers but they inevitably find that yields are reduced in the following year.

Woodchip corrals are not that common, nor are concrete "feeding pads", but they are both likely to come in soon. Traditional farms in the region hold around 1000 units of livestock (where 1 unit = 1 sheep; 1 dairy cow = 6 units) whereas today the typical is more like 2000 units (and a typical dairy concern will have over 1000 head of cattle). Much of this increase in size is due to the formation of corporate farms at the expense of independent family farms.

- Jeremy is involved in the "500 Soils" project. This is equivalent to NZ's "10 Rivers" project. The soils project concentrates on Land Capability Classes 1 to 4 (which in Canterbury occupies about 33% of the area). Predictive models are being developed to look at the effects of land use change, livestock changes, changes to soil management practices and crop management (e.g. stubble management). This "Land Management Index" compliments the "Soil Quality Index".

One finding of the Soil Quality Project is that crop yield is proportional to aggregate stability. Olsen P (i.e. available or labile P) is also being looked at. Another parameter is "anaerobic mineralisable nitrogen" which is used also as an indicator of biological activity. Cadmium has also been investigated and trends of elevated levels (double background levels) have been linked to superphosphate fertiliser applications. At the moment levels are not too high (highest

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<sup>5</sup> <http://www.morst.govt.nz/rst-links/crown-research-institutes/>

concentrations are in the order of 0.2 ppm). In other regions Cd levels are much higher. For example, in the Waikato Region higher concentrations (around 0.8 ppm) have been caused by a combination of superphosphate applications (high rates have been necessary because of the allophanic soils fixing P) and geology (higher background levels).

- Superphosphate is used (as opposed to the more concentrated triple superphosphate) because of the lower levels of sulphur in the soils. Fertiliser is applied aerially but GPS systems (which allow more accurate applications and avoid streams etc.) have been slow to be adopted and only in the last two years have they begun to become more common. Also, precision farming is coming in in the Plains.
- Jeremy is attempting to measure soil erosion rates on the Plains by charting the movement of Cs<sup>137</sup> (radioactive caesium) which was deposited by fallout from French nuclear bomb testing in the Pacific. This ceased in the '70s which gives Jeremy the opportunity to use residues to calculate rates of erosion. He has found that rates of erosion are most significant on the rolling hill-lands of the Plains. Even though the rates are quite low they are still agronomically significant simply because the soils themselves are quite shallow. Off-farm pollution problems are not so serious, but on-farm and in-field losses can lead to reduced productivity and cause problems to the recolonisation by pasture or tussock grasses. The main causes of erosion are over-grazing by sheep or rabbits. Also arable cultivation can lead to increased erosion because of a reduction in aggregate stability following loss of organic carbon.

Farmers still deny that erosion is a problem; this is the main reason why the research is being undertaken.

One way of controlling erosion (and increase aggregate stability) in the lowlands is through direct-drilling. Direct-drilling on the silt loams is being encouraged in order to maintain soil structure and protect the organic matter. Farmers are being encouraged to take up this practice.

- A major weed of the tussock-grassed High Country is a non-native plant called Hieracium. It both out-grows the native grasses and produces allelo-chemicals (which also apparently affect neighbouring plants of the same species). Hieracium is encouraged by rabbits therefore much attention is being devoted to the control of these pests.

*The Centre for the study of Agriculture, Food and the Environment, University of Otago, Dunedin*

- The lack of data is hampering efforts to alter farmer behaviour. Agricultural activity is seriously degrading the environment. In some areas nitrate levels in drinking water are 30x WHO limits. No date has been set by which time water quality should be improved.
- The group I met were dismissive of a top-down approach to improving environmental quality. Farmers do not like regulations! A culture change needs to be evolved by all those concerned, only then will improvements be adopted by the farmers.

- Market forces, especially EU controls, will, to a large extent, dictate what happens to NZ agriculture. All exports to the EU must comply with regulations including those relating to production processes impacting on the environment. This is the main factor behind the Fonterra / Farming / Government's "Clean Streams Accord". Some orchards in Otago region were bankrupted when the EU regulations were changed in the '90s and the enterprises failed to up-grade their systems. It costs farmers a lot of money to demonstrate compliance and obtain export licences (maybe upwards of \$11,000) but many now depend on overseas markets.

*Mike Bearse, soil scientist, Crop and Food Research Institute, Christchurch.*

- Mike is a microbial ecologist / soil scientist who is working on soil organic matter and tillage systems. He has also been involved in developing soil quality monitoring manuals, and increasing farmer awareness and uptake of the manual. He has also developed a Soil Quality Management System for farmers.
- The use of agricultural contractors in the Region has a big effect on soil quality, as it does in the UK. For example, pea contractors working for large processing companies regularly cause compaction at harvest. Since the peas are only grown one year in several, the compaction is of little concern to the contractors and the problems are borne by the farmers themselves.
- Winter feed systems are large sources of nitrate, NO<sub>x</sub> gases and FIOs. The main crops are forage rape, kale, swedes and "chow"<sup>6</sup>. Also multi-graze forage crops, especially triticale, are grown. Triticale is sown later than the brassicas and has two growths in a winter. It is grazed and allowed to regrow when it is then cut for silage. One benefit of the system is that at least it is an all-year-round crop cover for the soil (thereby maybe reducing erosion). Despite the advantages of strip-grazing, the crops are only 50% utilised, according to Mike, due to a combination of some spoilage plus the need to avoid over-grazing which would affect re-growth.
- Mike is working on some direct-drilling and establishment trials on the typical silty loams of the Canterbury Plains. Results suggest that direct-drilling decreases compaction, reduces NO<sub>x</sub> emissions following grazing and increases re-growth. The trials are looking specifically at re-establishing grass on "run-out paddocks" (long-term leys that have significantly lower productivity) which are usually ploughed, sown to forage crops for three years, then resown to grass. The trials are comparing grass with cover crops, grazing and non-grazing, traditional management with direct-drilling and spring barley<sup>7</sup>.

*Steve Thomas, soil scientist, Crop and Food Research Institute, Christchurch.*

- Steve is engaged in research looking at C and N cycling, and modelling NO<sub>x</sub> emissions for the National Inventory.
- Stock density in Canterbury can be very high, up to 6 cows / ha. This level of intensification has been brought about mainly through the use of bought-in feed and irrigation. Water use efficiency is of prime importance since, even though the water itself is free, consent to abstract needs to be paid for, as does, more

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<sup>6</sup> *chou moellier* is known in England as marrow-stemmed kale

<sup>7</sup> even though winter wheat is the main crop now grown in Canterbury

importantly, the pumping. Bore holes in the Region can be very deep (> 200m) and so pumping costs can be high (upwards of \$1000 per day (~£300) for the 90 day season). There is no recommended method of irrigation scheduling. Consents are based on maximum rates (not gross amounts) of abstraction but yearly quotas are now being introduced by the Council. Most farmers do not monitor their Soil Moisture Deficit. Margins are large enough at the moment that they don't have to worry so much about water use efficiency.

- The Central Plains Irrigation Scheme covers 60,000 ha and involves damming a valley for water storage. Consent is currently being sought for abstraction. "Border dyke" (i.e. flood irrigation) systems are frequently used still in Canterbury and these are very inefficient and result in much wastage of water (which also carries with it nitrates and FIOs). Many farmers are wanting to convert to sprinklers applied via central pivot systems<sup>8</sup>.
- Steve is involved in the national IRAP Programme – Integrated Research in Aquifer Protection. He's investigating the processes occurring in the vadose zone below the rooting depth, as affected by rotations, irrigation and fertiliser rates<sup>9</sup>.

Preliminary results suggest that highest rates of leaching occur at the high rate of nitrate application *and* high rate of irrigation. Although this seems obvious, data such as these are important to convince New Zealand farmers that their current practices are unsustainable.

In addition, Steve's group have found that NO<sub>x</sub> emissions were low but since the gravels can be 300m deep the cumulative effect on nitrate leaching could still be highly significant.

*Allan Hewitt, soil scientist, Landcare Research, Christchurch*

- Allan is researching "hydro-pedology" in an attempt to produce spatial models which, along with GIS and informatics, will permit interpretation of soil qualities with the aim of predicting the consequences of land use change within catchments. In particular, predicting the effects of increased irrigation intensity on leaching and drainage water quality. He is also modelling the effects of waste disposal to land.
- He is now also involved in the new soil mapping programme of New Zealand which has recently been initiated. The soil data base is at present quite patchy. There is complete coverage of the country at 1:250,000 but only 50% has been mapped at 1:50,000 (and only 40% in the South Island). 6 pedologists are involved in the project. Base-funding is provided, at the moment, by Central Government. Future funding will be sought from the RCs.
- The NZ Soils Repository will bring together all available information from previous mapping exercises (i.e. the NZ National Soils Database), from countless small projects, from research and field trials, and from innumerable other sources. One of the main problems with such a diverse range of sources is the different methods of sampling and lab analyses used. The new Soils Repository takes these

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<sup>8</sup> The radius of these enormous systems can be as long as almost 2km. Most research says that 0.4 km radius is the optimum length.

<sup>9</sup> Water is applied at rates that return the soil to Field Capacity (zero SMD), and rates 75% > the optimum rates. Fertiliser N is applied at zero N, 1 N (200 kg N / ha – the recommended rate), and 2N (400 kg / ha – replicating typical farmer rates).

differences into account (without burdening the enquirer with excessive detail) and thereby greatly increases the quantity of data available. The aim is to provide a soil information portal which will provide on-line access to soils maps, analytical data, facts sheets and other information (climatic, topographical, ecological, geological, satellite imagery and so on). In return users will be asked to contribute their own data and so continue to expand the NZSR. Such an approach is similar in concept to web sites such as “Wikipedia” and “TradeMe”.

- Landcare Research are also investigating green roofs. One project, run in conjunction with Auckland City Council and Auckland University, aims to establish a 500m<sup>2</sup> demonstration roof that will serve to increase awareness of the benefits, costs and construction of such environmentally advantageous systems. The project is also attempting to identify suitable native species (Sedum, one of the most commonly used species, is a non-native and indeed is a *weed* in the South Island).
- The CRI (Crown Research Institute) is looking at dissolved organic nitrogen and results have indicated that as much as 87% of the Total N leached from soils can be in these forms.
- The Maori moniker of Landcare Research, “*Manaaki Whenua*”<sup>10</sup>, indicates how much emphasis the CRI places on Maori issues and sensibilities<sup>11</sup>. The organisation employs a Maori Liaison Officer at Senior Management level. The government provides funds for Maori-related projects and, of all the CRIs, Landcare Research receives the largest share.
- Precision agriculture is seen by many to be the way forward for NZ industry because of its efficiency, and the environmental and marketing benefits derived from the practice. “Landcorp” is NZ’s largest farming corporation and it uses its precision technologies to provide traceability, and to market its produce under their own “FarmPride<sup>TM</sup>” quality assurance programme. FarmPride<sup>TM</sup> not only provides the customer with confidence about food health and safety but, because of the use of precision farming technologies such as GIS and ATV-mounted sensors, also provides a means of managing and monitoring environmental impacts.
- Another quality assurance scheme, EUREGAP, set up by European retailers such as Sainsbury’s, also aims to reduce the environmental impact of farming and so will increasingly drive the development and adoption of precision agriculture technologies.
- The Sustainable Land Use Research Initiative (SLURI) emanated from Morgan Williams’ seminal report, “Growing for Good”, which highlighted the environmental problems caused by NZ agriculture, especially the conflicts between land use and land resources resulting in water pollution and soil degradation. The aim of the SLURI project is, in alliance with industry and Central Government, to better align outputs (including biodiversity, soil health and water quality, as well as produce) with national goals. One issue that has recently come to light is the high level of copper residues on old horticultural soils. Some of these areas are now being developed for housing and new Codes of Practice for developers have been produced.

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<sup>10</sup> **Manaaki** means to cherish, conserve, and sustain. **Whenua** encompasses the soil, rocks, plants, animals and the people inhabiting the land

<sup>11</sup> The Maori, for instance, are vehemently opposed to water pollution, as embodied in their concept of “*mana whenua*”

- Allan's institute lies within a Region that pays a lot of attention to the quality of the rural environment. The RC's name, Environment Canterbury, reflects this concern. Throughout NZ, the name of the RC reflects the relative emphasis placed on production or environmental protection, and also reflects the balance of electoral power between the rural and the urban communities. "Environment Canterbury", for instance, has a much more urbanised population than the "Otago Regional Council" area. "Horizons" is the name of the Palmerston North Regional Council which, uniquely in NZ, perhaps reflects their emphasis on marketing the economic potential of their region.
- NZ has one of the highest rates of land use change in the world, according to Allan. Farmers see an opportunity and they exploit it. The spirit of economic adventure and risk-taking has perhaps been nourished by the lack of farming subsidies since 1984. Although this is very admirable in many ways, this attitude also carries with it severe risks to the environment, especially given the lack of stringent regulations on land use. On the other hand, the ability to so quickly change tack and alter land use may also provide opportunities for matching land use to land suitability and for optimising management of the land and water resources.

*Jim Moir, soil scientist, Centre for Soils and Environmental Quality, Lincoln University, Christchurch*

- Jim is a member of a group lead by Professor Keith Cameron. The group is engaged in investigating solute transport and methods of reducing nitrate leaching. Findings suggest that very high rates of nitrogen leaching losses can occur in urine patches (1000 kgN/ha/yr from cattle; 300-400 kgN/ha/yr from sheep urine patches) and the group is vigorously promoting Nitrification Inhibitors (NIs) as the main way of cutting down such losses.
- Inputs in the Canterbury Region's grazing systems can be very high due to the use of strip-grazing fodder crops and grass on sacrificial paddocks, high stock densities, the common practice of buying in fodder maize, the absence of housing stock over winter, and the lack of feed pads.
- Lincoln University's farm is a pasture system, backed-up by silage when growth is poor. To save the soils and pasture from pugging, the dairy herd (800 head) is grazed off-farm every winter for 6-8 weeks. Grass growth is much better in July/August (i.e. winter) when the cows are returned for calving. This system has been helped locally by a general move to more arable: cover crops such as maize can be grown all-year-round for the benefit of both livestock and arable farmers.
- The stocking rate at LU farm is high (~4.6 cows / ha) partly because of the use of centre-pivot irrigation, and consequently N leaching rates (especially from urine patches in the winter) are correspondingly high also. The NI trials have concentrated on developing the optimum delivery system. The product they have developed (in association with a fertiliser manufacturer) is "Eco-N" which contains "Didin" (or DCD<sup>12</sup>). The research looked at using Didin with fertiliser granules (the commonest system used in the UK) but they found that the ground coverage was not sufficiently complete and many urine patches were missed by this delivery method. An alternative, dissolving Didin in water, proved too costly

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<sup>12</sup> Dicyandiamide is a chemical that inhibits the microbial transformation of ammonium (which is not leached) to nitrate (which is far more mobile).

because of the amount of water needed. In the end, the group concluded that the optimum delivery system involved creating a slurry or suspension of the NI and applying it at the rate of 10kg in 150l of water per ha<sup>13</sup>. The suspension is applied twice per year: in the autumn (1<sup>st</sup> week of May), and in the winter (1<sup>st</sup> week of August). The NI remains active over the 3 months of winter. Total costs are ~\$62/ha/application.

- There is no evidence that microbes, other than the target organisms, *Nitrosomonas*, are affected by the NI. Results have been impressive with losses being reduced and also yield increases of up to 20% reported. At the same time NOx emissions have also been reduced by up to 75% with no commensurate increase in ammonia losses.
- Eco-N was released commercially in 2003 by Ravensdown Fertiliser Co-operative Ltd. Sales are now high with 80,000 – 100,000 ha of grassland treated with this product in NZ (mainly in the South Island). Results have been favourable on a range of soils including sandy loams, clay loams and the pumice soils of the Central Plateau (Lake Taupo area).
- Note: researchers in other areas of NZ are more sceptical about the efficacy and cost-benefits of Eco-N. Doubts centre around the length of time during which Didin remains active. It could be that in the warmer parts of the country the NI breaks down too quickly for it to be useful.

*Glyn Francis, soil scientist, Crop and Food Research Institute, Christchurch*

- Farming in Canterbury changed about 20 years ago from predominantly livestock (60:40 stock:crops) to mostly arable (30:70) and has made the Region the main cropping area in NZ. In the last 10 years, the dairy sector has seen an increase in herd size and intensification of production. Most of the intensification of grasslands has occurred on the very permeable soils where irrigation and N fertiliser are essential.
- The Soil and Land Use Research Initiative (SLURI) is a collaborative project within the CRIs. Another joint project, LUCI (the Land Use Change Initiative<sup>14</sup>), is investigating nitrate leaching and groundwater quality. So far the main influence on Groundwater nitrates has been cropping, but the recent changes from sheep to dairying will mean that grasslands will soon become the dominant source. Models produced by Crop and Food indicate that water quality will be adversely affected in 50 – 100 year's time if trends continue unabated. The RC is determined to prevent this and plans for regulating nitrates in drainage water have recently been drafted: where levels are < 16 mg nitrate / litre then no action will be necessary; between 16 – 22 mg/l, farmers will have to draw up nutrient budgets and identify good management practices. If levels exceed 22mg/l, farmers will have to implement changes in their management to effect reductions of 5% p.a. in the nitrates leached from their land. Farmers will have three choices: reduce stocking rate; use nitrification inhibitors; or increase the efficiency of cows (including manipulating the diet). One factor which will have a bearing on the RC's willingness or capability to implement these new regulations is the political

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<sup>13</sup> The suspension effectively supplies >400 particles / cm<sup>2</sup> over the field.

<sup>14</sup> a project closely allied to another, the Integrated Research for Aquifer Protection ([http://www.irap.org.nz/upload/irap\\_newsletter1.pdf](http://www.irap.org.nz/upload/irap_newsletter1.pdf))

background of the councillors: there are more urban councillors than those who represent the rural community.

*Brent Clothier, Soil Scientist, HortResearch, Palmerston North*

- HortResearch obtains much of its funding from revenues accruing from commercialisation of, literally, the fruits of the research: the licencing of the gold kiwi fruit alone brings in \$5m a year. Understandably much effort in the organisation is devoted to genetics and product development. In the pipeline, for instance, are a red-fleshed apple and a red-starred kiwi fruit.
- SLURI<sup>15</sup> is a co-operative research project involving most of the land-focused CRIs. There are 5 main themes: Soil functioning; Managing land use; Resilience under change; Valuing natural capital; and Strategic land use management.
- Brent is researching irrigation efficiency in vineyards (“wineries”) and fertiliser efficiency on horticultural crops such as kiwi. Kiwi growers tend to apply excessive amounts of N (200-300 kg N / ha) and leaching losses are heavy, especially because the soils tend to be gravelly and highly permeable.
- Irrigation efficiency is very important in many viticultural areas (especially Marlborough, the most famous wine-growing region in NZ) because a) water affects the quality of the grapes<sup>16</sup>, and b) water for irrigation is almost fully allocated therefore there is little room for expansion of vineyards.
- Another project is concerned with calcium content of kiwi fruit. The fruit are susceptible to a disorder akin to bitter pit in apples and the CRI are investigating methods of increasing uptake of Ca from the growing media.
- Brent’s group is also researching the effect of squash (pumpkin) production on the very permeable volcanic soils of Tonga. High rates of N fertiliser is resulting in the leaching of nitrates down to a fresh-water lens that lies sitting above the saline groundwater table. Summer rains raise this lens and water (along with the elevated nitrates) seeps out into the coral lagoons. Eutrophication (nitrate levels exceed 50 ppm during this period) can lead to the death of the coral and, apart from the devastation of the ecosystem, seriously affects revenues from tourism.

*Iris Voegeler-Cronin, Researcher, HortResearch, Palmerston North*

- Iris is investigating nitrogen and sulphur movement in soils along with compaction and water infiltration on intensively managed horticultural crops. She is monitoring soil quality indicators, such as oxygen diffusion, within and between wheelings especially with respect to their effects on soil function (e.g. microbial activity, buffer capacity, earthworm activity).
- Organic (as opposed to conventional) fruit production depends on sulphur application for disease control and this can lead to build-up in the topsoil leading to impaired soil function. This has happened in other parts of the world (such as the vineyards of Burgundy), and, along with elevated levels of copper, has necessitated the removal and replacement of topsoil before vines can be replanted.

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<sup>15</sup> <http://www.sluri.org.nz/>

<sup>16</sup> too much water encourages leaf growth at the expense of grapes and sugar content; too little and yield is reduced because of water stress

*Louis Schipper, Soil Scientist, Waikato University, Hamilton*

- Louis is involved in the national “500 Soils” Project. The aim of the project is to increase understanding of soil quality in New Zealand. Funding was provided by the Sustainable Management Fund. Prior to the 500 Soils Project there was no nationally consistent or scientifically-based soil quality monitoring data for New Zealand. Along with Louis, researchers are concentrating on 7 key soil properties and analysing them in samples taken from 800 sites throughout the country.
- 81% of NZ soils met the soil quality standards as defined by this project. 19% failed mostly because of reduced macro-porosity (i.e. compaction) under dairying (but also sheep and beef production). Another problem highlighted was the high level of Olsen’s P (available P) in many soils. The dangers presented to production, water quality and soil health that have been identified by the project are now being addressed by the RCs.
- Louis is also interested in the N saturation of soil organic matter under pasture. Based on a minimum C:N ratio of 10:1, he asks “what will happen to OM, nitrogen and carbon after decades of applying high rates of N? What is the C:N ratio now? How long before the ratio of 10:1 (i.e. saturation) is reached and leaching rates increase?”. Preliminary results following re-sampling of old sites have shown that C levels are decreasing – why is this happening under permanent pasture? The results of his research will feed into models of climate change and may affect the NZ government’s approach to the Kyoto Protocol and Carbon Credits.
- Another project dear to Louis’ heart is the use of sawdust or “denitrification walls” to control lateral movement of nitrates. The concept involves digging a trench and filling it with a readily decomposable substrate (sawdust). The trench is situated downslope of any lateral movement and in front of surface waters such as streams or lakes. Water, carrying nitrates, flows through the trench whereupon the anaerobic microbes reduce the nitrate to NO<sub>x</sub> gases thereby effectively cleansing the water. The results have shown much higher NO<sub>x</sub> emissions from these trenches compared to the paddocks thus demonstrating the effectiveness of the walls. The system is cheap (since it uses a waste product) and can also be adapted to cope with point-source pollution (e.g. feedlots) or fitted to the end of drains (as they are trialling in Canada). The system is also being used to treat sewage sludge and hydroponic effluent.
- The main constraint to the effectiveness of this method is the need for an impermeable stratum in the subsoil or parent material. Researchers in Australia, for example, are finding the walls useful on duplex soils. Louis is now developing the idea as a commercial venture.

*Monica Peters, wetland ecologist, Landcare Trust, Hamilton*

- Monica has two main areas of interest: restoring wetland habitats and the management and organisation of lands run by Maori Trusts. Much of the area to the south of Hamilton and north east Waikato was, until the last century, wetland consisting of a mixture of peat lakes (abandoned oxbow lakes of the River Waikato) and lowland raised bogs. Because of the installation of extensive drainage works (“hump and hollow” systems generally, the equivalent of “rig and

fur” in Scotland) these habitats are now rare and certain endemic species found in such wetlands are now endangered. One of these endangered plants is the cane rush (*Sporadanthus ferrugineus*).

- Monica has been given the opportunity to restore an area of wetland on a farm that has just been granted permission to subdivide a significant acreage (i.e. to sell for “life style blocks”) on the proviso that some conservation work is carried out.
- Before we looked at the restoration site, Monica took me to see what the habitat should look like (in 200 years or so!). The scientific reserve is used by researchers at the University of Waikato and CRIs like Landcare Research. It’s a fair size (1.2km by 0.7km) and appears to be little affected by run-off or deposition of ammonia from the surrounding intensively managed pastures. There is some ingress of weeds at the edges (bracken, *Rubus*, *Salix*) due to the drier conditions and higher N and P. The vast majority of the reserve, however, consists of a pristine and unique (if low species diversity) lowland raised bog consisting of rushes mainly (including cane and wire rushes), some sphagnum, and giant heathers.
- Monica’s restoration area is ~4km away from the reserve. It is a small (44m by 9m) strip of poor grazing land adjacent to an existing (although modified) wetland. Her plan is to strip away the “mineralised” (i.e. enriched) topsoil, replace with “good” peat<sup>17</sup> and replace with wire rush<sup>18</sup> and then cane rush (which is the main reason behind the project).
- The practical phase of the project was scheduled to begin in October 2006 but it will be several years before the results will be seen.

### CONSULTANTS

*Don Ross, CEO, Landcare Trust, Christchurch*

- The Landcare Trust has a national focus which is unique in NZ. A major influence on the agricultural community (if not the farmers directly) has been the publication of Morgan William’s “Growing for Good” report (2004). The Parliamentary Commission for the Environment report stimulated a change in direction in farming, criticised many people, and highlighted many environmental problems. The LT was at the vanguard of the response: they ran many seminars in the rural communities around the country, accompanied by the Commissioner himself. The report was sent around the world and rang bells in NZ especially with the large co-operatives such as Fonterra who were very concerned about the possible negative publicity that might impact on the effective (overseas) marketing of NZ products.
- The Landcare concept was introduced in 1990/91 in the Highlands of the South Island with groups meeting to discuss, in those early days, rabbit control. Consultation and community involvement were essential characteristics of their approach right from the start, as was the initiation of research and monitoring and dissemination of results.
- The Trust today has 24 full time staff located throughout the country. A major focus now is analysing factors affecting farming behaviour and attitudes,

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<sup>17</sup> which is being stripped from an area which is being mined for horticultural growing media

<sup>18</sup> Wire rush, another endemic species, is considered to be a “peat builder”. It’s a pioneer species.

particularly regarding sustainable land management. Many of the LT's projects are aimed at: a) data monitoring and analysis; and b) community liaison. Funding of the Trust amounts to \$3m p.a. derived from central government (mainly the Ministry for the Environment), corporate sponsors (e.g. Transpower) and individual research grants.

- One of their projects involved the development<sup>19</sup> and distribution of "Stream Health Kits" which allow individuals (such as farmers) and communities to monitor the quality of their surface waters. A good idea, but unfortunately the lack of sufficient funding for marketing and training resulted in poor uptake. A similar project – the Forestry Monitoring Kit – goes further, offering mentors in every Region and grants for fencing off streams (part-funded by the QE II Environment Trust) in order to reduce adverse impacts caused by excess nutrients etc. Farmers also receive rates relief if they participate in the project.
- Regional Councils and farmers are all in denial about the deteriorating environment: "Evidence is overwhelming that there is a problem", and there are increasing numbers of people getting involved in pressure groups.
- A significant number of farmers are also choosing to do something positive to protect the countryside. A group on Banks Peninsula (just to the east of Christchurch) for example have co-ordinated a conservation covenant which has a fund of \$50,000.

Banks Peninsula was once 98% covered in mature native forest and bush. This decreased to around 2% by the 1980s but due to the efforts of farmers, the local community, the LT and the QE II Trust, this figure has been increased to 15%, and the Conservation Trust aim to increase this even further. Banks Peninsula is an important area for endemic species and for some NZ plants at the southern extremes of their range.

The geology of the peninsula is also special (compared to the rest of Canterbury) being composed of basalt rocks (the soils are therefore base rich, of high pH and have high P levels). The Landcare Trust (part-funded by Christchurch District Council and the National Biodiversity Fund), led by 5 key farmers, aim to eradicate predators and rampant alien grazers (such as goats), to control weeds (such as gorse and *Pinus contorta* "wildings"), and reintroduce native birds such as the tui (an endemic honeyeater).

*Shelley Washington, Researcher, Landcare Trust, Christchurch*

- Shelley co-ordinates many of the South Island's projects, especially on the west coast. One such project involves 30 farms that surround the largest lake in that area, Lake Brunner. P levels in the lake are increasing and algal blooms are becoming more frequent. One of the main problems (both to farming and to the movement of nutrients) is the 6000 mm of rainfall experienced in the region every year. Consultants from the LT visited the farms and discussed farm plans and methods that could be adopted to reduce the impacts on water quality.

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<sup>19</sup> In conjunction with the National Institute for Water and Atmospheric Sciences, NIWA

Several common problems arose during these discussions. One was the lack of sufficient storage capacity in the effluent lagoons. Others related to uncontrolled stock crossings and access to water bodies<sup>20</sup>. By identifying common problems and sharing good practice, the project hopes to persuade farmers of the need and the practicable methods available for preventing eutrophication in Lake Brunner.

- A similar community project, again co-ordinated by LT, is on-going in the Westport region (of the west coast). Again, dairy farming is involved, but leaching is also occurring from a landfill site. In addition, coal mining is expanding (the Westport / Greytown area is the main source of coal in NZ), and gold mining is also causing problems<sup>21</sup>.
- In conjunction with NIWA<sup>22</sup>, the Landcare Trust are monitoring run-off and nutrient management following drainage of peatlands and gravels<sup>23</sup> (using diggers to produce “hump and hollow” systems).
- Sustainable Development doesn’t only depend on good environmental practice. The Trust have investigated the *economic* sustainability of a soil management technique called “flipping”. This is essentially a deep cultivation operation (penetrating down to 2 – 3 m) designed to rip out subsoil compaction and iron pans. 60 tonne diggers are needed which therefore renders the procedure very expensive. On the other hand, dairy farming (in those areas where drainage is impeded by the compact soil) would not be possible without this “subsoiling” operation. Thus, the economics are being analysed by LT.
- Biological control of ragwort is also being investigated. Two moth species have been imported from Tasmania and they show promise. Stringent host-testing has shown that they will not become a problem when they are released, and so the only thing LT have to establish now is their efficacy.
- The LT are working with communities and the RC around Rotorua in an integrated catchment management project that aims to delineate the social, economic and environmental issues surrounding water quality. Working groups involving representatives from all stakeholders have been set up and national workshops have been held to share information.
- In Northland (the RC north of Auckland in the North Island), the Trust is working with communities to find ways of protecting NZ’s national bird, the flightless kiwi.
- In Marlborough (South Island) – a dry Region where sheep and beef are common – another project is addressing the problems of over-grazing and erosion in the High Country.
- In Nelson, South Island), the Trust is co-ordinating community groups involved in a variety of resource projects including biodiversity, water quality and catchment projects.
- Closer to Shelley’s home, in Canterbury, the “Greenway Canterbury” project aims to encourage farmers to plant native vegetation to produce corridors of natural habitat from the coast to the High Country. The ultimate objective is to restore the

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<sup>20</sup> The braided streams in the area change location on a regular basis and are very difficult to fence off.

<sup>21</sup> For instance a gold-mining company has recently been ordered to clean up a river that was degraded. The cost to the company will be \$22 million.

<sup>22</sup> The National Institute for Water and Atmospheric sciences

<sup>23</sup> Suffering from high ground water tables

native biodiversity of a Region which was once *covered* in bush and forest and now amounts to something around 0.05%.

- Summary: despite their relatively small size, the Landcare Trust is very successful in its field. Its budget has grown remarkably in the short time that it's been in existence which indicates the high regard the organisation is held by people in government and in industry.

The group is engaged in a very wide variety of projects most of which involve all aspects of sustainability – environment (of course), communities and individuals, and economics.

Its independence (from government, big companies, green pressure groups and the farming community) and its talented and dedicated staff allow the Trust to liaise smoothly and with distinct ease with all the various stakeholders that influence the rural environment. The number and diversity of projects co-ordinated by the Trust is very impressive but the main common theme running through them all is communication of ideas and facilitation of improvements by consultation and co-operation.

*Helen Percy, Acting Manager, Sustainable Farming Fund, Hamilton*

- The SFF was initiated in 2000 AD by the Labour government on the back of their election banner, “Vote Agriculture”. The fund has an annual budget of \$9.5m which funds community projects of a research or extension-based nature. According to their philosophy, the projects should ideally have a social, an economic *and* an environmental focus.
- The average size of a project is \$200,000 allocated over a three year period. All monies have to be match-funded (either from industry (for example, a fertiliser manufacturer), co-operatives (e.g. Fonterra) or Regional Councils) but it doesn't have to be 50:50. An external panel (consisting of academics, representatives of industry, consultants etc.) scrutinise and vet the applications that get through to the short list.
- Catchment projects are popular this year (2006). One of these that is on-going centres around Lake Rerewhakaaitu and involves nitrate leaching from adjacent dairy farms. The local Regional Council, Environment Bay of Plenty, has told the farmers that they *must* reduce the amount of nitrates draining from their land. In response, a consortium of farmers, researchers from AgResearch<sup>24</sup>, and an independent agricultural consultant submitted a proposal for a project looking at practicable (i.e. feasible, economic and convenient) methods for controlling leaching. The project also benchmarked the catchment (monitoring nitrate leaching in boreholes). One of the methods they are trialling is the placing of “phosphorus socks” in streams to absorb P. They have also piloted the nutrient budgeting software, “Overseer”, to allay fears about its usefulness, usability and fairness.
- Another project located around Lake Rotorua (again in the Environment Bay of Plenty Region) is concerned about the effects future regulations might have on land use and management. The community group consists of representatives from Federated Farmers (the main farmers union in NZ), the Landcare Trust, the

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<sup>24</sup> A Crown Research Institute (CRI)

Regional Council and Maori Trust Land members. The project is looking at mitigation options for reducing N and P loss from sheep, beef and dairy land. Again, a feature of the project is defining the area's characteristics and monitoring the loss of nutrients. The group is trialling practical methods such as placing hay bales across streams. Following the ethos of the SFF, the results (successes *and* failures) and ideas generated by the research have been disseminated to a wider audience via field days and publications. A very respectable 80+ candidates attended each of the farm talks.

- The SFF personnel also organise meetings between project supervisors in order to share ideas. For example, those involved in seven separate projects around Lake Rotorua were brought together along with people involved in Sustainable Management Fund<sup>25</sup> Projects and those funded by FRST<sup>26</sup>. Summaries of these meetings are placed on the SFF's website. Very usefully, the meetings often highlight gaps and overlap / repetition in research. There is now much greater sharing and co-ordination of ideas, information and data.
- 10% of the projects undergo annual scrutiny via the Independent Performance Valuation Programme. The main aim of this audit is to ensure that milestones have been met and the financial accounting is accurate.

### **PRACTITIONERS**

*Randolph Hambling, Manager, East Coast Forestry Project, Gisborne*

**‘Sometimes a whole hillside will wrinkle and slide like snow melting off a roof, its huge corrugations smothering and smashing the wretched sheep, half or wholly burying them in every posture.’**

*Herbert Guthrie-Smith (1969)*

- Gisborne is the “erosion capital” of NZ. A combination of steep slopes, unstable Tertiary mudstones, tectonic activity and intense summer rainstorms coupled with inappropriate farming practices (including deorestation and over-grazing) have resulted in severe erosion over much of the Region.
- Farmers are being encouraged to “retire” sensitive land. To compensate for this they intensify production on good land. One farmer, by doing this, reckoned that he derived the same income from 800 ha as he once did from 2000 ha.
- About a quarter of the 800,000 ha of the Region is considered to need erosion protection. Of the 500,000 ha of pasture land, almost 50% should be retired and planted with trees. So far the East Coast Project has planted 35,000 ha. Before this the State Forestry Service planted another 90,000 ha before their disbandment in 1961.
- The Region is subject to very damaging cyclones. In 1988 Cyclone Bola caused immense destruction. Nearly one meter of rain was reported to have fallen in a three day period. A farm had a 10 ha ravine carved out in one night by the rains. The off-farm damage caused by Bola was estimated to cause \$160 million in loss

<sup>25</sup> The SMF is run by the Ministry for the Environment as opposed to MAF which runs the SF. SMF projects are related but can involve waste management, recycling, energy and pollution control projects that have nothing to do with farming.

<sup>26</sup> FRST – the Foundation for Research, Science and Technology. This is a government-sponsored fund.

of infrastructure (roads, bridges etc.) and in compensation payments to farmers, as well as lost revenues for the Region.

- In another example, and in more recent times, cyclones have been responsible for the loss of 450 head of cattle on another farm at a cost (in 2004) of ~ \$180,000. The reclamation scheme on this site, involving 50 ha of *Pinus radiata* at a planting density of 1250 stems / ha, cost \$50,000.
- In response to Bola, the East Coast Project was set up in the early '90s. Reforestation of at-risk land is voluntary and so progress has been slow. Regulations to enforce retreat of land are inevitable, according to Randolph. The Project has substantial funding (\$184 million over 28 years) but the uptake by farmers has been slow<sup>27</sup>. Most applications (and there were 30 this year. The best year had 61 applications) are successful but the money allocated is dependent on the potential profitability of the harvested timber. Profitability of the pines depends largely on world markets and on distance of haulage (and therein lies the main problem in this isolated corner of the North Island).
- Part of the financial package made available by the Project involves the Regional Council mapping farms at a scale of 1:10,000. Erosion Risk is highest on Land Capability Classes VII and VIII. The Project targets Class VII land for replanting, relying on reversion of natural vegetation (either "assisted" by seeding and applying fertiliser, or by allowing natural colonisation) on Class VIII land. Planting willow and poplar poles at low density (12 – 15 m intervals) only works on Class VI land (e.g. in the Wairarapa area) or better. On Class VII land, grazing should be prevented entirely and the land is completely retired by planting densely with *Pinus radiata* (or Douglas Fir, *Pseudotsuga menziesii*, at higher altitudes where *P.r* becomes affected by frost).
- *Pinus radiata* is chosen because it grows very quickly (it's harvestable within 30 years) and gives a good quality timber crop. Land is still at risk of erosion whilst the saplings are younger than five years (eight years old if the storms are as intensive as those experienced during Cyclone Bola).
- Willow and poplars can be very useful if planted at high densities; many of the situations where they have failed have been because the farmer has skimmed on cost or been too concerned with maintaining enough grass for grazing.
- In some cases, the slow mass movement known as "earthflow" can be seen where trees are bent over at their heels and subsequent growth has produced a vertical trunk. The effect is called "butt sweep" or "hockeystick". Earthflows occur where land is saturated but not too steep. The result is very slow but still significant loss of land. Farmers are reluctant to cover these areas with trees because the land provides extremely useful grazing in the summer when the rest of the hillside has been burnt off with drought.
- Of the target land remaining to be planted, 20% is owned by Maori. But of the effort being invested in soil conservation about 33% is being undertaken by the local iwi<sup>28</sup>. Much of the land does, however, tend to be retired by default i.e. because of the unwieldy nature of the iwi's management (hundreds of shareholders may have voting rights on parcels of land covering a mere 40 ha in size) decisions are very hard to come by and so often nothing is actually done with the land and it reverts to bush.

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<sup>27</sup> Ideally the project aims to plant at least 10,000 ha a year; the current rate is < 1,000 ha

<sup>28</sup> Iwi are Maori "tribes"

*Scott Bradley, Farmer, Waikato Region*

- Scott is manager of a farm on Maori Trust Land. It is a 550 head dairy concern occupying 250 ha (not all of which is good grazing land). When he first came onto the farm a year ago the effluent from the parlour was being drained into a settlement pond. The trouble was that a pipe led from the pond directly to a stream which in turn entered the Waikato River – so, in effect, the effluent was being discharged directly into the river. Scott persuaded the Board of Governors that it would be in their best interests to rectify this problem (in order to prevent possible embarrassing adverse publicity in the future). The pipe has now been blocked and the effluent (via newly purchased irrigation equipment) is now being applied to the land. Unfortunately only a small area is used to receive the effluent and it's uncertain (given the lack of soils data) whether or not the soils are being overloaded with nutrients, especially P.
- Scott is also conscious of the need to collect effluent from the feedlots. He has recently constructed a concrete feed pad and has dug a settlement lagoon down-slope of it.
- In addition, he is also aware of the need to use nitrogen more effectively but has recently been advised (by a fertiliser sales representative) to maintain, if not increase, his purchases (even if he didn't intend to apply it all) *just in case* controls are introduced by the Regional Council to limit N inputs based on historic rates of application.
- Scott is fully aware of the new Waikato-wide fertiliser regulations (whereby he is required to complete a farm nutrient budget because he applies more than 60kg N / ha / yr) but he is less certain of water abstraction regulations. He is also more concerned, to some extent, on improving the visual (cosmetic) impact of his farm by e.g. clearing away “unsightly” gorse and replacing it with productive grasses (even on unstable, steep, unsuitable slopes).

*Emily and Anders Crowfoot, Farmers, Castlepoint Station, Gisborne*

- Emily and Anders are farmers from Vermont, USA. They have bought a 28,000 ha farm (which is mainly grassland) and have around 28,000 units (mainly sheep<sup>29</sup>). The soils have been formed from Tertiary rocks (in particular mudstones) and on the steeper slopes they are very susceptible to slumping and earthflows. Spectacular erosion events occurred on the Station in their first year and these galvanised the Crowfoot's approach to “sustainable land management”.
- Working closely with the RC and consultants, the farm was mapped at 1:18,000 and classified into Land Capability management units. These units identify the need for erosion control and the necessary erosion control method (e.g. retreat of land from grazing or the installation of willow or poplar poles), the need for subsoiling, or the efficacy and rates of nitrogen fertiliser. This fits in with the Crowfoot's philosophy of understanding their resources and matching land use and management to the soils, slopes and climate. A case in point is the winter grazing of the cattle on the better drained, pugging-resistant coastal sands. Shelter belts of flax (*phormium tenax*) are important to protect against the cold winter

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<sup>29</sup> In NZ, one unit = one sheep; 1 cow = 6 units

southerlies, but, conscious that shelter belts also take up space, the flax can also be harvested for forage, fibre (textiles) and pharmaceutical chemicals.

- Apart from water erosion on the slopes, wind erosion has also been a problem on the Station. The East Coast is a very windy area and the first year they tried to plough a paddock the entire topsoil was blown into the sea. The key to erosion control, they have found, is sustainable management: control of stock movement and density, minimum tillage and pole planting (the farm has its own nursery).
- Good nutrient management is also essential. Traditionally the Region has relied upon clover to supply the N but now Emily applies fertiliser on responsive areas. These areas are north-facing (dry) slopes, and the N is applied only in the spring (when early bite is required). She has found that the N stimulates the clover as well as the grass<sup>30</sup>. Only 40 kg N is applied per ha which is probably not enough to reduce N fixation significantly.
- Some of the ideas for the management of the swards on the Station have been derived from field trials established on the farm. The trials are looking at the effect of N fertiliser on yield, lamb mortality (since they say they have evidence that links lamb poisoning with nitrate application) and grass quality (especially linked to nitrogen uptake – amounts, forms and toxicity). The trial is looking at 0 kg N / ha, 60 kg and 120 kg on north-facing paddocks where the growth potential is generally lower (due to drought and desiccating winds) except in the spring (when moisture conditions are more favourable and good growth is needed for lambs). 10 lysimeters per paddock are used to monitor nitrate leaching.
- Strategic, and limited, application of N appears to be a very successful management ploy on Castlepoint Station. At the same time, aerial top-dressing of superphosphate and lime (the latter is used to control manganese uptake and toxicity which is thought to cause a 75g / day penalty in lamb growth) have also improved productivity.
- In summary, Emily and Andes' approach to sustainable farming is not radical but as an holistic system which involves setting environmental and management targets, constantly questioning *why* they do things in a certain way, their planning, their intensification, their constant monitoring, and their belief in and practice of the scientific method. In the final analysis, it *is* successful.

*Brett Craig, Poultry farmer, Oamaru, Otago Region*

- Brett owns a 60,000 layer production unit. 66% of the feed (barley) is home-grown on 500 acres of land. He is extremely concerned about the sustainability of the enterprise and much of his philosophy and practice is geared to ensuring the financial (and environmental) viability of the unit for his family, the employees and succeeding generations.
- When he took over the management of the farm the first attention he gave was to the soil which he found to be in a poor state (both chemically and physically). In order to rectify the compaction problems on his silt loam he turned to direct-drilling – with mixed results (structure deteriorated after 2 years of no-till). Soil OM tends also to be low. High applications of hen pen are helping in this regard but Brett is also looking into the use of green manures e.g. Italian Ryegrass. Soil pH is high (~6.9) due to the hen pen but trace element problems have not yet

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<sup>30</sup> although she hasn't looked to see if the clover is still nodulating or fixing N

arisen. If (or when) they do occur the farmer reckons that he will rectify deficiencies with aerial sprays from the ‘copter.

- Whilst Brett was investigating the possibility of going organic (an idea he subsequently rejected) he came across an organisation of growers called The North Otago Sustainable Land Management initiative (NOSLaM). The purpose of the group was to encourage uptake of more efficient and environmentally-sound management practices (direct-drilling being one of them). Each farm had to first identify “significance” issues in order to prioritise problems. Nutrient management plans and nutrient budgets were commonly employed. One major outcome of his involvement in NOSLaM was iso14001 certification of his farm (cropping area only). This is an environmental Management system which entails setting an environmental policy (for the farm), baselining the current state of the farm, setting goals and revising the goals and actions for the following season. It is an iterative process which aims for constant and continual improvement. The EMS was audited by NOSLaM who, in turn, were audited by an external quality management organisation. Only one other farm in NOSLaM became iso14001 certified.

Brett did not want to renew his certification. The initial certificate opened doors for him into markets that might otherwise not have been interested in his produce. The main reason for going through the iso14001 process in the first place was to attempt to ensure financial sustainability i.e. to make sure his eggs were sold at the highest price. “Sustainability” to Brett is more about profit and “repeatability of the management process without it breaking down” (e.g through the failure of soil health), than good environmental management *per se*. The “triple bottom line” so far as Brett is concerned all depends on the *one* bottom line. Sustainability is purely about staying in the black, keeping his business afloat and supporting 20 plus staff and his family.

#### *New Zealand Farm Environmental Awards*

- Good practice is rewarded and disseminated to the wider farming community. Principles of good pasture management include: don’t over-graze and open up the sward (this reduces weed invasion, maximises grass growth and prevents soil erosion); don’t graze sensitive lands when they’re wet (reduces “pugging”, protects soils and slopes, increases yield and suppresses weeds); promote clover growth by careful grazing especially when swards are droughted and stressed; use fencing to subdivide land according to its capability and suitability for different livestock; direct or minimum till wherever possible (reduces time, labour and fuel costs); alter the stock density to match feed supply and reduce pugging and to allow greater flexibility during periods of unseasonal weather.
- Some highly profitable farms in the Waikato region are actually reverting to less intensive grazing systems which depend more on clover and less on supplements. For some this has been a lifestyle choice in the first instance, but the lower costs of production have more than compensated for the lower yields. More farmers are using feed or stand-off pads (often comprised of pumice or gravel) to keep cows off the land when it rains: pugging is recognised by the good farmers as being highly detrimental to paddocks and they see it as a high priority to avoid causing it.

## **REGIONAL COUNCILS**

*Phil McGuigan, Environment Canterbury, Christchurch*

- EC has ~400 staff. Their remit is environmental regulation and compliance. Phil's group is involved in external relations; it is the advocacy arm of the RC. He believes in "social marketing" which attempts to bring about behavioural change (in e.g. land management) by consensus i.e. bringing stakeholders together and building policy from the community upwards.
- The group's main project areas are: land and biodiversity; urban and peri-urban concerns; industrial initiatives; integrated catchment management and coastal areas; Living Streams; and Education for Sustainability.
- One major project is attempting to increase the efficiency of irrigation water use. At present many farmers still employ the traditional irrigation method of "border dyke" (or flood) irrigation on their sheep and dairy lands. This method is inefficient and leads to loss of nutrients and potential pathogens. Also, the irrigation water is allocated on a rota system: farmers receive their water on a 17 day rotation whether they need it or not. The situation is both damaging for the environment and unsatisfactory for the farmers. The RC is trying to encourage uptake of more efficient methods.
- Water quality has deteriorated in Environment Canterbury Region mainly because of sedimentation. This has come about through: a) access of stock to watercourses (resulting in streambank erosion); b) mechanical removal of vegetation from ditches (which were once controlled by grazing livestock)<sup>31</sup>. The RC is engaged in an awareness-raising project which highlights the problems and encourages uptake of less damaging practices and mitigating methods e.g. planting shade trees on the north banks which prevent vegetation from growing in the streams and blocking them.
- Environment Canterbury is rapidly approaching the limit of sustainable use of abstracted water. Dams and reservoirs are becoming more common on farms.
- Many farmers in the Region are enthusiastic about environmental improvements because they want to see wildlife return to the area (e.g. many of them are keen anglers) and they realise that good management of their farm will enhance the value of their property.
- The meat industry run "monitor Farms" which demonstrate good practice, including paying attention to environmental management.
- Env Canterbury oversees an "Environment Enhancement Fund" which focuses on biodiversity. The funds are contestable and are bid for by community groups. The \$5000 has to be match-funded. Total amounts allocated are \$150,000 a year. Other funds are available in the region, for instance "The Honda Tree Fund" (for every dual-fuel car bought, 10 trees are planted), and the "Ballance Farm Environmental Awards"<sup>32</sup> where farms have to demonstrate whole-farm sustainability.

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<sup>31</sup> The diggers create steep-sided banks which are prone to slumping and erosion.

<sup>32</sup> Ballance are a fertiliser company in NZ

- Canterbury is a dry region and suffers from quite severe summer droughts that drastically reduce grassland productivity. Farmers wishing to use irrigation water have to compete with another major user – HEP. The Lake Tekapo dam system, for instance, provides 25% of NZ’s electricity. As a result the region has extreme allocation problems. Because of the way consents are given (they last 35 years), and the increase in demand (mainly through intensification of pastures, but also because farmers are applying for consents “just in case”), and because pumps are not metered (and so the Council doesn’t have an accurate idea of how much irrigation water is being used or by whom), streams are now drying up (which, of course, also exacerbates the eutrophication problem). It’s estimated that 600 consents could be called in or put on hold this coming summer.
- Phil’s group’s approach to environmental management is to aim for continuous improvement in small steps via agreements, negotiation and consultation rather than regulation and penalties. In order to build this social capital the Council has a team of 10 officers to liaise with the farming community, and encourage dissemination of good practice especially through the use of “Leaders” and opinion-formers. It is distinctly a bottom-up philosophy.

*Susie McKeague, Otago Regional Council, Dunedin*

- Susie’s job is withing Environmental Education – “change through community consensus”. Her department has a budget of \$1m p.a. She has 5 staff.
- Dairy herd sizes in the region are large: a small-holding (family-owned) would typically be ~ 350 head; a big (often corporately-owned) farm would be > 800. A herd larger than 900 would have two milking parlours. It is anticipated that farms smaller than 150 head won’t survive.
- There are some air quality problems in ORC caused by poor agricultural practices. Farmers can burn whatever they like. Prunings from vines and pit fruit (peaches, apricots etc.) in Central Otago basin causes localised air quality problems when burnt. Domestic heating and cooking often relies on wood burning stoves and burners (because electricity, oil and gas supplies aren’t reliable in winter): these also contribute to the problems.
- Wind-generated electricity isn’t well advanced in NZ. Two large schemes involving hundreds of turbines have recently been proposed for ORC.
- Susie’s perception is that the highly regulated agricultural regime in Europe is not very good for the environment.
- The main problems in the region are declining water quality caused by the intensification of agricultural production. South and west Otago suffer from very high winter rainfall causing high rates of leaching which lead to eutrophication problems particularly in the smaller tributaries. One of the contributory causes is the all-year-round grazing of livestock. Fonterra (the dairy industry’s marketing arm) apparently are reluctant to encourage housing of livestock because they think this will damage the image of NZ farming and overseas markets might react adversely. Having said that, Susie thinks that housing of stock is inevitable. Another problem is strip-grazing of winter forage.
- One of the ways being used to reduce the adverse effects of grazing is the fencing off of waterways. The target is eventually 100%; by 2005 97% of streams had been protected. Some of these fences are “hot wires” (electric fences) and are only installed when stock are present.

- Bathing waters are not so important in the region since swimming is not a major activity. However, *E. Coli* standards still apply.
- In Otago no consents are required for applying effluent (from feed pads and milking sheds) but standards are imposed.
- Irrigation is a highly organised affair in Otago, and it has to be because summer rainfall can be as low as 300 mm in some areas. Irrigation “races” (ditches, canals) can stretch for hundreds of kilometers in the Hill and High Country. These races are owned and maintained by private companies

In Central Otago abstraction problems are of concern to the RC. Water for irrigation is limited and is in much demand especially as many farmers now want to intensify their production. Unfortunately much of the available water has traditionally been allocated to the gold-mining industry which, today, seriously under-utilises their proportion. This historic distribution of water resources is now limiting agricultural development in the lower reaches of the rivers.

- Fonterra and ORC have broached an agreement to try and minimise the environmental impacts of dairy farming in the region. All farms contracted to Fonterra will have to complete a “restricted” Environmental Management System by September 2006. ORC will audit these EMSs. This is the first agreement of its kind in NZ. Farmers will have to pay for the EMS (or do it themselves). The “stick” is that if water quality is not improved then the RC will impose more stringent regulations. The EMS will be charged at around \$NZ 500 (for 4 hours or so of consultation).
- The North Otago Irrigation Company has also established a partnership with the RC with a view to managing the consequences of intensification. This company has agreed to supply 70 dairy farms with irrigation water (supplied via 2m diameter pipes). In order to satisfy the consent for abstraction (as awarded by ORC) the farmers must produce a farm management plan. If even *one* farmer doesn’t comply then the RC could, in theory, shut off water supply to *all* the farmers in the group.
- A big employer in the region, especially in Dunedin, is a major Cadbury’s plant which processes local milk production. In NZ as a whole, 95% of milk production is exported. Dried milk is another important processed product. Perceptions of environmental quality are essential to these export markets.
- Dairy farming is highly profitable in the region mainly because of economies of scale, and the good price for milk paid by Fonterra. Herd managers (at the age of 21) are paid ~\$45,000 a year plus perks such a free home, food and use of vehicles.
- Tourism is very important in Central Otago (Queenstown) and here water quality is excellent. Queenstown is famous for outdoor pursuits such as skiing, summer “tramping” and bungee jumping. “Free access” occurs on Crown Property land (owned by the State) but not on Freehold land (permission must be sought). The main problem in the Queenstown area is the preponderance of non-native trees, but they have been there for so long, and have become such a part of the scenery, that they could not be felled and replaced with native vegetation.
- In NZ, the approach to environmental management varies from RC to RC, for example Hawke’s Bay has a completely different approach to Otago.

- Otago Region is quite wealthy with a mixed economy of mainly agriculture and, to a lesser extent, tourism. Agriculture itself is very mixed with sheep, dairying, topfruit and viticulture.
- Aerial application of fertilisers and pesticide is common. All applications are managed by means of GPS in the Highlands and so spreading stops when the helicopter approaches streams and lakes.
- Tenure review is currently on-going in NZ. Much of the environmentally-sensitive (and ecologically-rich) High Country is owned by the State and farmed via leasehold. Much of the discussions centre around exactly how much land the Crown should retain.
- Climate is a major factor determining land use and management in the Region. Summer droughts are influential as are the fierce winds (Otago is situated between the Roaring 40s and the Furious 50s).
- There is lively conflict between conservation and tourism. The native vegetation was cleared early in the colonial era and exotic tree species such as *Pinus contorta* were planted as timber crops. These trees spread readily and the “wilding” seedlings cause problems for the remaining native species. The trouble is that tourists have now come to associate these plantations with the area and hence there are many pressures acting against restoration of native habitats.

*Alan Campbell, Environment Waikato, Hamilton*

Introduction to Waikato Region: The Waikato River drains 13% of the North Island. It rises in the Central Volcanic plateau; the headwaters, including the Tongariro R., drain into oligotrophic Lake Taupo (a very important lake for the Maoris, for fishing (trout) and for tourism.).

Since Europeans began colonising in the 1800s the Waikato catchment has suffered great changes. Most of the catchment below L. Taupo has been altered by agricultural development (mainly sheep and beef); non-native species (plants and animals; aquatic and terrestrial) have been introduced and the original forests and peatlands have been lost resulting in increased nutrient levels and erosion.

A fair amount of forestry and native bush remain around the lake itself (41% of the catchment) but pasture and agricultural intensification are increasing and lake water quality is deteriorating.

Eutrophication is enhanced by sewage and stormwater discharges, but all wastes now receive some form of treatment. There are only 340,000 people in the catchment and the major industrial pollution comes from meat and dairy processing and forestry. Some natural pollution results from geothermal inputs.

Water abstraction and discharges into the river are now closely regulated. Extensive introductions of exotic biota have been made, notably trout (from Loch Leven), coarse fish, and macrophytes.

There is also extensive use of the water in the Waikato River catchment for electricity generation. There are 8 hydro-electric dams on the Waikato River below Taupo causing barriers to migratory animals, downstream effects due to impoundments, and

alterations to water flow regimes. Impacts of geothermal power stations, and the water-cooled Huntly Power Station in the lower Waikato are more localised.

- Agricultural impacts on the environment in the Waikato Region are becoming more obvious. Algal blooms are common on Lake Karapiro, as are FIOs. All lowland rivers in the region are polluted. 80% of the bathing waters monitored by the Regional Council failed the minimum standards in 2003. Nitrate is especially a problem.
- Environment Waikato (the Regional Council) have responsibility for all environmental concerns including water management. Integrated Catchment Management is a major method of managing water resources in the region. ICM aims to manage water resources at source and on a scale large enough to incorporate the entire catchment area.
- The RC has been taken to court by conservation groups (such as Fish and Game and “Ecologic”) who have challenged their regional plan. The action was dismissed on a technicality and, to circumvent a revisit to court, the parties agreed to discuss how the plan would be revised to satisfy all those involved. The result was a 3 year project to change farmer behaviour (essentially to voluntarily reduce nitrogen inputs) in 2 trial areas. The project is entitled “Integrated Catchment Management”. Target levels of N have been identified and an awareness campaign has been started to make farmers more conscious of the effects of eutrophication and of the need to manage N more effectively. Farmers are also warned that if the target levels are not achieved then regulations will be enforced in the future. At the same time the RC is well aware that they could still face another day in court if progress isn’t made.
- Another initiative Environment Waikato have introduced is a need for all farmers who apply  $> 60 \text{ kg N / ha / year}$  (in effect *all* farmers) to produce a nutrient management plan for the farm, which should go some way to increasing the efficiency of fertiliser and manure use (but perhaps doesn’t address the more environmentally-pressing problem of increased stock density associated with intensification). Unfortunately most farmers are not yet aware of this new rule. The RC is working with the fertiliser companies who will then explain the new regulations to their clients. Also, the sales representatives are being trained in the use of nutrient budgeting software (“Overseer”).
- Effluent management is also a problem in the region. The intensive dairy herds produce plenty of waste in the milking parlours and this has to be treated. The most efficient way is via the use of dual ponds (one anaerobic, the other aerobic) with the resulting clean water being pumped into streams. The most common method, however, is collection in one pond followed by spreading the waste onto land. Although this is more time consuming (because the static irrigator has to be moved every half hour or so) it requires less land take (one less pond to construct) and the nutrients are recycled. Also, land treatment, as opposed to discharge to streams, doesn’t need a consent from the RC. Disposal to land still requires compliance with regulations and a recent survey established that around 60% of farmers were not following best practice. The RC made it plain that they were going to monitor farmers and penalise those that broke the rules. The very obvious use of helicopters by the RC helped to convince the farmers that the council were serious in their intentions to enforce the regulations.

- Despite the influence of Fonterra<sup>33</sup> and the “significant impact on farmers of the ‘Clean Streams Accord’”, only 28 – 38% of streams have been fenced off in the Waikato Region, even though the Council allocate grants totalling 35% of the costs of fencing. This is one of the main reasons why water quality in the region is so low.
- Fonterra are very keen to improve the environmental performance of dairy farmers for the main reason that they foresee “non-tariff” trade barriers being imposed either by Brussels or by EU supermarkets in the near future. Fonterra has a major say in NZ dairying and there’s a chance that severe penalties might be imposed by them on farmers who don’t have nutrient management plans and are deemed to be environmentally irresponsible. These penalties might take the form of fines or, in extreme cases, the refusal to buy milk from the farmer.
- A further problem for Waikato Region occurs in the Lake Taupo area. Lake Taupo is (at the moment) in virtually pristine condition. It is an iconic lake representing all that is good in the country. It is New Zealand’s largest freshwater lake and the revenue generated from tourism and leisure<sup>34</sup> far exceeds that coming from agriculture.

The lake is oligotrophic but trends suggest that eutrophication is occurring. ‘Chlorophy a’ and N are both increasing (e.g. N in streams draining from pastures has increased by 50 – 300% since the ‘70s) and clarity is decreasing.

The catchment has increasingly become intensified as farmers take advantage of the fertile, well-drained alluvial terraces by clearing away exotic (non-native) forestry and converting to pasture. 27,000 ha of such plantations have recently been felled. The extra land now under dairying has had (and will continue to have) a great impact on leachates and erosion.

Although the flat lands themselves are not at risk of erosion, the steep-sided ends of the terraces *are*. The RC is hoping to encourage the farmers to replant these areas in trees. Soil erosion, stream bank erosion and increased sedimentation are also increasing the incidence of flooding.

In the meantime, dairy farming is increasingly loading Lake Taupo with nutrients and FIOs. A new regulation is being introduced in the area this year which is targeting the 140 dairy farms surrounding the lake. N inputs are now limited to the amount of N leached (as calculated by the nutrient budgeting software, “Overseer”) based on their 2001 to 2004 mean. Farmers will need a consent from the RC to apply N fertiliser and if they wish to apply more they will have to buy credits. If they apply less then they will have N credits to sell. In essence it is a “cap and trade” system.

The aim is to gradually force the farmers to control their leaching, and to eventually reduce nitrate losses by 20% of the 2001-2004 levels. Cenral Government, Environment Waikato and Taupo Distruict Council have made available \$NZ 80m for this progamme. The money will be used to buy N credits

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<sup>33</sup> Fonterra is a dairy co-operative whose membership includes ~ 90% of dairy farmers. It’s the equivalent of “First Milk” or “Wisemans”

<sup>34</sup> from a huge diversity of activities ranging from angling to sky-diving and jet-boating. It’s also renowned as the best trout fishing area in the naion

from farmers (and thereby force them to reduce their inputs) or compulsory purchase farms (and retire them to forestry).

One unforeseen consequence of this policy has been that farmers outside the Lake Taupo area have thought that similar restrictions will eventually apply to them as well and so they have taken to maintaining fertiliser purchases (at the recommendation of the fertiliser sales representatives) when they might have voluntarily begun to reduce inputs (due to the increasing cost of nitrogen). Some farms have even bought *more* fertiliser in order, they think, to allow them some flexibility in the future if regulations were to change.

Other controls on “manageable nitrogen” include improved sewerage systems in the urban areas surrounding the lake, and better farm management practices.

Unfortunately land management practices undertaken 30 years or so ago released nitrates into the slow-moving groundwater. This “nitrate in transit” is contributing 20% of the human-generated sources of N, and not much can be done to control it.

Why has nitrogen suddenly become so popular in New Zealand? There are three possible reasons for this: a) the opening up of gas wells off the coast of Taranaki in the ‘80s producing a cheap source of energy and nitrogen; b) an AgResearch promotional video went out to farmers with the central message – “The use of urea is the cheapest supplementary feed a farmer can buy”!; and c) clover was badly hit in the ‘90s by the clover root weevil and many farmers were forced to change to bagged N.

One way to reduce leaching from high input fields is to irrigate them (so long as it’s done carefully). Irrigation increases plant growth (including better root systems) and activity (including nutrient uptake). Poor plant growth results in less uptake and sequestration of N and the N that remains in the soil is prone to being leached out during intense summer storms.

Unfortunately the allocation of irrigation consents in the Region have already been mostly distributed. The RC is fully aware of the need to avoid over-allocation and so their objective is to allocate only 10% of available water in a 5 year low event. (This is in stark contrast to the Canterbury Region where over-allocation regularly results in dry streams and rivers). Farmers of course are up in arms about this especially when they see full rivers running past their properties. More and more farmers are looking to irrigate their pastures; the Soil Moisture Deficit never gets really low in the Region (the grass rarely browns off even in the heart of summer) but the farmers see irrigation can still significantly increase production. Ten years ago very few farmers irrigated their grass; today the ones that have already obtained irrigation consents are the happy ones.

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