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Conference pictures

The New Zealand Institute of Agricultural & Horticultural Science Inc

John Lancashire
President

New Directions

Some exciting prospects for involving primary sector science in important debates about the future of the New Zealand economy have emerged in recent weeks. The excellent programme "Growing smarter with less water", organised by John Keoghan and the Canterbury section for our annual convention, raised many important points which are summarised in this issue of *AgScience*. It also linked well with comments made by the visiting UK chief scientist, Sir David King, who listed water as the major global challenge for the 21st century. Compared with many parts of the world New Zealand is well off, but we are still dealing with a scarce resource so we have to move beyond the common knee-jerk response rejecting charging. Until we put a value on this economic input to our production systems, we will continue to waste water in inefficient irrigation systems, as illustrated by a number of papers at the conference.

Sir David also gave a very interesting address in Wellington on 1st October on the development of climate change policy in the UK. It was obvious that science played a huge and on-going role in the policy. This has been in marked contrast to a recent announcement by our government that it has set up a 31-person committee "to advise government on the details of its climate change policy". It does not contain a single scientist. Your Institute has written to the climate change minister, David Parker, asking him to explain this extraordinary decision. Unfortunately this is not an isolated incident, because there are increasing number of examples of policy being developed which ignores or takes little account of known scientific information. It is ironic to hear that some ministers believe that science has not delivered enough useful results for the country, when in fact often little or no account is taken of available data. This is an issue which the science community needs to urgently take up with government.

The long awaited OECD report on New Zealand's innovation policy was finally released in August. There is often disappointment with reports of this nature because drafts are written and commented on by governments before their final release. In this case, despite the government's spin, there are plenty of criticisms which will be familiar to members. For example "over-reliance on competitive bidding processes for relatively short periods of funding can entail high transaction costs and have undesirable consequences"; and "in New Zealand a better balance needs to be struck between highly contestable funding and truly stable funding". And: "In some cases the contractor (crown research institutes, businesses and so on) may be better placed than the customer (government agencies) to say what societal, business or even government needs might be". Further, the report says "innovation policy should not neglect natural-resource based sectors, which offer considerable scope for economic growth through the application of advanced science and technology". Finally, in this selection of recommendations, the report says: "CRIs should be provided with more core funding of say, one-third to one-half of their total budget". As the Prime Minister said at the launch, some of these recommendations are already being actioned. But the report also says that our investment in research, science and technology is far behind most OECD countries. As Phil O'Reilly of Business New Zealand points out: "…the Nordic countries eat us alive and we do not have that strategic drive at the senior political level". For example, Finland, a country very similar to ours, has a science council headed by the Prime Minister that directs the country in research spending and innovation strategy. Nor does the report address many other science concerns in New Zealand, including micro-management by the Foundation for Research, Science and Technology, and the frequent failure to translate scientific data into policy. In summary, it's a useful start to the debate but much more pressure needs to be exerted on government to get real change.

In the last issue of *AgScience* Steve Maharey, the Minister for Research, Science and Technology, said I was wrong to claim there was "a very wide societal consensus in New Zealand that we were not spending enough on R&D". I agree that is what I said, and I was wrong to assume that it was true because of the large number of public statements from non-scientific organisations such as the Manufacturers Association, the rural sector, the NZ Institute, the Knowledge Wave Trust, KPMG, the former Parliamentary Commissioner for the Environment Morgan Williams, and business commentators such as the *National Business Review* and Rod Oram, at the *Sunday Star-Times*. I agree there is a need to get society switched into the need for increased funding of science, but the government cannot ignore the consensus of most businesses, manufacturers, opinion leaders and OECD that we need to spend more.

Finally, members should be aware that the Royal Society distinguished speaker for the year is Professor Paul Callaghan. He will speak at Christchurch on 13th November, Dunedin on the 19th, Auckland on the 22nd and Wellington on the 26th. The title of his lecture is "Beyond the farm and theme park". It's fairly obvious what the content will be so I urge members to attend if they can. Times and venues are on the Royal Society website (www.rsnz.org).

John Lancashire
President

Cover: C Wells

A role for scientists
but not on the leadership panel

The Government had yet to announce its plans for dealing with greenhouse gas emissions, when cabinet minister David Parker addressed the Institute of Agricultural and Horticultural Scientists forum in Christchurch in August on the future of Canterbury farming. But he did recognise (it would have taken no great prescience) that scientists would have a major role to play in whatever is done to tackle the challenges presented by climate change (see Page 5).

The importance of research, science and technology to provide solutions to climate change had been widely recognised in the public consultation on climate change policy earlier this year. Submitters said they were keen to see more research, primarily on low-emissions technology.

What this means in dollar terms became apparent on 21st September, the day after the government announced its emissions trading scheme along with new forestry and land management initiatives. Research, Science and Technology Minister Steve Maharey noted that the government is investing nearly $50 million a year for the next five years in scientific research into climate change. This includes $40 million of existing funding, $3 million from Budget 2007 and a contestable $6.7 million fund announced in August to promote sustainability and respond to climate change.

Government research funding is being provided for a broad range of scientific areas, from investigating the relationship between Antarctica and climate change, to looking into new forms of bio-energy, developing technology for low carbon energy and controlling wild animals to reduce emissions.

"Climate change is one of the most pressing issues of our generation, and science and research have a pivotal role in making sure New Zealand tackles it responsibly and effectively," Maharey said. The country's ability to use science and technology to develop models of future climate change was becoming increasingly important as decisions were made on how New Zealand could best respond to it. Funding also would be used to investigate how we can best prepare and adapt to future changes in our environment, and to ease the transition to New Zealand becoming a truly sustainable society.

The government has named 31 leaders across business, agriculture and forestry, science and the environment, the union movement, and non-government organisations to join a high-level group to advise the government on emissions trading and related issues. Prominent businessman Stephen Tindall is leading the group, known as the Climate Change Leadership Forum. It will help the government to develop climate change solutions which – if all goes well – are durable and broadly supported by the wider community.

Announcing the forum, Parker said it was important that the government works closely with representatives of key sectors across the economy and society in the detail of the emissions trading scheme to deal with climate change and put New Zealand on a more sustainable footing. The forum will report directly to the Ministers of Finance and Climate Change through monthly face-to-face meetings.

Mind you, the government has not put a scientist on the team. Science and business is represented by Sue Suckling, a business woman who chairs NIWA.

The government's plan to fight climate change includes:

* Introducing an emissions trading scheme to put a price on greenhouse gas pollution;
* Introducing measures to encourage forest planting and better land use;
* Increasing renewable electricity generation to 90% of New Zealand's total by 2025;
* Improving fuel and energy efficiency in buildings, homes and business;
* Making the public sector carbon neutral; and
* By 2040 per capita emissions from the transport sector are reduced by half, and New Zealand is one of the first countries in the world to widely introduce electric vehicles.

"Emissions trading is the way the world is going," the government said in documents explaining its plans. The European Union already has an emissions trading scheme, and other countries like Australia and Japan are investigating their own schemes. Under the scheme proposed for New Zealand, a business which cuts its level of greenhouse gas pollution may be able to sell its savings (called "units") on a market like the sharemarket. If a business decides to continue polluting or can't reduce emissions it can buy units to cover its liability. But while all sectors of the economy must be in the scheme, it will be phased in gradually between 2008 and 2013 to give some sectors time to adapt. New Zealand will be the first nation to include agriculture in its climate-change measures, although this will be stalled until 2013. Agriculture is the largest single source of emissions in this country because we are large-scale farmers. But as economic commentator Rod Oram has pointed out, the agricultural sector prospers because it innovates in a highly market driven and almost unsubsidised economy unlike most of its competitors overseas. Therefore, if farmers want to remain at the forefront, they will have to lead on environmental technology and management too. – *Bob Edlin*

The Labour Government wants New Zealand to become a sustainable, carbon neutral nation.
To achieve this Labour has set the following goals:

- By 2020 we achieve a net increase in forest area of 250,000 hectares.
- By 2025, 90% of electricity is generated from renewable resources.
- By 2040 per capita emissions from transport have been reduced by half.
- We are one of the first countries to widely introduce electric vehicles.

The future of Canterbury farming

This article is based on a summary of the Forum presented by the Canterbury Section of NZIAHS in August. The summary was prepared by John Hampton, from the Bio-Protection and Ecology Division at Lincoln University.

The future of Canterbury farming is bright. While climate change will bring challenges, the future is exciting too. Climate change will have good effects and bad, but the region has a knowledgeable farming community, good infrastructure and innovative people involved with the land. Water will be the key to the region's continuing prosperity and market forces will dictate which new opportunities become successful.

While change is difficult for many people, for Canterbury farmers it has been a feature of their livelihoods for the past 20 years. Numbers in the dairy sector have burgeoned from a small number of mostly town suppliers in 1990 to more than 800 dairy farms in 2007. Similarly, virtually zero exports of vegetable seed in 1990 has blossomed to become more than 5,500 tonnes worth around $40 million by 2006.

Canterbury farmers must now brace for climate change: the region's climate will be warmer by 0.2-1.4 degrees Celsius by 2030 and 0.5-3.4 degrees warmer by 2080. This will trigger significant changes – more heat waves, droughts and floods; more westerly winds; fewer frosts and less snow. Rainfall patterns will change, too. Eastern parts can expect 5-10% less rain while rainfall will increase in western catchments.

Some effects will be beneficial. Plant growing conditions will be enhanced because of higher carbon dioxide concentrations, longer growing seasons and reduced frost risk. Flow rates in Canterbury rivers will increase. There will be opportunities for new crops, such as kiwifruit. Lamb losses will be reduced. Native forest regeneration will be encouraged.

On the downside is the likelihood of an increased frequency of droughts and their greater severity. Crop yields will be reduced by the shortened growth duration resulting from higher temperatures, although increased carbon dioxide may reverse this. Pasture quantity will increase, but the quality will be reduced because species will flower earlier. There will be increases in annual and biennial weeds, in pest populations and susceptibility to pest damage. New invasive pest species and animal diseases will compound the difficulties.

So what strategies should be implemented to help adapt to climate change?

Let's start with water. Canterbury has plenty of it. Trouble is, supplies are insufficient at peak times.

More efficient water use calls for farmers to irrigate to meet the needs of their crops, thereby avoiding wastage, cultivating plants with higher water-use efficiency, and being more assiduous with irrigation application systems. Water conservation will call for schemes that include water storage and a small number of large storage reserves. There will be a need for a significant re-allocation of water and better management of rivers and ground-water systems. Measures will be needed to ensure water quality, to protect the aquifers – from the clean streams accord, to nutrient management planning.

The aim with plant breeding will be to produce cultivars with better capacity to withstand drought, higher nitrogen use efficiency, adaptation to higher carbon dioxide concentrations, and improved ability to withstand pest and disease pressures.

Changes or increases in the plant species grown can be expected to result in crops of forage sorghum and maize for the dairy industry, more grape varieties (sauvignon blanc, perhaps?), annual clovers for pastures and biofuel crops.

Among the biosecurity issues, there must be a concern to prevent pest impacts and ensure hazards are quickly identified.

Biocontrols can be highly effective, but the success of these may be affected by climate changes.

The effects of climate change can be mitigated, of course. For starters, energy use can be reduced on farms by adjusting tractor settings to reduce fuel consumption, using global positioning system units to avoid unnecessary passes, and increasing irrigator efficiency.

Greenhouse gas emissions can be reduced through improved efficiency and/or reductions in fertiliser and agri-chemical use, reduced use of fossil fuels, nitrous oxide reduction.

Methane reduction? Maybe, through rumen modifiers and targeting the manipulation of the rumen ecosystem.

Land use is among the other key issues. Urban sprawl needs tackling, because of the limited supply of high-quality soils. Rural subdivision and lifestyle blocks increasingly are spreading on to these soils. Questions are raised by the demand for land for biofuel production, too. The development of these fuels is another key issue. By 2012, 3.4% of the country's petrol and diesel sales under current policy targets must be biofuels. That's 300 million litres, either imported or locally produced. Whether Canterbury land should be devoted to growing the appropriate crops is a key question.

in a changing environment

By David Parker, minister responsible for Climate Change issues & Minister of Energy.

An edited version of the minister's presentation to the Forum.

The Labour-led government sees climate change as part of the wider issue of sustainability. To tackle it, we need to progressively change our economy and society so we use our resources more sustainably. And while doing our fair share as a country to reduce our greenhouse gas emissions, we must encourage developing countries to avoid the high emissions development path we have already followed.

No matter what we do, however, greenhouse gases already in the atmosphere mean climate change will occur to some degree, and indeed is already occurring. We can expect gradual changes in climate as well as changes in the frequency and magnitude of extreme events. We can expect reductions in plant growth through greater soil moisture deficit in summer over the next several decades in eastern areas of New Zealand. This may be compensated in part by expected increases in winter temperature, which will increase the length of the growing season.

We can expect average and worst-year pasture production to decline for east coast locations such as Canterbury. By the 2080s severe droughts are projected to occur between two and four times as often in Canterbury. Flows in the rivers fed from the Southern Alps in Canterbury and Otago are expected to increase, but it is not clear whether this will compensate for the likely increase in water demand. In any case, flows in other lowland streams in the east are likely to decrease with the drier local climate.

This country has a unique interest in agriculture and horticulture. In May, accordingly, the government announced a new research fund to bolster New Zealand's international leadership position in helping the agriculture and forestry sectors to respond to climate change. The fund will be used to foster international work on agricultural greenhouse gas measurement and mitigation. It will help with technology and knowledge transfer to developing countries through the development of formalised collaborative relationships and exchange programmes.

As a small trading nation, we also need to recognise the shift in attitudes in our key overseas markets. The term "food miles" refers to how far food has travelled before you buy it. Just a few days ago, the *UK Times* quoted the author of *How to Live a Low-Carbon Life* as saying "Don't buy anything from the supermarket… or anything that's travelled too far". Thanks to important work by Lincoln University and AgResearch, a little more light is being injected into this issue. Indeed, last week the *New York Times* quoted this work in asking if it "wouldn't make more sense to stop obsessing over food miles and work to strengthen comparative geographical advantages". Nevertheless, this shows how vulnerable New Zealand is to the perceptions of the consumers of the food we export.

But how can we reduce emissions? New Zealand's unusual greenhouse gas emissions profile presents a challenge to manage. Nearly 50% of our emissions come from agriculture, compared to 12% on average in many other developed countries.

In December last year, the government consulted broadly on climate change and energy policies. For agriculture and forestry we proposed working with sectors and local government to prepare a Plan of Action to adapt to a changing climate, reduce emissions and enhance sinks, and capture business opportunities. This Plan of Action will need to be supported by a substantial investment in research and technology transfer. This presents a real opportunity for your Institute to contribute to climate change mitigation and adaptation.

Key developed countries are moving towards emissions trading schemes. In late July emissions trades started in Australia and Canada in anticipation of mandatory trading schemes in both countries. The United States already has a healthy voluntary emissions market and some states will soon add obligatory markets for utilities. The most advanced "cap-and-trade" scheme for greenhouse gases operates in the European Union.

Participants in such schemes are allocated, or purchase, a share of the emissions permits, which they can trade with others. Those who can reduce emissions can benefit from their reduced emissions by selling their surplus credits to those who need more.

New Zealand's scheme will be economy-wide, and include all sectors, and all gases. Even in the absence of such a scheme, there are many progressive initiatives as the agricultural and horticultural sector moves towards smart, efficient farming. Grove Mill winery, for example, is the first winery in the world to receive carboNZero certification, demonstrating that it added no net carbon dioxide emissions to the atmosphere in the production and distribution of its wines.

Nitrous oxide from animal waste and nitrogen fertiliser use makes up one-third of all agricultural emissions. The dairy sector and fertiliser companies are making significant progress in encouraging farmers to manage nutrients efficiently to reduce nitrous oxide emissions (and nitrate leaching). Nutrient budgets are one of the key tools. There is considerable research under way, funded by fertiliser companies, the Pastoral Greenhouse Gas Research Consortium and the government, to optimise the use of nitrification inhibitors to reduce nitrous oxide emissions and nitrate leaching.

Your Institute aims to be recognised as the champion of agricultural and horticultural science in New Zealand and you want to help influence science policies on agricultural and horticultural science. Well, I have a job for you: New Zealand agriculture and horticulture are facing unprecedented challenges in a changing environment in terms of:

- A changing climate, with risks of droughts and storms, but with opportunities of longer growing seasons;
- Changing and increasingly critical consumers, demanding produce with environmental integrity;
- A policy environment in which the Government must address our international obligations and liabilities, and encourage farmers and others to address their emissions.

The continued development and use of agricultural and horticultural science and technology have a major role to address these challenges.

Climate models of 21st century global warming coupled with climate scenarios provide sensitivity analysis tools for long-term planning. But seasonal to decadal variability is influenced by natural variability phenomena of El Niño Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO), which can produce significant extremes. Dr Jim Salinger, from NIWA, says adaptation to these and to a warmer and largely drier climate will provide challenges to the future Canterbury farming environment.

Climate change and variability in Canterbury

New Zealand and Canterbury average surface temperatures have increased by 0.7°C since 1871. These temperature increases are consistent with warming observed around the globe, and the international panel on climate change (2007) has concluded that warming of the climate system is now unequivocal.

The warming of the climate system is very likely due to the observed increase in anthropogenic greenhouse gas concentrations – increases in carbon dioxide, ozone, methane and nitrous oxides. By 2100 the atmospheric concentration of these greenhouse gases in carbon dioxide equivalents is expected to be at least twice, and possibly four times pre-industrial levels, leading to further warming of the climate system.

As well as global warming there are other influences on the climate system due to natural climate variability. These promote inter-annual to decadal climate variability. In the last quarter of the 20th century, more prevalent west to south-west flows have occurred, with a higher incidence of El Niño events. This resulted in a decrease in precipitation over much of Canterbury. The El Niño-Southern Oscillation (ENSO), through El Niño and La Niña events, influence the variability of Canterbury's climate seasonally. The Interdecadal Pacific Oscillation (IPO) shifts climate every one to three decades and will also influence precipitation.

Climate change over the next few decades will be driven by the underlying trend of global warming. Inter-annual to decadal climate variability will be super-imposed on top of this trend.

To ascertain the impacts future climate change will have on Canterbury, scenarios have been prepared for the 2030s and 2080s (Wratt et al. 2004). Published scenarios and climate model results indicate that the westerly circulation is likely to strengthen, especially over the South Island. For Canterbury a warming of 0.2 to 1.4°C is likely by the 2030s (see table) and 0.5 to 3.4°C by the 2080s.

The winter is the season that shows the most warming. The amount of warming is dependent on future emissions of greenhouse gases, but the median warming rate in mean temperature is about 0.2°C per decade. Daily temperature extremes (overnight minimum and daily maximum) will also vary with regional warming, in addition to changes in mean temperature. Small changes in the mean (average) temperature value can potentially have a large effect on the frequency with which a specified high temperature is exceeded, or with which temperatures below a low value (such as 0°C) occur.

Figures for projected changes between 1990 and 2100 in the number of days per year below freezing, and the number of days per year above 25°C are inferred from the Hadley GCM. They contrast the B1 (low emission) SRES scenario and low climate sensitivity with the A2 (high emission) SRES scenario and high climate sensitivity. There are large decreases in frost occurrence in Canterbury ranging from 10 to 30 days a year. This could reduce the number of frosts by 50% or more. There are increases in the number of days above 25°C from five to 30 days a year.

The scenarios show that many parts of Canterbury are expected to become drier. Mid-range precipitation decreases are in the order of five to 10% in annual precipitation for eastern parts of Canterbury by the 2080s. In the western foothills and MacKenzie basin, however, precipitation increases are likely with increased westerly winds. These changes will impact on soil moisture and drought. In a study Mullan et al. (2005) used accumulated potential evapotranspiration deficit (PED), the amount of water that would be needed to be added to a crop over a July to June growing year. Depending on the climate model and scenarios used, what is a currently is a one-in-20-year drought from PED events becomes one-in-five-year or less to a one-in-10-year drought in many parts of Canterbury by the 2080s. For example in the one-in-20-year drought the PED increases by 20 to 70mm by the 2030s and 50 to 200mm by the 2080s in eastern Canterbury. At Lincoln and Darfield this decreases the return interval by the 2080s from one in 3.5 to 10.5 years. Finally the mid-range projection for the 2080s is a 60% increase in the annual mean westerly component wind speed (Wratt et al. 2004).

ENSO and IPO also give seasonal to decadal variability of the Canterbury climate. With the 1978 phase change to the positive IPO, annual Canterbury precipitation decreases between five to 15%, with average seasonal PED increasing at Ashburton from 312 mm to 361 mm. Any reversal of phase may increase precipitation, and decrease PED. ENSO, which operates on seasonal to inter-annual time scales, also impacts particularly on precipitation. El Niño seasons on average, apart from autumn, typically receive five to 20% less precipitation while La Niña autumns and winter precipitation increases by five to 25% decreases in spring of zero to 20%. The summer response is indeterminate. For Ashburton average seasonal PED is 367 mm for the El Niño phase, and 240 mm for the La Niña.

Projected changes in mean temperature (°C) and precipitation (%) for the 2030s and 2080s, relative to 1990 for Canterbury. The ranges are based on results from 40 SRES emissions scenarios and six climate models, from Wratt et al. 2004).

Changes 2030s	Summer	Autumn	Winter	Spring	Annual
Temperature (°C)	-0.2 to 1.3	+0.1 to +1.1	+0.3 to +1.8	0.0 to +1.3	+0.2 to +1.4
Precipitation (%)*	-16 to +5	-20 to +1	-15 to +11	-11 to +4	-12 to +3
Changes 2080s					
Temperature (°C)	+0.0 to 3.3	+0.4 to 3.5	+0.8 to 3.9	+0.3 to 3.1	+0.5 to 3.4
Precipitation (%)*	-22 to +38	-36 to +8	-32 to +12	-21 to +3	-17 to +3

* *Precipitation changes are for Christchurch and Hanmer only.*

By Associate Professor Derrick Moot, from Lincoln University

The biological implications of climate change for Canterbury

The biological impacts of climate change predicted for agriculture in Canterbury include both direct effects, from increased ambient CO^2 levels, and indirect effects related to the change in climate and consequently weather patterns. The availability of additional CO^2 for plant growth is expected to benefit C3 plants more than C4 and white clover more than ryegrass (Hodgson et al. 1992). For temperate C3 species (most species currently grown in Canterbury) higher concentrations of atmospheric CO^2 allow the same rate of photosynthesis with less water loss or a greater amount of dry matter production per unit of water lost.

Either way, the result can be summed up as enhanced water use efficiency (WUE) of plants. But the benefits of any CO^2 "fertilisation" or improved WUE may be offset by several factors. These include acclimation, whereby the photosynthetic apparatus of plants becomes acclimatised to the higher levels of CO^2. Furthermore, to take advantage of increased CO^2 levels additional fertiliser inputs may be required and specifically more nitrogen.

Indirect effects of global climate change on the Canterbury climate have been outlined previously (Salinger, 2003). The impacts of these on plant processes can be assessed through their effect on the rate and duration of growth. Increased seasonal temperatures will enhance plant growth rates and extend the potential growing season. The ability to utilise these improved growing conditions will require availability of irrigation water to overcome lower rainfall and increased durations of dry periods. Furthermore increased temperatures accelerate plant development which will mean earlier maturity for arable crops and seed head emergence of pasture species such as perennial ryegrass.

Several SIRIUS scenarios (SIRIUS is a wheat simulation model) have shown the increased yield benefits of increased CO^2 exceed the loss of growing time from accelerated maturity. Indeed for arable crops grown in dry-land conditions the earlier maturity may be of benefit in avoiding soil moisture deficits.

The extent of the impact from warmer seasonal temperatures can be assessed by a cumulative probability analysis of historic mean seasonal temperatures and projection of these for future scenarios.

For Lincoln, the 40-year mean winter temperatures range between 5.5°C and 7.8°C. Temperatures are above 6.5°C fifty percent of the time. Future temperature scenarios for 2030 suggest middle value increases to between 6.7°C and 8.2°C. The result is more winter growth potential with a reduced risk of frost and therefore the potential to utilise species that suited to this changed environment.

Capturing the growth benefits will require different strategies for irrigated and dryland pastoral farmers. Using nitrogen and irrigation (Mills et al. 2006) showed that a perennial pasture produced about 22 t DM/ha at a growth rate of 7.0kg DM/oCd/ha above a base temperature of 3°C. Extrapolation of this linear relationship to future temperature sums estimates potential pasture production of 25 t DM/ha by 2030 and 30 t DM/ha by 2080. Both scenarios assume nitrogen is not limited, which is unlikely both at present and in the future.

In contrast, a cocksfoot pasture that receives no nitrogen grows at about fifty percent less dry matter. For dryland pastures the ability to maximise pasture growth during warm moist springs becomes more important and winter annual legumes such as subterranean clover will be more important. Equally the use of deep tap-rooted species like lucerne allows access to water that other species can't reach. Given the conservative nature of the relationship between water used and dry matter grown (Brown et al. 2003) the ability to extract water is a key advantage for dryland species.

The projected dryland pasture yield remains at about current levels (6.5 t DM/ha) with the limitation of growth through water stress partially compensated for the by the extended growing season.

Nick Brooks looks at the possible impacts of climate changes, based on NIWA predictions. In this edited version of a paper he presented to the Forum, he sees no major changes to the arable industry from climate change up to the year 2030 – but he warns that other developments may influence the long-term sustainability of this sector.

The Possible Impacts on the Arable Industry

The Canterbury Plains, with a cool temperate climate, has a world class reputation for excellent arable production. The alluvial soils are young and fertile and Canterbury enjoys a comparatively reliable annual rainfall of 550-660mm, spread fairly evenly throughout the year. Proximity to the Southern Alps and the cool Pacific Ocean means the summer temperature can drop significantly overnight. The effect is to slow seed maturation to a point where it allows good seed development.

One of the region's key weather advantages is the famous nor'wester wind. Farmers know nor'wester days are good for harvesting due to the low humidity producing seed close to ideal storage conditions. So the rare combination of locale, soil and climate creates an excellent environment for arable crops, and as good as, if not better than other regions around the world – the UK, Oregon in the USA and Denmark.

Canterbury's predominant land use is arable cropping, and Canterbury is the principal growing region for cereals, peas, grass seed, white clover, brassicas, process vegetables and so on.

The increased temperatures expected from climate change are likely to be generally positive for arable farmers. Higher temperatures will allow earlier sowings of crops and they will generally reach maturity faster, depending on sowing time. Warmer temperatures shouldn't affect winter-sown crops (such as winter wheat) because the changes are unlikely to be enough to impact on vernalisation (>10 degrees). The biggest impact from higher temperatures potentially is reducing yields of temperate crops such as cereals by reducing the grain fill period, which is why cooler regions like Southland produce world record crops.

Scientists believe increased levels of carbon dioxide could have a fertilising effect, potentially offsetting the negative impacts from higher temperatures. A recent study by Jamieson and Cloughley 2001 indicates a potential yield increase of 10-15% in wheat. This is likely to be different with crops such as maize but the increase in temperature may make it more viable in cooler regions. But increased yields mean increased input requirements to grow the crop. Hence increased nitrogen fertiliser and irrigation will continue to be vital for achieving those high yields, particularly on lighter soils.

Water is the biggest concern. Eastern regions like Canterbury are predicted to be the most at risk from water shortages. Demand is expected to increase due to increased evaporation along with a possible reduction in average rainfall (10-15%) that climate change may bring. This may not include areas close to the foothills like Methven (because rainfall is predicted to increase in the west). Therefore, more irrigation over longer periods will be required. There may be an increase in the frequency of droughts but perhaps the biggest risk in Canterbury is extreme events, such as flooding.

Changes in pests and diseases haven't received detailed study, making predictions highly uncertain. In general, the warmer, drier conditions in Canterbury could reduce the incidence of some diseases that favour either cool and/or wet conditions. Overall, these incremental or small changes probably will be required in disease management. Aphids and BYDV potentially could present a greater problem because of increased activity over the autumn, winter and spring periods, especially winter (with fewer frosts predicted). Also predicted is an increase in aphid reproduction and development, leading to an increase in crop management. Insecticides will need to be safe and compatible with natural enemies as they could increase and offset some of the population rise.

Current predictions are for large decreases in frost occurrence ranging from 10 to 30 days a year. This could represent a reduction of 50% or more on current frost events. There will possibly be less late season frosts which will be good for crops such as ryegrass, vulnerable to frost damage during flowering.

Proactive adaptation will avoid negative impacts and increase the benefits of climate change to the arable industry.

Breeding new cultivars that are suited to the changing conditions in Canterbury may be required. We need to be thinking about this now, because of the long time frames from breeding/screening to commercialisation (in some instances up to 10 years). Features to select for could include temperature tolerance, drought tolerance and pest and disease tolerance. GM crops offer significant opportunities for reducing the reliance on fertilisers and pesticides.

Some experts suggest arable crops such as soya beans, rice and sorghum may become increasingly viable in Canterbury. More forage sorghums and maize seem especially likely because of the expanding dairy industry. With maize we will see a greater range of hybrids being grown due to the reduced risk of frost and higher temperatures. But as we know from the past, the success of a new crop will be largely dependent on market conditions, and changes would be required in terms of infrastructure (for crop storage and processing) and crop markets.

I believe we have the infrastructure (seed companies, FAR, Crop & Food, AgResearch, for example) in place to adapt to climate change. The government intends investing a lot of money in this area so we can expect research and development expanding. Profitability will continue to be a big part of this with many growers getting involved in benchmarking their crop management practices.

But some other developments potentially will be more significant than climate change over the next 20-30 years. Irrigation is a critical one. We are now starting to see the rush to secure water. There is enough water in Canterbury for everyone (town and country) but we are not being smart about using it. We need to start investing in new water schemes that include water storage.

Another factor is the doubling of land values in Canterbury over the past five years. Land values generally exceed its productive values but this has now reached a new high. Dairying has had a huge influence on these values – even some cropping farms are being converted. But the dairy sector provides a significant market for crop residues, grain, silage and pasture seed. Both sectors could do more to work together for the benefit of both.

Urban sprawl is not a new issue, but it needs to be put back on the table for debate. We need to learn how best to deal with it. Canterbury (and New Zealand) has a limited source of high quality soils and we need to make the best use of them. Rural subdivision could force farmers on to less productive land. Councils need to get smarter about where they allow residential/urban growth and we all need to get to grips with the issue, to ensure we have the correct processes for the future.

Edited from a eulogy delivered by Bruce Clothier.
James Kerr was his PhD supervisor, mentor, critic and friend

Dr James Patterson Kerr

Jim Kerr will be remembered for his scientific record and footprint on the landscape of New Zealand's agriculture and horticulture as well as his skills and humanity.

On a work trip in the 1980s to our research centre in Havelock North, he took me on a short-cut through the Ruataniwha Plains to show me his family farm. Quintessential Jim – work and family.

James Patterson Kerr, raised in central Hawke's Bay, went from schools in that region to Massey University, where he graduated with a Masters of Agricultural Science in 1959 on the impact of soil water on pasture production. He then joined the Department of Scientific and Industrial Research (DSIR), and in 1962 transferred from the Grasslands Division to the newly formed Plant Physiology Division (PPD).

Jim and his wife Ruth then took a long trek that was to be a watershed in soil and agricultural science for New Zealand. He went to the University of Wisconsin in Madison to do a PhD under the redoubtable Champ Tanner. This was huge for New Zealand agricultural science. Jim connected with the then leading laboratory in the world. Subsequently, through this link Jim established a Wisconsin hapu here in New Zealand. This has had lasting benefit. A huge legacy. Many scientists owe their careers to Jim's move and the Wisconsin connection.

He returned in 1967 to work with Ken Mitchell, director of PPD. Following Ken's transfer to the Ministry of Works and Development, Jim became director in 1975.

Under his mentoring and leadership, those were heady days for the division in the late 1970s and early 1980s – a purple patch of team work, scientific productivity and new science. The team was broad-based – soils, micrometeorologists, plant physiologists, biochemists, and budding molecular biologists. Senior scientists – Roger Slack, Grattan Roughan, Tony Taylor, Bernard Forde, Ken Giles and Bill Sutton. Headstrong youthfulness – Paul Gandar, Mike Beardsell, Hugh McPherson, Sue Gardiner, Keith McNaughton, Dan Cohen, Ian Warrington, Lindsay Davies, John Browse, Ian Brooking, Jenny Rowley, Allan Hardacre, William Laing, John Christeller, and a very impressionable young PhD student – me. Then followed the next generation, Steve Green, Dennis Greer, Alan Green, and many others.

Jim's strengths were his strategic vision, humanity and humility. I have solicited comments from colleagues: "Jim inspired loyalty and was loyal"; "Jim was a bridge builder – neither parochial nor tribalistic"; "A champion of the primary sector".

The latter remark is reflected in Jim's election to Fellowship of the New Zealand Institute of Agricultural and Horticultural Science, erstwhile membership of the Massey University Council, and the Ferguson Hall Trust. He was a respected networker, and a knower of all those involved in New Zealand science and agriculture.

Jim also was a lover of sport in general, and team games in particular. The latter was tested when I refereed his beloved Napier Boys High School to a loss in their Polson Banner game against Palmerston North Boys' High School in 1981 in the curtain-raiser game to the British Lions match in Palmerston North. In his inimitable way, Jim made a special effort to criticise, albeit constructively, some of my refereeing decisions. He was, as ever, incisive and fair minded. He would always, with equanimity, express a certain view with clarity.

In the late 1980s and early 1990s, things in science were moving apace. Jim was, with a positive frame-of-mind as ever, fully engaged in the process. He looked forward to the reforms. In tumultuous times, he became a group manager in the new division of DSIR Fruit & Trees in 1989. In ever more-tumultuous times, with the advent of the Crown Research Institutes, he became a general manager in the fledgling HortResearch. As ever, he was optimistic, and possessed a strategic view of the future.

Despite the flak, Jim could see the wood for the trees.

In the mid 1990s, he left HortResearch and began work with Alistair Aiken and Martech where his strategic vision and incisive knowledge were both valued and appreciated. He worked assiduously with Martech on a range of projects that highlighted and stressed the role that science plays in powering the engine room of the New Zealand economy – agriculture and horticulture.

The Fresh Facts about NZ Horticulture, which Jim set up, is now an annually produced ready reckoner of facts on the value of horticulture to New Zealand. This will continue as a valuable asset and a lasting recognition of Jim's vision for our country's economy.

— By Brent Clothier

2007 Award Winners

Jubilee Medal

Recognising outstanding contributions to primary resource science.

Dr Stephen Goldson
For his work on bio-control on Argentine stem weevil and clover root weevil and development of the Sniffertech technique for finding unwanted biological material in containers. Stephen is chief scientist at Containescan. His leadership is reflected in his election as president of the Plant Protection Society, as a fellow of the Institute of Agricultural Science, fellow of the Royal Entomological Society of London and fellow of the Royal Society of New Zealand, and as chief science strategist in AgResearch.

Postgraduate Award

To encourage and assist young scientists to attend and present their research at an international conference.

Dr Rachel Anderson
Rachel, in her first year of post-doctoral research work with AgResearch, will use the $2,000 award to attend the Gut Microbiome conference in France. She will be presenting results from her FRST post-doctoral fellowship project entitled "Keeping the gut microflora at bay; cross talk between the guardians of the epithelium."

Fellows

Fellowship of the Institute recognises members who have given outstanding service to agricultural and horticultural science.

Dr Jeff Reid
Jeff has served New Zealand's horticultural and agricultural industries for more than 25 years, his work characterised by a drive for cost-effective, sustainable solutions to industry problems. Often this has involved quantitative modelling of how crops respond to their environment and management factors such as irrigation and fertilisers.

Dr Richard Falloon
Richard has contributed to agricultural and horticultural science across a broad spectrum, from basic research on plant pathogens and their interactions with host plants, to development of specific disease management strategies, leadership for plant protection sciences in New Zealand, and international leadership of his science discipline.

Dr Warren McNabb
Warren has been a leading researcher and section manager in AgResearch, increasing our understanding of the interactions between nutrition and gene regulation in ruminant animals leading to added value foods with improved functionality and improved animal productivity and health.

AgResearch Technology Transfer Award

Dr Keith Cameron
Keith makes a huge contribution to technology transfer through his roles as head of the Centre for Soil and Environmental Quality at Lincoln University and with the South Island Dairy Development Centre, informing farmers and industry leaders about nitrogen issues. The development of eco-n by Keith and his colleagues, in conjunction with Ravensdown, has been one of the most significant new technologies introduced to New Zealand agriculture in the past decade.

Sir Arthur Ward Award

Dr Derek Moot
Since his appointment in 1995, Derek has communicated to a wide audience of students, farmers and rural industry leaders. In 2004 he was presented with a NZQA National Teaching Excellence Award. In 2003 he edited the NZ Grassland Association symposium on Legumes for Dryland Pastures and has been a constant champion of he merits of lucerne.

Special Thanks

Dr John Palmer
Institute president John Lancashire made special thanks in recognition of John's work on the council and piloting the amalgamation of NZIAS and NZSHS, and for putting together the science programmes for NZIAHS conferences.

CANTERBURY SECTION AWARDS

PGG Wrightson Seeds Significant Achievement Award

2006 Award Presented to ***Adrian van Bysterveldt*** and ***Peter Gaul*** (Lincoln University Dairy Farm)

2007 Award Presented to ***Dr David Scobie, Denis O'Connell*** (AgResearch Lincoln) and ***Dr Andy Bray*** (Meat & Wool New Zealand).

The New Zealand Horticultural Science Advancement Trust 2008 Awards

Are you working in horticulture and do you need financial assistance to develop your ideas, attend a conference, disseminate information or sustain a project that might advance horticultural science in New Zealand? If so, and you are a member of NZIAHS (including a Student member), then you are encouraged to apply to the New Zealand Horticultural Science Advancement Trust for year 2008 awards.

Applications are considered on their merits, including the benefits to New Zealand horticulture. In recent years individual awards typically ranged between $1,000 and $2,000.

While most applications are for assistance to attend international symposia and meetings, consideration is given to any project that advances horticultural science in New Zealand.

An application form is available from:

- Steve Clarkson email: sclarkson@infogen.net.nz
- Jenny Taylor email: secretariat@agscience.org.nz

CLOSING DATE FOR APPLICATIONS IS 15TH NOVEMBER 2007

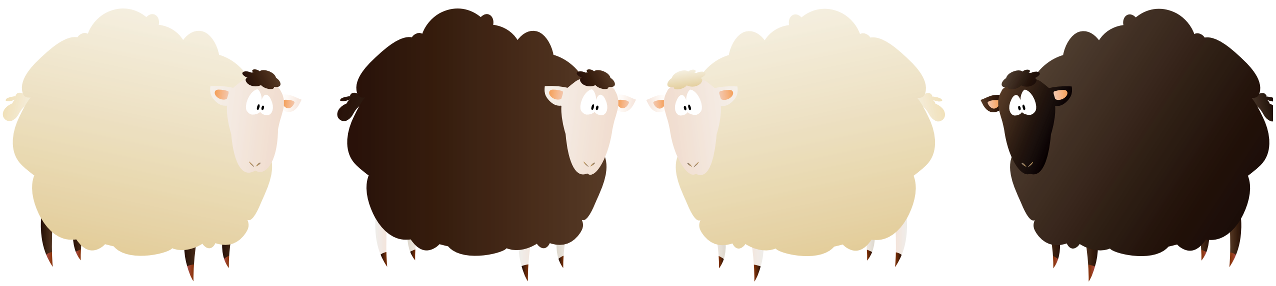
New members

We welcome

Raj Saini (Auckland)
Paul Johnstone (Hawkes Bay)
Hamish Brown (Canterbury)

Corporate members

- AGMARDT
- AgResearch
- Ballance Agri-Nutrients
- Catalyst R&D
- Crop & Food Research
- Dairy InSight
- Federated Farmers of New Zealand
- Horticulture New Zealand
- HortResearch
- Lincoln University
- Massey University
- PGG Wrightson Seeds
- Ravensdown Fertiliser Co-op



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