Manaaki Whenua
Landcare Research

Landcare Research
DISCOVERY

Issue 11 March 2005 ISSN 1175-7329

What's Inside:

Winds of change sweep the rural research landscape

The nature of research into New Zealand's rural landscape has undergone major transformations in the past 20 years. Funding levels have waxed and waned with consequences on scientist numbers working in the sector. Soil research is now divided amongst several research agencies working within a competitive environment.

Paralleling these structural changes has been a significant change in focus by the primary production sector, the end-users of the research, from improving production to considering production along with a host of other desirable outcomes, many of which have a beneficial effect well beyond the farm gate. Farming has become more complex with many external pressures from regulators and markets, so farmers need the best information available to help balance these pressures along with their budgets. Increased intensification and diversification have brought uncertainty regarding impacts of production methods on the basic soil resource and potential impacts on the wider ecosystem. An added pressure is the urban–rural divide; as more of the population have lost contact with their rural roots their understanding of the importance of farming to our national economy has diminished. These issues are superbly described in the Report from the Parliamentary Commissioner for the Environment "Growing for Good".

The research response to these pressures has been to focus more on critical end-user needs, to look holistically at the rural sector with scientists working alongside social scientists and economists, and critically, to improve links with end-users to co-define research questions, promulgate results and by providing user-friendly tools.

Every cloud has a silver lining and the removal of considerable central government funding from soil science research in 2003 galvanised interest and concern from various community sectors. Following some catastrophic climatic events resulting in major human and environmental impacts, the spotlight returned to the need to protect our rural landscape. We then received a lower but most welcome reinjection of funding from Government in October 2004. By this time researchers in four key Crown Research Institutes (CRIs) considering rural issues had formed a strong alliance and defined a way forward to link and, where appropriate, integrate their research so that end-users get the best teams to work on the most important issues. The collaboration is expanded upon in the article on page 11.

Other research highlighted in this edition of Discovery focuses on emerging issues such as the increasing load of reactive nitrogen in New Zealand's biosphere and atmosphere. While nitrogen is essential for plant growth it will, in the wrong place, result in changes in biodiversity and degradation to waterways. There is a call for better access to more user-friendly research results, data and information. We are addressing that through S-map, a digital soil database for the needs of the 21st century. In the Antarctic, mapping soils in the Wright Valley will help understand and protect those fragile soils. Managing land at a catchment scale has always made sense but rather than considering single land uses and their impacts on water quality and quantity the focus is now on the mix of land uses, how they interact, and the social, environmental and economic consequences.

Despite the ups and downs, rural land research is well placed to serve the needs of the rural sector in New Zealand.

Maggie Lawton

Dr Maggie Lawton
Science Manager, Rural Land Use
Landcare Research

Diana Leuffkens

Photo credits: left to right, Harley Betts 1, 2, 6, 8, Dave Morgan 3, Landcare Research Slide Collection 4, 5, Peter Buchanan

S-Map – the way of the future

Landcare Research scientists are constructing New Zealand's first digital nationwide soil map – the S-Map. Their aim: to fill gaps in the knowledge of soil, and to upgrade existing soil maps to provide consistent national coverage.

Until now, soil maps have included factors of climate and to some degree vegetation and rock type. This was necessary for land use interpretation of soil data, because these factors were not mapped independently. However, now that geology maps, land cover and digital terrain models are becoming available, soil mapping can be freed from the need to be all things to all people. S-Map will provide more detailed soil information than has been provided before, in response to renewed demand for soil information.

Landcare Research soil scientist Dr Allan Hewitt says because S-Map is purely digital, the detail shown is not constrained by paper map design requirements. Produced at a scale of 1:50,000, it will incorporate more detailed soil information where available. This resolution, particularly in upland areas, will be much greater than for existing maps.

"Also, because S-Map is accompanied by a database rather than a report, it will be possible to link it to other databases.

"Another strength of S-Map is standardisation. Each previous soil survey had an independent map legend. Although soil correlation ensured a level of consistency within regions, there are still many names for essentially the same soil. S-Map has ordered soils into 'families' and subdivisions of families into 'siblings'. Tables will cross-reference family names back to other well-known names.

"S-Map also accounts for uncertainty. Soils would be easier to cope with if attributes of soil units were described by crisp numbers, but soils are not like that. Our knowledge is fuzzy at best, and we need to describe this fuzziness. Thus probability distributions are estimated for most soil attributes in S-Map."

A useful tool

Dr Hewitt says S-Map will underpin other research, and can be used in tertiary education. It is a tool for city, district and regional planning, and will be vital for sustainable management of land, helping planners and managers to focus intensive soil uses where the soils can best cope. It will aid in environmental risk assessment, because it will help identify which soils are vulnerable to pollution through particular land uses. S-Map can also help identify soils where either rare plants or weeds and pests will thrive or do badly.

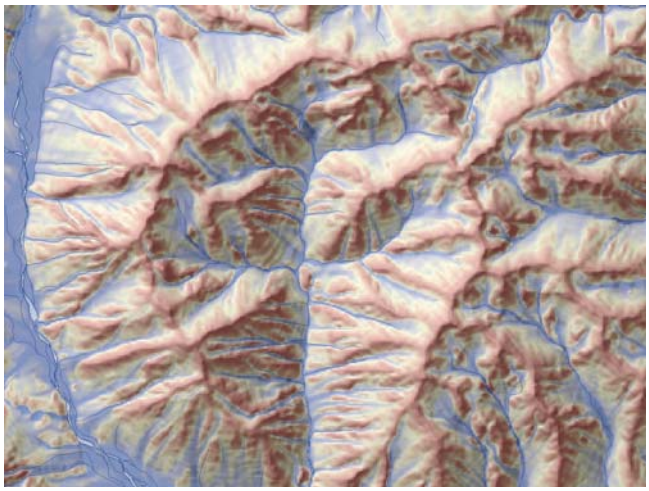


Image: James Barringer

A map layer used in the production of S-Map that shows probable areas of high water table (in blue) in the Canterbury High Country.

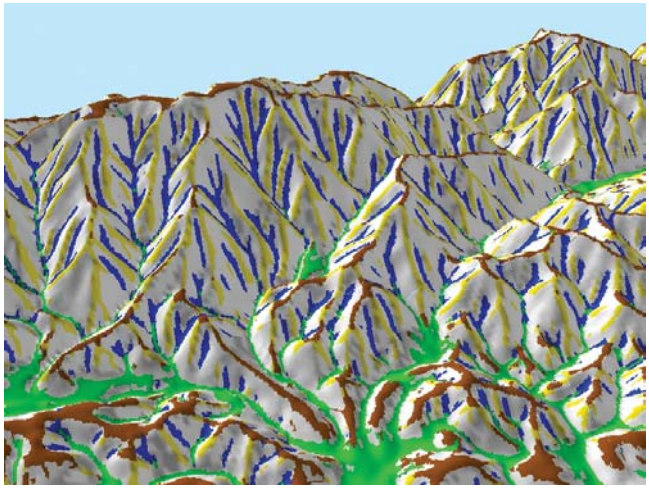


Image: James Barringer

A landform analysis of part of the Motueka catchment. In this perspective view, ridges are brown; spurs yellow; side slopes white and hollows blue. Green shows alluvium. These factors are related to soil depth, age, leaching and wetness.

S-Map is designed to fit in with other databases. For example, it will link in with LENZ – Land Environments of New Zealand (see *Discovery*, Issue 6, July 2003). "There is a lack of soil data to support new tools like LENZ," Dr Hewitt says. "LENZ is based very strongly on our soil mapping for many parts of New Zealand, especially in hills and non-arable areas where old mapping is very poor.

"With more soil information, LENZ can perform better.

"S-Map is also designed to link in with the National Soils Database curated by Landcare Research. The NSD was set up 50 years ago, and now contains information on soil from more than 2,500 New Zealand sites (see Discovery, Issue 9, April 2004.)

"S-Map will also work in with Q-Map, the new digital national geology coverage that the Institute of Geological and Nuclear Science is currently constructing.

"The challenge will be to enable S-Map to be searchable across

these other databases."

Dr Hewitt says work on S-Map is progressing strongly, covering sections of the Nelson region, Otago, and Canterbury. Work is also underway in Wairarapa and Northland.

Advances in soil science are helping to speed S-Map's progress.

"Normally you would have to dig a hole to know what the soil was. But we are learning a lot more from clues on the land surface – landforms, vegetation; this allows us to predict **without** digging lots of holes," Dr Hewitt says.

"We can much better map where the high quality soils may be, which have the greatest potential for extensive use, and which are the most vulnerable to the effects of pollutants. This will greatly help land managers to focus their most intensive soil use in the right areas."

Dr Hewitt says the S-Map team is currently in talks with regional councils about how councils can benefit from S-Map, and how they can contribute to S-Map, for example, through providing information.

Funding: FRST (Foundation for Research, Science and Technology)

Contact: **Allan Hewitt**
Landcare Research, Lincoln
(03) 325 6700
HewittA@LandcareResearch.co.nz

Soil tells secrets of one of the world's last frontiers

Antarctica – the coldest, driest, windiest continent – is the least known of the Earth's land masses, but new research on the soil in this harsh environment is highlighting its fragility.

Only 2% of Antarctica's surface is free of ice, revealing unique gravelly soils formed in extreme conditions.

Landcare Research scientist Malcolm McLeod is leading a project to map the soils in Antarctica's Wright Valley, a dry valley about 50 kilometres long and up to about 8 km wide, and a 45 minute helicopter flight north-east of Scott Base. Snowfall in the valley is less than about 10 mm each year and the mean annual temperature is around –20°C. The project is part of an international effort to map the soils in Antarctica, similar to what has already been done in the Arctic.

Mr McLeod camped in the dry valley for a month over summer with his fellow researchers: Dr Allan Hewitt of Landcare Research, Dr Megan Balks from the University of Waikato and Professor Jim Bockheim from the University of Wisconsin; in temperatures down to a relatively mild –6°C. The team often trekked for up to three hours along the valley each day, because vehicles are prohibited on the delicate soils. They dug small soil pits, described the soils, took samples where appropriate and trekked back.

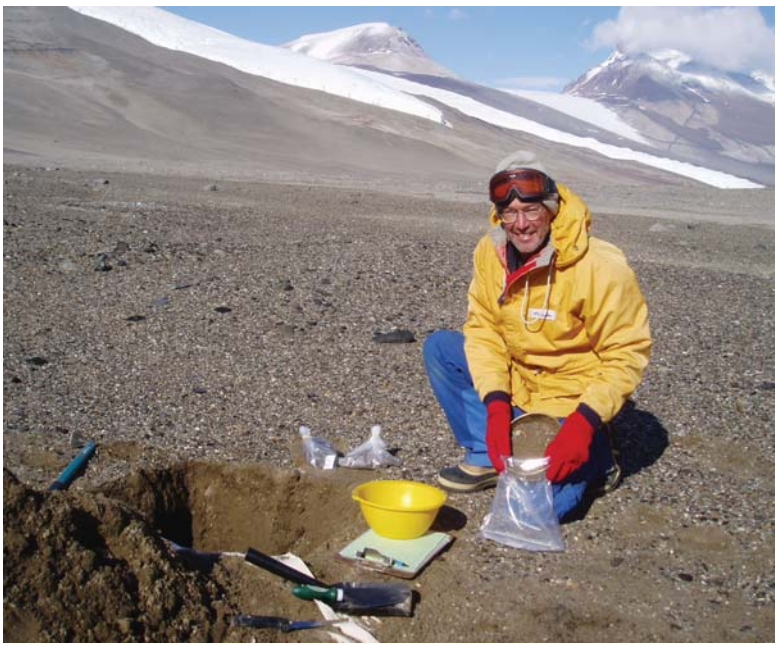
Mr McLeod says the research is building on Professor Bockheim's data collection work, which has been integral to determining the glacial history of the valley.

"Knowing where glaciers were and when is important, because it tells of past climates and what happens during climate change.

"The ages of the soils are our major clue to the presence or absence of past glaciers, hence the importance of the Wright Valley. Soil development is strongly related to age.

"The older soils had thick, dense salt pans in them. The older they were, the more water had evaporated from them. The younger soils were frozen from about 30 centimetres down.

"There is currently debate on the extent of some glacial deposits, and our work will shed light on



Jim Bockheim, University of Wisconsin

Malcolm McLeod sampling soils in Antarctica's Wright Valley.

Malcolm McLeod

Frozen in time: these wheel tracks were made from vehicles in the Wright Valley about 20 years ago. Their enduring presence highlights the fragility of the valley's soils.

Malcolm McLeod

This large lump of salt has been extracted from soil, and is about 3.5 million years old. A tell-tale sign of older Antarctic soils, the salty deposits were left as water evaporated.

this," Mr McLeod says.

The soil map will also provide a basis for ongoing ecological and microbial work.

"Older soils may contain a different microbial population to the younger soils, possibly because of differences in available water.

"Water also determines the amount of biological life such as microbes and algae in a soil. Our soil map will identify where moist soils are more likely to occur, although even these areas are frozen for about 10 months a year."

Mr McLeod says the research trip also brought home to him the vulnerability of the soils.

"The wheel tracks from vehicles that were there about 20 years ago were still obvious, as a result of the cold, dry and windy conditions. It is a fragile, delicate environment, which of course is why we walked everywhere, and carried our waste out with us.

"Also, we quickly learned the effects of walking on soils. Loose, powdery soils get quite badly disturbed, but footprints do not show up quite as much on the coarser soils.

"We have developed a technique to rapidly determine soil disturbance caused by foot traffic. Our soil map will also incorporate this information. As more tourists enter the valley our soil map may act as a guide to the more fragile areas, which can then be avoided.

"Similarly, when scientists are camping, some areas are best avoided because of their soil vulnerability to fuel spills, for example."

Mr McLeod and his team covered about a third of the Wright Valley this visit, and have taken soil samples back to New Zealand for analysis of salt content and particle size.

The team will return to the Wright Valley to complete their task over the next two summers.

Funding: FRST (Foundation for Research, Science and Technology)

Contact: **Malcolm McLeod**
Landcare Research, Hamilton
(07) 858 3700
McLeodM@LandcareResearch.co.nz

Country issues go to town

Landcare Research soil scientist Dr Graham Sparling (described by many as "Mr Soil Quality") has been honoured by the New Zealand Soil Science Society by being asked to present the prestigious Norman Taylor Memorial Lecture. He used the opportunity to discuss how our hunger for ever-increasing productivity from our soils may affect soil microbes, and long-term soil health and performance.

"We know remarkably little about soil organic matter, the biology of soil animals, and soil microbiology," Dr Sparling says. "We assume soils will always continue to grow crops, treat wastes, purify water, retain contaminants, help prevent floods, etcetera. We tend to focus only on the value of crops our soils produce.

"We need to recognise this, and use our soils more gently."

Intensive farming practices are often in the spotlight, with the public concerned about the increasing use of agricultural chemicals such as pesticides and fertilisers, and agricultural waste contaminating waterways. However, Dr Sparling says town-dwellers are the real drivers of pressures on rural land.

"More than 90% of us live in cities. Urban communities want farmers to produce high quality goods at the cheapest possible price. It's a worldwide trend. There are fewer

people working the land, which means more farm machinery, greater use of chemicals, more energy use and the need to transport things over long distances."

Dairy farming often receives negative attention for water contamination issues.

"About a third of dairy soils have nutrient levels in excess of what is required for agronomic benefit. To put it in human terms, they are 'obese'."

Dr David Lowe, University of Waikato

Graham Sparling, delivering the Norman Taylor lecture. Taking care of soil is Dr Sparling's prescription for a healthy future.

This makes it much more likely that the excess nutrients (nitrogen and phosphorus) will contaminate water, particularly when the soil drainage has been worsened by cattle compacting the soil surface.

But as Dr Sparling puts it, it's not all "fertiliser and belching cows" that are to blame for the stresses on soils. "Urban people and large retailers are driving the demand for cheaper food. Farmers are simply responding to market pressures.

"Look for a sustainability endorsement on a product before you buy it," says Dr Sparling.

And although urban sprawl may not seem an obvious strain on rural land use, Dr Sparling says it is.

"Many people are surprised that New Zealand's 'ecological footprint', or environmental impact per capita, is actually larger than Germany, France and Britain; and much bigger than China and India. Cities are spreading onto prime agricultural land. And we like having large houses, owning several cars and eating lots of meat and dairy products; all of which need more land and energy than vegetarian diets, denser housing and using public transport or cycling.

"For the first time, we can expect the next generation to have a worse standard of living than ourselves, because of resource depletion and environmental degradation."

Dr Sparling says he is aware that his messages sound pessimistic, but he urges people to remember that soils are non-replaceable.

"By taking care of soils, soils will take care of us. As Louis Schipper explains (*see next article*) they provide the only way to convert nitrogen to harmless nitrogen gas in the atmosphere.

"Despite all our technical advances we still can't build soil. That potting compost all comes from natural soil in the first instance!"

Funding: FRST (Foundation for Research, Science and Technology)

Contact: **Graham Sparling**
Landcare Research, Hamilton
(07) 858 3700
SparlingG@LandcareResearch.co.nz

Nitrogen budget takes New Zealand to account

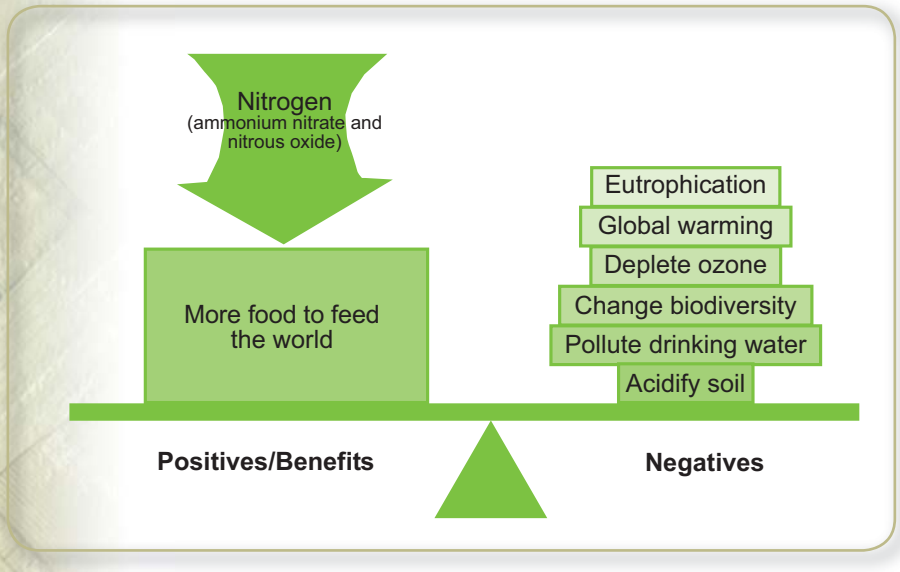
Researchers compiling New Zealand's first national nitrogen budget warn that we are in danger of copying some of Europe and America's pollution problems here.

Millions worldwide are alive today thanks to food grown with nitrogen fertilisers, but nitrogen also has adverse impacts on the environment. Humans have dramatically altered Nature's nitrogen balance by burning fossil fuels, by cultivating plants that promote nitrogen fixation, and by transforming nitrogen gas in the atmosphere into fertiliser.

In what has been described as "the nitrogen cascade", nitrogen contributes to global warming and ozone depletion, acidification, and eutrophication of soils. One of the most obvious effects is pollution of surface waters. For example, in the Gulf of Mexico, a "dead zone" polluted by nitrogen has grown to about 20,000 km^2.

Scientists have become so concerned that recently they signed the Nanjing Declaration on Nitrogen Management, which aims to develop an international protocol for dealing with excess nitrogen. Landcare Research has developed a preliminary nitrogen budget as part of this international effort.

The work draws on a huge range of datasets, and adds up all known inputs and outputs of nitrogen for each of the regions of New Zealand. It includes annual flows into and out of soil and plant systems, and also waste treatment, cities and towns. Losses



The nitrogen cascade – positives and negatives.

from leaching and erosion go to oceans via streams and rivers, to aquifers, as exports of produce, and increasingly to the atmosphere.

Soil scientist Dr Roger Parfitt compiled much of the budget, and says it indicates that New Zealand could follow the rest of the world in having excess nitrogen in the environment – but this doesn't have to be the case.

"Our calculations are for 2001, which is assumed to be an average year. Our work drew on a range of datasets, adding up all known nitrogen inputs and outputs nationwide.

"The amount of nitrogen lost to rivers is currently about 10% of the total applied to the land. Overseas this tends to be higher, at around 20–25%.

"The main problem areas are where agricultural land is used intensively. Around Hamilton City, 40% of shallow aquifers have nitrate concentrations exceeding World Health Organization limits. Some lakes in the Rotorua area have algal blooms, and nitrogen concentrations are increasing in Lake Taupo.

"It can take up to 40 years for groundwater to flow into these lakes, so the full effects of recent land-use intensification are not yet apparent. Also, agricultural land use has intensified in recent years in Southland and increased nitrogen losses are showing there."

Dr Parfitt says ammonia volatilisation is a problem where the ammonia drifts into native forests , enriching them with nutrients and possibly making them more vulnerable to weed invasion.

"If we continue to intensify at regional scales, losses will get even bigger, and problems will increase still further."

Forgiving soils

Landcare Research soil scientist Dr Louis Schipper led the nitrogen budget project. Dr Schipper says New Zealand has been fortunate because it has forgiving soils, and has not had intensive agriculture for as long as other countries. However, we are fast losing that advantage.

"Until the late 1980s, New Zealand was unusual among temperate countries because much of the agricultural production depended on biological nitrogen fixation.

"In comparison to other countries we still biologically fix a lot of nitrogen by clover, relative to using fertiliser. But clover fixation of nitrogen is probably declining as we shift to using more fertiliser nitrogen.

"Fertiliser nitrogen use has increased about 10-fold since 1988 to 340,000 tonnes of nitrogen in 2003."

Dr Schipper says the nitrogen budget should be regarded as preliminary.

"Very little is known about what happens to nitrogen between leaving the topsoil and entering the rivers.

"Also, we know little about denitrification – a key bottleneck – which is the only process that returns nitrogen to the atmosphere as a non-reactive gas, completing the nitrogen cycle."

Dr Schipper says future research will fill gaps in information at a regional level. "We need to better predict the impact of increased loads of nitrogen. For example, what will happen when New Zealand's soils become saturated with nitrogen? How will it impact New Zealand's nitrogen budget?

"A better understanding of the consequences of nitrogen use coupled with good policy and mitigation practices will reduce environmental impacts.

"It will also keep us up to pace with moves by other countries to reduce nitrogen pollution. In all of this we need to remember that a large part of our economy and lifestyle is based on the benefits of farming using nitrogen."

The Parliamentary Commissioner for the Environment, Dr J Morgan Williams, says Drs Schipper and Parfitt's development of a robust nitrogen budget for New Zealand is essential if our farmers are to be able to continue to use nitrogenous fertilisers while reducing their growing impact on our soils, waters and biodiversity.

"In my recent study of the intensification of farming entitled 'Growing for good', I focused on nitrogen use and impacts because while it is an essential 'fuel' of food production, its contamination of waters and soils worldwide is rapidly becoming a global concern. New Zealand has the opportunity to craft farming systems that use nitrogen much more efficiently.

"However, to do so we need to recognise the risks of our current farming systems and invest heavily in redesigning them. Soil sciences and all aspects of nutrient management and utilisation will be a key to the future economic and environmental performance of our primary sectors."

Funding: FRST (Foundation for Research, Science and Technology), SLURI (Sustainable Land Use Research Initiative)

Jennie M Parfitt

Dr Roger Parfitt at the Manawatu River at Hopelands, pulling up a bottle of river water to be analysed for nitrogen and phosphate.

Contact: **Louis Schipper**
Landcare Research, Hamilton
(07) 858 3700
SchipperL@LandcareResearch.co.nz
Roger Parfitt
Landcare Research, Palmerston North
(06) 356 7154
ParfittR@LandcareResearch.co.nz

Directors share rural commitment

Jill White and Alastair Lawrence have had distinguished, diverse and dissimilar careers in politics and business respectively, but their roles on Landcare Research's Board reflect their deep shared concern for rural and environmental issues.

Jill White was Labour MP for Manawatu in 1993-96, a list MP in 1996-98, and then Mayor of Palmerston North from 1998 to 2001. She was also Chair of the Environmental Risk Management Authority (ERMA) for 2000 and 2001.

Ms White's areas of interest in Parliament were in environment and conservation, science and CRIs, biosecurity and the Hazardous Substances and New Organisms (HSNO) legislation. She was Labour's spokesperson in several of these areas, including CRIs. As Palmerston North's mayor, she helped introduce the concepts of sustainable cities, "zero waste", ecological services and renewable energy sources.

As well as her role on Landcare Research's board, Ms White is also on the board of Toi te Taiao (the Bioethics Council); and is working towards her MA in History. Her thesis focuses on the Manawatu River.

Ms White says Landcare Research first caught her attention years ago, when reading about projects in the South Island high country in which scientists and local people shared knowledge to develop land management solutions.

"This combining of science and community appealed to me as a more effective use of resources, with hopefuly all parties and the local environment being winners.

"People generally enter politics to make a difference, and Landcare Research's mission of making a difference for a truly clean, green and sustainable New Zealand attracts me, as does the commitment to build relationships and work with tangata whenua."

Ms White says one of the greatest environmental challenges facing New Zealanders is developing and refining systems to measure and predict results of both our actions and our failures to act.

"We have awareness of the range and extent of issues, but environmental accounting is still in its infancy. Just as financial accounting systems have in time grown and developed into those we are familiar with today, environmental accounting can also grow and develop."

Ms White says she would also welcome the development of a stronger sense of science in society.

"I don't think it bad that people at times question the priorities of science, and I support Landcare Research's stance of engaging in dialogue. For sustainability to become a cornerstone of New Zealand's future, people everywhere must talk about it.

"There would be no understanding of sustainable land use, biodiversity and

biosecurity; and no innovative development of renewable energy resources without the scientist.

"The challenge to CRIs and the education system is to enthusiastically wave the flag of science to attract bright young students, and then nurture them. The challenge to Government is to set goals, then adequately fund and provide certainty to the science sector."

Diana Leurkens

Jill White and Alastair Lawrence.

Alastair Lawrence is an investment banker, a director of a number of private companies, and a member of the Takeovers Panel. Mr Lawrence's primary role is as a director and shareholder of Antipodes, a private investment bank that provides strategic and financial advice on investments and acquisitions to large public-listed and multi-national companies. Antipodes also invests direct equity in small to medium-sized New Zealand private companies.

Mr Lawrence was appointed to Landcare Research's board in July 2004.

"In my short time at Landcare Research I have observed the elements I believe to be critical to any organisation's success," Mr Lawrence says. "I see clarity of purpose in terms of well-defined company objectives, and a business focus which is absolutely aligned to the achievement of those objectives.

"I also see the deeply rooted commitment of staff to their science, to the achievement of the company's objectives, and to the philosophies underpinning those goals.

"Landcare Research is a truly impressive organisation."

Mr Lawrence says care for the environment was a fundamental value in his upbringing, on a farm in Wairarapa. "I was brought up to understand that it was part of my responsibility. My early months at Landcare Research have however been really enlightening in impressing upon me the vital role of scientific research to the sustainable development of the environment.

"I would like to see increased public awareness, and recognition, of the importance of environmental science."

Like Ms White, Mr Lawrence acknowledges the opportunities Landcare Research faces in moving forward.

"It is very challenging to strive for both financial objectives and public good objectives, given that much of the excellent science undertaken by staff can only be measured by benefit to the nation, not solely by increment to the company's operating surplus.

"Further, to achieve those objectives, particularly in light of constraints on the Government science research spend, it is imperative that we continue to develop additional sources of earnings."

Researchers get to the bottom of sediment

Landcare Research scientists are tackling a fishy conundrum: why are trout numbers in the Motueka River declining? It is clear that sediment on the riverbed is a factor, but unravelling its impact is proving to be a complex matter.

The Motueka River is world famous for its trout. However, competing demands have created a string of contentious land and water management problems. Demand for irrigation water and gravel extraction, along with pastoral farming and forestry, are all thought to impact negatively on the fishery. In the mid-1990s, trout numbers declined dramatically. This decrease has been linked to increased input of fine sediment from land erosion that settles on the riverbed affecting spawning, food supply and habitat. Sedimentation is also a concern for the potential expansion of scallop, cockle and mussel fisheries in Tasman Bay.

In the country's first study of trout and sediment in a single large river system, Landcare Research has joined forces with the Cawthron Instititue, NIWA, Massey University and Fish & Game New Zealand to cover the 2000 km^2 of the catchment. Two years into the six-year project, Landcare Research geomorphologist Dr Les Basher says researchers have refined their questions

– and are beginning to reach some surprising conclusions.

"For example, sediment yields are in fact lower than previously thought. We measured suspended sediment in the river. Our measurements gave lower values than previous predictions based on the general relationship between sediment yield and rainfall."

Bank erosion and landsliding were believed to be the main sediment sources, but where precisely was the sediment coming from? Could sediment input be reduced, or was it coming from natural erosion?

"We measured sediment from different subcatchments, and delivery to Tasman Bay," Dr Basher says. "We identified key sediment sources from aerial photos and field surveys, and analysed their relationship with land use.

"Our results contradict what was previously widely believed. They show much higher sediment yield from the hilly Moutere gravel terrain than the mountainous west bank terrain.

"This is potentially quite significant. The west bank is under native forest, whereas the Moutere gravel land is used for pasture and forestry. It may be possible that a change of land use in Moutere will improve matters, and it is also possible that the Moutere sediment comes from natural erosion, and is not land-use related. We will now try to find that out."

Research on other rivers has shown that if sediment levels on the riverbed exceed 10%, trout populations decline. "However, there aren't many areas in the Motueka River that currently exceed this value. Furthermore, we found in an assessment of fish numbers last year that in the one reach that exceeded this value trout numbers weren't significantly lower.

"So the relationship between riverbed sediment levels and trout abundance is not simple.

Les Basher

Bank erosion in the Motupiko River, which carries sediment into the upper Motueka River.

"In a big, productive river with good flow, trout are quite mobile, and sediment affects different parts of the river at different times. Also, there are hundreds of kilometres of river for trout to explore, and for this reason we think the trout can escape sediment flux.

"However, we clearly need more information on why trout numbers are low in some sites at some times."

On the rocks

Gravel extraction is a controversial topic in the catchment. There is a shortage of gravel for commercial use, and few data on how much gravel can be sustainably extracted without undermining riverbank stability.

Dr Basher and his team measured the amount of change in gravel storage on the river and compared it with the amount of gravel being extracted. They found that gravel taken from the riverbed is not quickly replenished.

"Analysis of historical records of riverbed levels show that the riverbed has been degrading since the 1960s.

"There is a low rate of input of new rocks from headwaters. This is consistent with the relatively low sediment yields. In most rivers a low suspended sediment yield means a low gravel yield as well."

A fish-eye view of the future

"Ultimately we hope to develop models of sediment dynamics that can predict the long-term ecological impacts of sediment on both the Motueka River and Tasman Bay," Dr Basher says. "Both areas are clearly of major economic importance.

"Discovering whether sediment stems mainly from natural erosion or from land use will be a major step. If the sedimentation is coming from natural erosion, we may have to accept that the trout population is always going to rise and fall.

"We will also explore the effectiveness of different sediment control options."

Funding: FRST (Foundation for Research, Science and Technology)

Contact: **Les Basher**
Landcare Research, Nelson
(03) 548 1082
BasherL@LandcareResearch.co.nz

Top models join forces to aid Raglan Harbour

Combining Landcare Research's land expertise with NIWA's water expertise is proving to be very useful in solving a problem of excess sediment in Raglan Harbour.

Landcare Research is a collaborator in a NIWA-led project to link a suite of complex computer models to form a single "super" model. This sophisticated system will identify key sources of fine sediment that is collecting in the harbour, degrading the estuarine ecosystem and damaging the fishery.

The research aims to develop a model that can show not only where the sediment originates, but how it is then transported and deposited in rivers and the estuary. This will also enable researchers to predict the impacts of changed land management techniques in reducing sediment generation.

Landcare Research scientist Dr Les Basher says the project is at the forefront of technology. "It involves linking together three computer models that simulate how sediment is generated and transferred to streams, how it travels down streams, how it is transformed in fresh and salty water, and finally, what it does once it reaches the estuary.

"Making all these models 'talk' to each other demands a huge amount of computer power," Dr Basher says.

The ultimate aim is to simulate the impacts of multiple changes in both land and water over a long time period. "For example, a storm that causes landslips may have little impact on the harbour in the short term, but a series of storms could have a serious cumulative impact.

"Alternatively, researchers may wait years to see the effects of a major storm event, but computer models could simulate the effects of a storm so we don't have to wait.

"Having this sort of information available will help researchers and local bodies demonstrate to land users the best way to manage land in different situations.

"Environment Waikato was a key driver of this project, and provided data from river gauging stations and sediment measuring sites. At project end they will have a new and very effective tool to help them make accurate predictions and aid their decision making."

Dr Basher says the model being developed would not be specific to Waikato, but could be used throughout New Zealand. "The information programmed into it would of course be different, but the model would show the interaction of land and water for any catchment in the country."

Dr Basher says the collaboration may well set the stage for similar ones in future. The project began last year, and is expected to be completed by about 2007.

Les Basher

Bank erosion in the Kahuhuru River, which feeds into Raglan Harbour. NIWA, Landcare Research and Environment Waikato are seeking high-tech answers to help stem the harbour's sediment woes.

Les Basher

There are many eroded cliffs such as this around the edge of Raglan Harbour, and these contribute to the excess sedimentation believed to adversely affect fish and shellfish.

Funding: FRST (Foundation for Research, Science and Technology), Environment Waikato

Contact: **Les Basher**
Landcare Research, Nelson
(03) 548 1082
BasherL@LandcareResearch.co.nz

Soil science synergy ensures greener pastures ahead

Top New Zealand soil scientists have joined forces to secure new research funding and provide a soil information "one-stop shop" for all land users, from government to farmers.

Farming today is typified by new and intensified land uses. Productivity has increased by 4% per annum since 1985, and industry targets are for this growth to continue. Agriculture and horticulture now provide half our export receipts and more than a quarter of our gross domestic product.

However, the Parliamentary Commissioner for the Environment warns that across our farming landscape the natural capital of our soils, rivers and lakes is under intense pressure. He adds that our key export markets will soon not want products sourced from farms that are polluting the environment.[1]

The four main Crown Research Institutes involved in soil science research have formed a major research partnership to improve knowledge of soil and land management in New Zealand, especially under land-use change and intensification of farm management practices. The Sustainable Land Use Research Initiative (SLURI) includes scientists from Landcare Research, AgResearch, HortResearch and Crop & Food Research. This is the first time since CRIs were formed in 1992 that they will work in such a seamless, integrated way to focus on an issue of national importance.

All four CRIs sustained major cuts in soil research funding in recent years, which was in part addressed through the new budget money last year. However, as Landcare Research Manager for Rural Land Use, Dr Maggie Lawton notes, SLURI is ideally placed to supply an increased demand for information about soil, for policy makers and farmers alike.

"A spate of extreme climatic events such as the Manawatu floods and the resulting damage such as landslips has raised interest in the condition of our land. We need to find out more about how to reduce and mitigate the effects of such climatic events, and SLURI members have the range of expertise to look at all aspects.

"Also, New Zealand changes its land uses more than any other Western economy. In Europe for example, land uses often remain the same for generations; but in New Zealand we may switch from sheep and forestry to dairying or from dairying to forestry, and so on over a much shorter timespan.

"We are moving ahead of any understanding of what this means for our soil quality and long-term sustainability of the soil resource, and for offsite impacts including water quantity and quality."

Dr Lawton says there are clear synergies from the CRIs working together. "Each one's strengths complement the others. For example, Landcare Research has expertise in the attributes of soil and sustainable land use across production sectors, what happens to soils through erosion, and through climatic events like flooding. We are also embarking on an emerging research area, that of defining the economic values of the services that soil performs for us – what soil is worth and the economic impacts of

Maggie Lawton

Aerial view of the Canterbury Plains, showing intensive and varied land use and bare soil in winter. SLURI is a one-stop soil information shop for all those seeking advice on soil.

its degradation. Other CRIs also have elements of these capabilities, but with a stronger focus on plant–soil interactions and production systems.

"As SLURI develops it will draw on expertise from other CRIs as required, and will encourage new recruits into this science field through university links."

Dr Lawton says that through SLURI all land users from Government to local government to private landowners will have easy access to a group of scientists with the widest possible knowledge of soil and land management. This in itself will create new efficiencies, and remove confusion about whom to approach about what work.

"In our first year of research, we will be engaging with a wide range of stakeholders to refine the key regional and national land management issues, and provide a land management research strategy for New Zealand," Dr Lawton says.

The chair of SLURI's steering committee, former Federated Farmers president Alistair Polson, says the formation of SLURI is very exciting. "The nation's wealth comes from our top 15 cm of soil. Agricultural productivity is rising by 4% a year, while most other sectors of the economy average less than 1%.

However, until now there has been no overarching body for coordinated research and stewardship of our soil.

"SLURI is the country's new soil research powerhouse, and will result in much more efficient use of taxpayers' money via the science rounds, and much better output from research.

"The concept of a virtual soil science centre is very exciting. CRIs will be linked electronically and enquiries can be made via a website – an easy way to get their enquiry to the best person."

SLURI will be formally launched in Wellington mid-year. The SLURI team will continue to be based at their respective CRIs, with SLURI's administrative centre based in Palmerston North.

[1] **Parliamentary Commissioner for the Environment, 2004. Growing for Good: Intensive farming, sustainability and New Zealand's environment.**

Funding: FRST (Foundation for Research, Science and Technology)

Contact: **Maggie Lawton**
Landcare Research, Tamaki, Auckland
(03) 547 4100
LawtonM@LandcareResearch.co.nz

FIVE PRIORITY ISSUES IDENTIFIED BY SLURI (to be refined through stakeholder discussion):

1/ Intensification and Soil Functioning: Tools to protect and maintain soil function under pressure from increasing inputs.

2/ Managing Land-use Change: Assessing the performance of new land uses on soils not formerly used for these purposes, and the prediction of plant performance to express certain traits or qualities.

3/ Resilience under Change: New system designs to sustain our existing land uses in the face of increasing climate variability and extreme weather events.

4/ Valuing the Natural Capital of Soils: Assigning intrinsic economic value to our soils and waters, to underpin rational land-use decision making and resource allocation by industry and policy makers.

5/ Landscape Designs: Tools to integrate and improve our understanding of enterprise and sector behaviours on different land uses to permit equitable allocation of resources and sustainable coexistence of land uses.

MOHAWK wind power

This newsletter was printed using vegetable inks.

Editor: Diana Leufkens
Layout: Anouk Wanrooy
Thanks to: Christine Bezar

Published by: Manaaki Whenua - Landcare Research
PO Box 40
Lincoln, New Zealand
Ph + 64 3 325 6700
Fax + 64 3 325 2418

100% RECYCLED

PAPER STOCK
Mohawk Options 118gsm
100% postconsumer fibre
manufactured with windpower

If you wish to be included on the mailing list for Discovery, contact Sarah Stokes, Landcare Research, Lincoln (03) 325 6700 StokesS@LandcareResearch.co.nz

All photographs contributed by Landcare Research staff unless otherwise indicated.

Discovery is also available online at www.LandcareResearch.co.nz/publications/discovery/