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USING HYBRID MAIZE IN NEW ZEALAND THE NEED FOR FARM AUDITS **ENVIRONMENTAL FARM PRACTICES**
TWO VIEWS ON MYCOPLASMA BOVIS **AVOCADOS A GROWTH INDUSTRY**

nzipim NZ Institute of Primary Industry Management

50 YEARS ANNIVERSARY

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NATIONAL OFFICE
Gleneagles Building
Level 3, 69 The Terrace, Wellington 6011
PO Box 5304, Wellington 6145
Phone (04) 939 9134
www.nzipim.co.nz
admin@nzipim.co.nz

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STEPHEN MACAULAY CEO

Carbon Zero Bill – step change or step too far?

Submissions on the Climate Change Response (Zero Carbon) Amendment Bill (the Bill) close on 16 July 2019. The purpose of the Bill is to provide a framework to develop and implement clear and stable climate change policies that contribute to the global effort under the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels.

A pleasing aspect of the Bill is to distinguish between biogenic methane as a short-lived gas, and all the other greenhouse gases (such as carbon dioxide and nitrous oxide), rather than set a single target for all greenhouse gases. While different to the approach of the Intergovernmental Panel on Climate Change (IPCC), splitting out methane better reflects New Zealand's economic base which is still heavily reliant on the production, processing and sale of agricultural products.

Within the Bill there is an interim requirement to reduce biogenic methane emissions to 10% below 2017 levels by 2030. While this target is highly ambitious, it is felt within the agricultural industry that this is achievable through the implementation of a number of changes within farm systems and promising research coming through the system.

However, the next target to reduce biogenic methane emissions within the range of 24% to 47% below 2017 levels by 2050 represents a considerable challenge for the agricultural industry based on what we know today. This aspirational target would appear to be heavily reliant on some yet to be seen new scientific breakthrough and/or technological advancement to effectively mitigate the methane emissions levels proposed in the Bill.

The 2050 target has caught many by surprise in the agricultural industry. The Parliamentary Commissioner for the Environment, Simon Upton, quotes modelling that shows methane from New Zealand agriculture does not cause extra warming beyond 2016 levels, and emissions need to reduce by at least 10% to 22% by 2050 with further reductions by 2100, which is significantly below the Bill's 2050 targeted range.

No doubt the final biogenic methane emissions targets will be hotly debated as the Bill progresses its way through the submission process.

The 2050 target will be immensely challenging and we should not underestimate the task ahead for livestock producers should this target be passed into legislation. I hope that science and new innovative on-farm practices come to the fore in helping farmers reduce their methane emission levels, while ensuring they can continue to maintain profitable and sustainable farm businesses into the future. However, given the enormity of the task at hand such optimism seems severely stretched.

For the type of step change required to achieve the 2050 targets under the Bill, we need to be prepared to test a range of different and innovative approaches to mitigate methane emissions on-farm, rather than restricting ourselves to the narrow range of research streams currently in the pipeline.

This involves pushing the boundaries of research endeavour further, which could include areas such as genetic modification in forages, among other potential options. Weighing up the inevitable conundrum of such research possibilities for what is possible and permissible needs to be deeply considered to reduce methane emissions to the scale proposed in the Bill. As difficult as this type of debate could be, this would better shape the discussion in developing a broader range of research strategies to mitigate greenhouse gases, and in determining future methane emissions targets going forward.

Whatever the final targets will be, reducing on-farm methane emissions (along with improving water quality) is one of the most important issues faced by livestock producers in the future. As an industry we need to be far better at providing well-researched and easily accessible definitive sources of information for rural professionals, to better guide their discussions with their farming clients in exploring different options in adapting their farm systems and in the identification of various actions to mitigate methane emissions and other greenhouse gases on-farm. J

JEN SCOULAR

NEW ZEALAND AVOCADOS – A GROWTH INDUSTRY

Demand for New Zealand avocados is growing around the world. The avocado industry is responding with the development of new markets in Asia, large-scale avocado plantings, a robust biosecurity strategy, and a collective approach to meeting the challenges faced by this rapidly growing industry.

Step change

The avocado industry in New Zealand has been through a step change over the last seven years from a cottage industry to one beginning to make its mark on the domestic horticultural scene. Last year saw the first shipments of avocados to China – New Zealand Avocado persisted through the five years that access negotiations took, but now see China as crucial to the sustainability of our industry as volumes increase. These increased volumes come from newly planted orchards in Northland at Houhora, 40 km north of Kaitaia, and at Tapora on the eastern side of the Kaipara Harbour.

Avocados were the first horticulture sector to receive Crown funding through the Primary Growth Partnership (PGP), which certainly supported the step change we have seen. At the time we contemplated if our efforts would be worthwhile due to the almost three years the application took to go through. Now we recognise not only the cash benefits of the programme, but also the ability to use the PGP as a platform for collaboration, strategic thinking and ambitious planning.

Demand growing

There is a bright future for the avocado industry. Consumer demand for avocados is driven by the health and versatility of the fruit. With India and China only just discovering avocados, there are opportunities to create market niches for those consumers who value safe, healthy and delicious food.

As people become more conscious of what they eat, how much meat they consume, and with veganism becoming even more popular, this creates a great space for avocados. Avocados are a nutrient-dense fruit that play a major role in healthy diets, contributing 19 vitamins, nutrients and phyto-nutrients. They are also an excellent source of healthy monounsaturated fats, are cholesterol-free, and have naturally low levels of sugar and sodium. The huge interest in avocados is therefore a tailwind we are benefiting from in New Zealand, for instance, they are the world's most pictured fruit on Pinterest.

Larger orchards and smaller trees

There are now vast new avocado developments in Houhora. New investments into avocados currently total nearly 1,000 ha, on top of the current 3,800 ha producing them. That investment is the result of the increase in values from avocados and the future opportunity seen by those investing in this industry. It is a very positive signal, and the New Zealand Avocado Board recently visited Houhora to see the developments, understand more about the technology and management practices being employed, and develop relationships which is hugely important in any industry.

The newly developed orchards were very open to the visit from the Board. Our Board members recognise that these orchards are breaking new ground and trialling new methods. They recognise the risks they take, and can see these operations are benefiting from the expert knowledge brought in from around the world.

The average size of orchards across New Zealand is less than 4 ha and the new developments, which are mostly conversions from dairy farms, range from 50 to 200 ha. Traditional avocado tree spacing is 10 x 10 m, or in the Bay of Plenty often 14 x 14 m, which is much wider than the new developments spaced at 5 x 5 m or even closer. The latest global technology is being used for soil preparation, clonal rootstocks, weed control, wind protection and nutrition.

Growers acknowledge they are still learning and adapting, as necessary, to optimise growth and future productivity. Most of the avocados in this country are of the Hass variety grafted onto a seedling or a clonal rootstock. Globally, there is no dwarf rootstock and New Zealand's fertile soils are almost too good for avocados – growers are often challenged with too much vegetative growth. It remains unknown how well intensively planted trees can be managed to constrain growth. However, with the newly planted hectares it is anticipated that trees will be kept compact and under 3 m tall, very different to the traditional expectation that they will flourish up to 6-8 m in height.

Across the growing regions – Northland, Bay of Plenty and South Auckland – the variation in productivity is huge. We have growers achieving 30 tonnes/ha, but the average across the industry is only about 9 tonnes/ha. We have significant swings in the volume of fruit each year. Management practices and location play a big part in the success of an orchard, and they are part of many factors that influence productivity.

International players

New Zealand produces less than 2% of avocados globally, the big players being Central and South America.

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US and South America

Mexico, from where avocados originate, produces more than 55% of the world's supply and exports over 80% of their crop to the US, trucking the equivalent of New Zealand's total annual crop every two weeks. California grows avocados, but their season lasts only a few months and salinity issues are creating challenges for their growers. So imported avocados are very much the norm, and most of these are trucked up from Mexico. Chile is the third largest avocado exporter and an exporter of multiple products over a long period.

China

I have been visiting the Chinese market as part of our access negotiations for five years. In that time, the number of cafes and restaurants selling avocados and avocado products has increased markedly, especially in Shanghai. China does grow avocados, but there is no professional industry and all the fruit grown there is consumed locally.

Mexico gained access to China about 10 years ago, and Chile and Peru had imports of their avocados approved four to five years ago. Imports have increased 250% in four years, but from a low base. As an industry, New Zealand Avocado recognises both the opportunities and challenges of the Chinese market and our exporters are taking a cautious approach to develop it.

Australia

Recently, a group of 12 Western Australian growers and avocado stakeholders visited New Zealand. Australia is an excellent market for our avocados. Our exporters have been very proactive in that market for more than 15 years and have built strong relationships, and are also starting to build strong infrastructure there. Australia is currently taking nearly 80% of our export avocados, but they are likely to open their market to Chilean avocados in the next 12 months or so. Currently, only New Zealand avocados have access to that market and we only supply during the summer months.

Due to different growing regions in Australia, domestically grown avocados are available all year round. New Zealand competes head-on with Western Australia, and our visitors were very clear that their new plantings would enable their avocados to meet the Australian consumer demand during our export season. This is a threat our exporters do not take lightly, as they maintain strong relationships with retail and wholesale markets over there and do not want to lose them.

The New Zealand avocado industry is in close discussion with the Australian avocado industry and producers around anticipated volumes into the Australian market over the next few years. To future-proof the industry, over 10 years ago New Zealand exporters began developing markets in Asia, starting with Japan. In 2013, an industry strategy was developed and supported by the New Zealand Government to invest in the development of new and high-value markets across Asia.

Other markets

We now also export to South Korea, Thailand, Japan, Singapore, Taiwan, Malaysia, Singapore and India. At New Zealand Avocado, we have websites and social media campaigns across most of those markets and have built up our number of followers to over 90,000.

For more information on global avocado trade data see the 'Further reading' section at the end of this article.

Horticulture Export Authority structure

Our avocados are exported under the Horticulture Export Authority structure, where New Zealand Avocado is the Recognised Product Group for the export of all avocados from this country. Growers, packers and exporters are required to register annually with New Zealand Avocado.

Exporters must also get an export licence from the Horticulture Export Authority. This structure enables the collaboration we see across the industry, and encourages the sharing of information on volumes, market conditions and future planning, but not on pricing.

Industry body role

As the industry body, New Zealand Avocado:

- Collects weekly information from packers and exporters on their volumes
- Consolidates forecast volume information from exporters to report on the expected flow of volumes by market for the current season and expected market destination for future seasons
- Collects productivity statistics at an orchard level, which means we can report the yield and consistency of yield by orchard across New Zealand for the last 10 years.

There is certainly still more work to do to ensure the future sustainability of our industry. New Zealand Avocado is starting to collect and collate better and more detailed climate data, and will assess this against production and quality outcomes. We are also starting to collect data to allow us to assess the sustainability of our industry. There is more work to do to ensure every avocado consumed by our global customers is a great experience, and while we are heading towards our productivity goals there is still some way to go to meet these.

Pests and diseases

Like all primary sectors, the avocado industry is under the constant threat of exotic pest and diseases. Passengers, cargo and even the wind can create opportunities for new pest introductions. The continual review of these pathways and the surveillance systems set up to detect and respond to new threats helps protect the industry and its valuable trade agreements. Recent detections of fruit fly in Auckland have highlighted the value of an early warning system and dynamic response plan, as well as the level of resourcing and investment that is required to sustain an effective response.

New Zealand Avocado continues to engage with researchers, other industry groups and the Government to help prevent and prepare for new pest incursions. The Government Industry Agreement for Biosecurity Readiness and Response (GIA) is a biosecurity partnership that formalises joint decision-making and cost-sharing. This ensures that industry organisations such as New Zealand Avocado have a formal role (alongside government) in managing their biosecurity risks, while also creating the platform and relationships needed to engage in the wider biosecurity system.

For established pests, the avocado industry requires compliance from all export growers to AvoGreen®, an industry pest monitoring programme. AvoGreen® has evolved beyond a simple IPM programme that justified responsible spray use to be a pest management system that is recognised within international export agreements.

As global trade increases, industries alongside government will need to invest in new ways of detecting and responding to pests. Technology at the border, surveillance systems post-border, and advances in sustainable biocontrol options will need to keep pace with rapidly changing trade dynamics and the global spread of high impact pests and diseases.

New Zealand's competitive advantage

New Zealand's unique growing conditions and robust industry systems give our avocados a competitive advantage, alongside this country's excellent reputation for growing safe and great tasting produce.

Research undertaken by Plant & Food Research in 2016 showed that avocados from New Zealand have twice the levels of vitamin B6 and 20% more folate than the published global standard nutrients for Hass avocados. Vitamin B6 aids in fighting fatigue, and folate is essential for cell division, which makes it very important for pregnant women and growing children.

New Zealand's proximity to Australia and Asia, combined with a specific focus on meeting market requirements for key markets in the Asia-Pacific region, gives us an advantage over competitors in these high-value markets. As a result of industry systems developed to meet specific market requirements, New Zealand has benefited from access to markets such as Korea and Thailand, where few competing supply countries are able to operate during the New Zealand supply window.

Risks and challenges ahead

With the increased investment into avocados, the continued global demand for avocados and the need for healthy food, there is a huge opportunity going forward. However, the horticulture industry also faces significant risks, from biosecurity to climatic events to changes in consumer demand.

With a strong Board, experienced exporters, disciplined packers and passionate growers, there is an opportunity to support greater investment into production areas, to see increased productivity on current orchards, and for there to be a continual improvement in efficiency across the value chain.

Consumers love avocados for their taste, their versatility and their health benefits. If we work together as an industry, heading in one direction, we will make the most progress towards our goal to be a globally competitive, high-value, sustainable export industry with a dynamic market in New Zealand.

Further reading

2018 NZ Avocado Annual Report: https://industry.nzavocado.co.nz/download/annual-report-2018/

UN Comtrade website for avocado import data: https://comtrade.un.org/db/default.aspx

Jen Scoular is CEO of New Zealand Avocado based in Tauranga. Email: jenscoular@nzavocado.co.nz.

2019 NATIONAL CONFERENCE

CHATEAU ON THE PARK HOTEL, CHRISTCHURCH
MONDAY 5TH AND TUESDAY 6TH OF AUGUST

Once again we have brought together a great range of speakers covering a diverse number of relevant topics and leading edge ideas from across the primary industry.

In this year's conference programme we will be looking at international markets and the global food demand outlook for our agri-food products, which includes presentations from Gerard Hickey of First Light and Innes Moffat from the Deer Industry NZ. Susan Kilsby from ANZ will then provide a market overview of New Zealand's primary exports.

We will also be looking at environmental factors influencing farm systems. Andrew Curtis of Water Strategies will be providing an overview of national water policy strategies and discuss what this means for farming enterprises, followed by a presentation by Phill Everest who will discuss Hind's Plan Change 2 and what this means for farming in the region. Aslan Wright-Stow of DairyNZ will be outlining some of the practicable steps in improving water quality and biodiversity on-farm, then Mananui Ramsden of Ecan will expand our understanding of

Mahinga Kai cultural values and what this looks like in a farming system.

Mark Webb and Angela Christensen of Fish & Game Central South Island will provide an external perspective about working with farmers in meeting respective goals. Robyn Dyne of AgResearch will discuss greenhouse gas emissions mitigation strategies on-farm, followed by a presentation on what carbon farming looks like on-farm by John-Paul Praat of Groundtruth.

This year's keynote speaker is Jesse Reader from Bosch AgTech Australia who will provide his insights into the emerging agri-tech landscape and new technologies that will be changing farm ecosystems as we know them. We will also feature a panel discussion on future debt financing, as well as a look at the implications of the Reserve Bank's proposal to increase bank capital levels.

We are also delighted to have the Minister of Agriculture, Hon Damien O'Connor speak at conference.

Once again we will be running concurrent sessions on Business & Governance and Technical & Extension sessions. The closing session features a one hour 'Hot Science' session where researchers will provide short presentations on selected research topics. In closing we are pleased to have Rich McDowell, from the Our Land and Water Science Challenge, announce the new research stakeholder information available for rural professionals.

Conference programme and registration forms are available from www.nzipim.co.nz. We look forward to seeing you at conference.

FOR MORE INFORMATION ON THE CONFERENCE, PLEASE CHECK OUT NZIPIM'S WEBSITE (WWW.NZIPIM.CO.NZ) OR CONTACT ADMIN@NZIPIM.CO.NZ | 04 939 9134

ANDREW BARBER

OUTDOOR VEGETABLE PRODUCTION – JOINING THE DOTS ON SOIL EROSION AND SEDIMENT CONTROL

An MPI SFF Project, Don't Muddy the Water, has quantified soil losses with and without various erosion and sediment control measures. Now commercial vegetable growers are joining the dots between research, guidelines, Erosion & Sediment Control Plans, implementation, and assurance through NZ GAP.

Sediment loss from cultivated horticultural land is a big issue. Many thousands of tonnes of economically valuable topsoil is carried in surface water run-off annually from farms, often entering waterways where it contaminates the freshwater ecosystem. Erosion and sediment control is therefore a priority in the horticulture industry, and specifically in the outdoor vegetable production sector where (as an essential part of the production system) paddocks are often left fallow or with minimal ground cover during critical times of the year.

Sediment retention ponds (SRPs)

Fortunately, growers have many tools in their erosion and sediment control toolkit – from the use of cover crops and wheel track ripping (erosion control), through to drain dropout pits and vegetated buffer strips (sediment control). One of the most important and effective sediment control tools that growers have available is an SRP, which acts as a settling pond by detaining run-off water, stopping soil bedload from leaving the property, and allowing suspended sediment to drop out and thereby clean the run-off water.

Horticulture New Zealand has brought all of these erosion and sediment control tools together in their Erosion & Sediment Control Guidelines for Vegetable Production (the Guidelines). The Guidelines state that at a minimum, an SRP should be sized at 0.5% (50 m^3/ha), or 1.0% (100 m^3/ha) if the catchment area is larger than 5 ha.

MPI SFF – Don't Muddy the Water project

The Sustainable Farming Fund (SFF) project, Don't Muddy the Water (DMTW), was established to quantify the effectiveness of SRPs, amongst other mitigation measures, on cultivated vegetable cropping land and to support and further improve our understanding of the Guidelines.

DMTW has been underway for three years, with one of the main project aims being to understand the efficiency of different sized SRPs. While research is still ongoing in this project, *Figure 1* shows a summary of the results gathered to date. The most interesting insights from this figure are:

The Erosion & Sediment Control Guidelines for Vegetable Production, which have become the basis for the E&S Control Plans

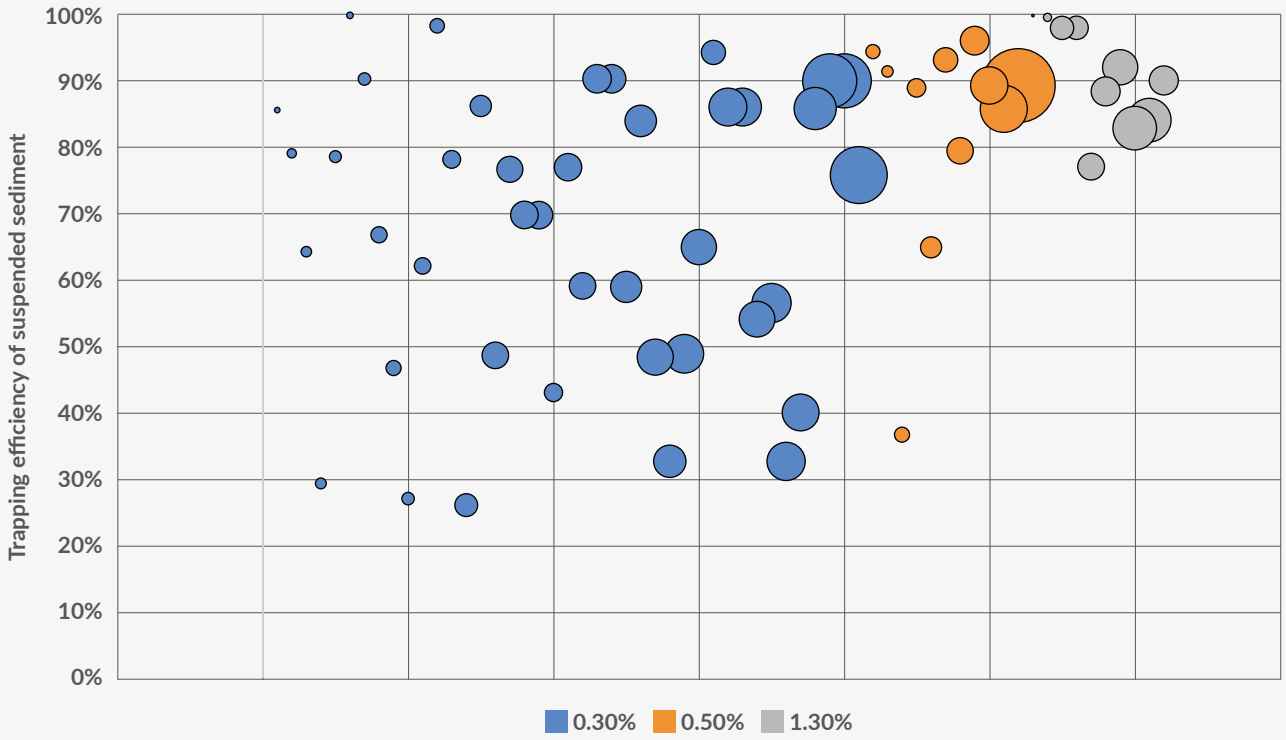

Figure 1. Proportion of suspended sediment removed by different sized SRPs. The colour of each bubble refers to the size of the SRP as a percentage of its catchment area, while the size of the bubble indicates the relative size of the rainfall event

Many thousands of tonnes of economically valuable topsoil is carried in surface water run-off annually from farms, often entering waterways where it contaminates the freshwater ecosystem.

- Small SRPs – at 0.3% (30 m^3/ha) – have the capacity for detaining more than half of the incoming suspended sediment (average of 68%), but are much more variable than larger SRPs
- The two larger SRPs (0.5% and 1.3%) averaged 83% and 91% suspended sediment trapping efficiency, respectively, and with much less variability.

These results proved that vegetable cropping's guideline of 0.5% could achieve the same if not better results than the much larger 2% ponds required on construction sites (explained by lower run-off and less fine clay particles). Another interesting result from the DMTW project was that SRPs of almost any size were found to remove all the bedload erosion from run-off. Any sized pond trapped over 95% of total erosion. Essentially, as soon as overland flow is slowed down, soil drops out along the rows, headlands and, ultimately, forebays and SRPs. SRPs are therefore not sized based on their ability to trap total erosion, but rather their suspended sediment trapping efficiency.

Suspended sediment is less than 5% of total soil erosion, yet SRPs need to be sized based on trapping this small percentage of soil. It can be a hard sell to recommend a significant increase in pond size, yet the difference in *total* erosion detained is minimal. For example, unmitigated erosion on cultivated land may be 25 tonnes/ha. An existing undersized SRP (0.25%) will trap 24.8 tonnes/ha, while doubling the size of the SRP to meet the Guidelines will trap 24.9 tonnes/ha.

Why increase the size of SRPs?

This then begs the question as to why go to considerable expense, approximately $5,000 in this case, to increase an SRP's size at all? Why not build 0.25% or smaller sized SRPs? The justification for increasing the size of SRPs comes from the need to mitigate the discharge of suspended sediment. Despite comprising less than 5% of total in-field erosion, the effects of suspended sediment on waterways can be catastrophic. Suspended sediment that enters waterways in run-off water acts to smother the fish and invertebrate species living in them, severely restricting the habitats and food sources available to these organisms and disrupting the entire ecosystem.

Suspended sediment can also carry other contaminants such as phosphate, harmful microbes and ecotoxic chemicals, further disturbing New Zealand's already fragile aquatic environments. A key finding of this project was therefore to emphasise the destructive effect of suspended sediment, and to reinforce that a 0.5% (50 m^3/ha) minimum sized SRP is necessary for consistently minimising suspended sediment loss from a farm.

A forebay and SRP set up with a weir to measure flow and a water sampling device that automatically grabs samples every 6,000 litres. All water flowing into and out of the SRP is recorded for flow rate and level of suspended sediment

Suspended sediment can also carry other contaminants such as phosphate, harmful microbes and ecotoxic chemicals, further disturbing New Zealand's already fragile aquatic environments.

Erosion & Sediment Control Plans

With the Guidelines grounded in common sense and now numerical research, the question becomes how to connect them to on-farm practices and how to use them to drive good and best management practices (GMPs/BMPs). An extension to the DMTW project has been granted to address progressing from research to implementation across the sector. This extension involves developing farm (paddock) specific Erosion & Sediment Control Plans that are a key component of vegetable Farm Environment Plans.

Farm Environment Plans are increasingly being required by councils to address concerns over sediment discharge from horticultural land. The E&S Control Plan takes a risk-based approach as part of a four-step process for every paddock:

1. Paddock assessment.
2. Implement control measures to stop or control water entering the paddock.
3. Implement erosion control measures to keep soil on the paddock.
4. Implement sediment control measures to manage the water and suspended solids that move off the paddock.

The E&S Control Plan details:

- The unmitigated erosion rates per hectare for each paddock
- The erosion rates at the current level of mitigations
- What the rate will be once the E&S Control Plan is fully implemented.

The erosion rates are calculated using an app developed as part of the DMTW project. The baseline unmitigated erosion rate is calculated using the Revised Universal Soil Loss Equation (RUSLE). The baseline erosion rate for cultivated vegetable production takes into account the location of the farm, average rainfall, slope, soil type and row length. The current and future erosion rates utilise the results from the DMTW project when calculating the impact from a wide range of erosion and sediment control measures.

The E&S Control Plan sets out the schedule, location and specifications of any improvements. For some growers this may mean constructing new SRPs, but for others it may require expanding existing SRPs or installing bunds or vegetated buffers. While growers already use a wide

A newly installed SRP following the completion of an Erosion & Sediment Control Plan

range of erosion and sediment control tools, the E&S Control Plans formalise these, ensuring alignment with the Guidelines, and documentation of construction and maintenance schedules.

Implementation issues

Having gone to the effort of putting measures in place, there are a number of implementation issues that can trip growers up. Vegetated buffer strips can be compromised by channelisation, a factor considered in the app, while SRPs can be undersized, with snorkels that have too high a flow rate and emergency spillways that are not stabilised or are too narrow.

Areas for improvement such as these will be considered in the E&S Control Plan, which will also specify when each stage of the improvement works or new construction should be completed. Consideration is given to ground conditions at the site, as well as priority rankings for each paddock. The generated E&S Control Plan and observed actions can then be used as evidence in assurance programmes such as New Zealand Good Agricultural Practices (NZ GAP).

NZ GAP works through the same process as other assurance programmes with trained, third party auditors doing a site inspection and evaluating the site against a checklist, utilising the Farm Environment Plan to do so.

Sustainability dashboard

Finally, the metrics used in the E&S Control Plans could potentially be aggregated and used in an industry-driven sustainability dashboard. Dashboards and individualised reporting can help drive change through improved understanding, directing new research into identified knowledge gaps, as well as (most importantly) creating a grower feedback loop that allows for continuous improvement of good practices. Not only can these dashboards help drive change, but they are a very powerful way of quantifying and telling horticulture's story.

This same dashboard approach has been used extremely successfully in the New Zealand wine industry by Sustainable Winegrowing New Zealand, focusing on agrichemical, water and electricity use. Information collected by this organisation is reported back to the individual growers and wineries, with benchmarking reports allowing each grower and winemaker to assess their own performance against catchment, regional, national or same size winery benchmarks.

National reports are then generated to give an industry-wide overview and to monitor trends. With the improved data collection processes in the outdoor vegetable industry driven by NZ GAP and the Farm Environment Plans, this same approach could be used to drive performance change and increased uptake of GMPs/BMPs.

Andrew Barber is the Director of Agrilink based in Auckland. Email: andrew@agrilink.co.nz.

MARK EVEREST

FROM THE GROUND UP – THE ROLE OF COMPLIANCE IN ACHIEVING PRACTICE CHANGE

Regional water quality and quantity targets have been set across the country by communities under the directives of regional councils. How are farmers individually going to meet our emission reduction obligations? Compliance reporting for farms about the limits to which they are subjected requires awareness of emission risks. Awareness can stimulate consideration of practice change on-farm. Nutrient budgets, Farm Environment Plans and audits are tools used to both stimulate awareness and measure the effect of practice change on emissions.

Nutrient management rules

There are rules in life, some of them are written in law and some are unwritten, often considered ethics or morals. Irrespective of the structure (legal or moral) rules should be put in place as an absolute, but be broad enough that they give scope to operators to innovate and develop different pathways to get to a destination. To navigate where we are going we need to understand where we have been, what resources we are working with, and a map of how we are to get to the destination. In the nutrient management space:

- Nutrient limits set within Land and Water Regional Plans (LWRPs) are our destination
- Nutrient budgets show where we have been
- Farm Environment Plans (FEPs), nutrient budgets and innovators are our resources
- In most regions, communities have been tasked with first designing the roadmap and secondly building the roads to get to the destination.

Regional council and community role

Some time between 2000 and 2010, the New Zealand Government began writing legislation requiring regional councils to establish limits for national resources, and the policy about water quality is known as the National Policy Statement (NPS) for Freshwater Management (made operative in 2011). The Freshwater NPS requires that regional councils, through a community consultation process, set their own structures and planning framework to establish their natural resource quantity and quality targets and enable communities to develop a framework to reach these.

For the agricultural sector in most regions the current primary resource focus is water (watch this space for a greenhouse gas revival). Regional plans include the LWRP in Canterbury and Southland, the Horizons One Plan in the Manawatu and the Regional Natural Resources Plan in the Bay of Plenty.

Many councils have constructed their water quality framework in such a way that provides for them to break their region down into smaller 'catchments' or 'zones', where more localised and tailored plans can be developed to cater for catchment-specific targets and issues.

Once a plan with targets is made operative, all members of the community are obligated to monitor and report their contribution to emissions and their change in emissions to support the community achieving their set targets. Just like speed limits on the road, environmental regulation requires defined limits (rather than targets) and a way of measuring compliance with the limits.

Measuring the effects of practice change – Overseer

Regional councils have elected to estimate emissions from agricultural practices, in lieu of cost-effective tools to directly and accurately measure emissions. The model that is currently approved by most regional councils to predict emissions from agricultural practices is Overseer.

Overseer is a rather curious tool and unlike any other software currently in operation. It is unique in the sense that it is able to model the dynamic biological interactions between soil, water, air, plants and animals. It is a long-term model that is best suited to assessing relative change in emissions between farm systems, assuming the farm programmes are in a 'steady state'.

It is important to understand that Overseer has some limitations in accurately modelling some crops or complex farm systems due to some deficiencies in industry research to inform the model. The science and agricultural community are aware of these deficiencies and are working collaboratively to undertake research that will give farmers a better understanding of how their farm practices impact their emissions, which will also inform and strengthen the Overseer model. However, irrespective of the limitations, as long as the operator constructs nutrient budgets for comparison following the same protocol with each model, Overseer is very good at assessing relative change in emissions.

In-situ soil nutrient and drainage measuring technology is evolving constantly. Within five years, cost-effective and accurate soil nutrient drainage technology will become more readily available and commonplace. This will not, however, replace the need for constructing nutrient budgets with Overseer. This bold statement is made for three reasons:

- As communities, we are trying to assess a relative reduction or change in emissions, which if accurately and consistently modelled can be done with software
- We know from the P21 research, FAR drainage trial research, groundwater bore nitrogen concentrations and on-farm moisture probe drainage records that there can be significant fluctuations in nutrient emissions from season to season, which could make compliance reporting very difficult
- Not all technology suits every farming operation.

It is worth considering that if we have consented nutrient loss limits, then accurate reporting of every paddock's emissions will be valuable. However, this would only be prudent once there is at least five years of data to enable a demonstration of a trend or average (effectively what Overseer does for us now). It is critical that compliance reporting does not confuse continuous long-term improvement with short-term anomaly data.

The speed at which on-site measurement tools are being developed is exponentially increasing, and their ability to assess potential crop deficiencies or surpluses (both current and forecast) with accuracy will be a game changer for agriculture management in years to come.

As long as Crown Research Institutes, universities and industry continue to develop a more robust understanding of our biological system that is farming, Overseer will continue to evolve at the same rate.

It is to be expected that the uptake of this technology will be driven by farmers' desire to be more efficient with inputs, and with on-site tools enabling more precise feeding, watering and treatment of crops. These tools will form part of an improved management suite, which will in turn assist in reducing emissions.

Farmax and FarmIQ (or other software supporting farm management decisions) do not report nutrient emissions. However, they can be useful in collecting physical farm parameter information essential for the preparation of an Overseer nutrient budget or FEP.

Overseer is dynamic, and (like tax law) discretion is offered to the operator to determine the 'most appropriate' way to model a farm, which of course leaves some room for manipulation of the compliance reporting framework. The fortunate thing about using 'discretion' within Overseer is that the operator can generally only manipulate the system once, i.e. if the consenting officer or auditor do not notice discrepancies in the modelling methodologies, made deliberately in order for the applicant to obtain a desired consent, the farmer will be required to operate within this consented limit in subsequent seasons.

Evolution is something that is constant within Overseer, which results in some variation in reported nutrient losses between its versions (software engine changes). While a changing modelled nutrient loss from a static farm system may be frustrating for some farmers, evolution of the software really is a good thing. Each version change of Overseer is a refinement of the engine, or an addition of a new part of science, which when successfully incorporated ultimately improves the accuracy of the model. As long as Crown Research Institutes, universities and industry continue to develop a more robust understanding of our biological system that is farming, Overseer will continue to evolve at the same rate.

Stimulating on-farm practice change – FEPs

Given the Freshwater NPS stipulates that regional council plans must also provide a framework for reporting change (particularly improvement) over time, regional councils needed a commentary from farmers to describe practices and to stimulate them to identify potential improvements that could be made to farm management over time. This resulted in the FEP (also known as a Farm Plan, Land Environment Plan, Land Management Plan and Sustainable Milk Plan).

The FEP is not new; it has been around for a number of years used mainly for the consenting of activities in what have historically been perceived as more environmentally and publicly sensitive areas. Now that the whole country is seen as environmentally and publicly sensitive in some way, shape or form, the farming community are required to articulate their management practices to evidence efficient use of resources.

The underlying purpose of the FEP is to stimulate farmers to think about their on-farm practices, their appropriateness, and identify any areas within their management that could be improved to enhance resource use efficiency and minimise emissions. Overseer nutrient budgets form a section of the FEP and guide farmers to focus on any nutrient emission weak points of their operation. Once identified, a management practice change strategy can be noted in the FEP and a strategy implemented to attempt to mitigate this emission weak point.

An FEP is a working document and is supposed to be regularly updated and kept current. Like any working document, if an FEP is going to be of use, the person responsible for management on the property needs ownership of the document (so they need to generate it). The FEP needs to be succinct enough that it is read and reflected on. The FEP is not an exam, it cannot be wrong, and it is not intended to make farmers fit within a tick box.

Quality check – auditing FEPs and nutrient budgets

Have we been honest in our Overseer nutrient budget and FEP? Perhaps. Having the nutrient budget and FEP audited is a quality check exercise. An independently accredited auditor approved by the regional council checks the accuracy of the prepared nutrient budget against some known farm records (farm account stock reconciliations, fertiliser purchase order summaries, farm map records) and grades the quality of the prepared nutrient budget.

Auditors also check that an FEP contains all the appropriate information. Once a property tour is complete, the auditor should discuss the prepared FEP with the farmer (as with the Overseer nutrient budget) to:

- Check the content is an accurate representation of current management practices
- Then discuss areas for improvement within management and within the document, and suggest (if applicable) changes that could further encourage practice change to reduce emissions.

The FEP is then graded by the auditor (all regional councils have a slightly different grading criteria), like the nutrient budget, based on the level of confidence in the accuracy

While considerable improvements have been made to on-farm efficiency, with many of the easy gains attained, significant emission reductions are still required in some catchments in not much time and with what tools and techniques?

of the content, as well as how likely current management practices will minimise nutrient emissions. This practice needs to evolve. An audit by definition is meant to be a data quality check rather than a farm emission risk grading (a financial accounts auditor does not comment on business viability – they check data integrity). If regional councils want an emissions risk grade applied to each farm, they should include this as a separate measure.

The audit is more of an honest evaluation of the content in the FEP and nutrient budget. The audit report accompanies the FEP and Overseer nutrient budget, which are then used by the regional council to assess compliance with any consent or emission limit to which a farm is subjected.

Summary

The Freshwater NPS requires water quality and quantity targets to be set, and regional LWRPs enable communities to set water quality and quantity limits and use nutrient budgets, FEPs and audits to encourage practice change on-farm. In short:

- **Overseer:** Nutrient budget – estimates nutrient emissions from a property
- **FEP:** Describes farm practices and management – it guides farmers to articulate these and potential improvements that could reduce the farm's environment footprint
- **Auditor:** Checks how accurately the nutrient budget and FEP reflect on-farm practices.

All these processes and documents are designed to stimulate the thinking of farmers about on-farm practices and identify which of them might impact on the environment. Once a risk awareness about a practice is developed, the farm management team make a plan to minimise the risk of any practices having an adverse effect on the environment.

As a nation, the farming community has made significant investment in infrastructure and knowledge development to improve on-farm efficiency and minimise emissions, but most catchments still have a very long way to go. Many catchments have significant emission reduction targets to meet.

While considerable improvements have been made to on-farm efficiency, with many of the easy gains attained, significant emission reductions are still required in some catchments in not much time and with what tools and techniques? The hard questions we all need to ask ourselves are: 'As a community are we going to get to the destination?' and 'How am I as a farmer practically going to meet my emission obligations?'

Mark Everest is a Farm Consultant at MRB based in Ashburton. Email: mark@mrb.co.nz. J

PENNY PAYNE AND HELEN PERCY

WHO TALKS TO WHO ABOUT ENVIRONMENTAL FARM PRACTICES IN NEW ZEALAND? A SOCIAL NETWORK ANALYSIS

The December 2018 issue of this Journal contained an article by Professor Peter Kemp of Massey University about improving agricultural extension in New Zealand and the need for more social science in this area. This research contributes to that cause, presenting a social network analysis of 'Who is in the conversation' about environmental farm practices in this country.

The exchange of knowledge and information happens between people, including researchers, rural professionals and farmers, and others. This article looks at who the key players in the conversation are, which topics are being talked about, trust in information providers, and the usefulness of the information. This can help to identify strengths and weaknesses in agricultural extension in New Zealand, to enable organisations and industry to improve their communication effectiveness.

What is social network analysis (SNA)?

SNA is a method that presents a 'snapshot' of a particular network at a given point in time. It asks 'Who is in this conversation?' From this, areas for improvement can be identified – who is out on the periphery of the conversation and needs to be brought in, and where there are bottlenecks or individuals who are 'gatekeeping' information. SNA is a useful way of visually depicting changes in a network over time, particularly after an event which might be expected to cause changes in the network (e.g. environmental regulation). We were interested in looking at this particular conversation to see if it was what we expected – whether farmers were seeking information from the familiar industry players and if different groups are having conversations about the same things.

For this research, a survey was emailed out to 822 people in the New Zealand agricultural industry, including rural professionals, government agency staff, farmers and researchers. Our intended audience was not only farmers, but also wider next and end users of agricultural extension. Farmers who did receive the survey are likely to be more engaged members of the extension network, as they were existing members of mailing databases related to agricultural extension. Of those who were sent the survey, some were part of AgResearch's database and others were general industry contacts, including from email addresses provided through industry contacts and websites. Some participants fulfilled multiple roles (e.g. farmer and consultant), and were able to select multiple roles in the survey. They were then able to respond to the survey in the capacity they preferred (e.g. as a farmer, or as a farmer and consultant).

Responses were received from 259 (31.5%) individuals. Participants were located across New Zealand, with 43.4% female and 56.2% male. The largest group who responded were agribusiness professionals (41.8%), followed by farmers (16%), government (14.8%) and industry sector organisations (14.8%). Participants answered the question, 'Who are the three main parties, individuals or groups, that you contact when in need of information about environmental farm practices?' Contact was defined as direct contact, via phone, electronically (e.g. email), or through face-to-face interaction. 'Environmental farm practices' were defined as 'things that affect environmental practices on the land, which might include knowledge for decisions, innovations and/or technologies.'

Participants were able to name up to three 'parties', usually organisations, and were then asked:

- How often they communicated
- How useful they rated the information provided by the party
- On average, the extent to which they trusted that party as a source of information.

Participants could then name up to three individuals within an organisation ***(Figure 1)*** and what they usually contacted this person about (from a list of topics).

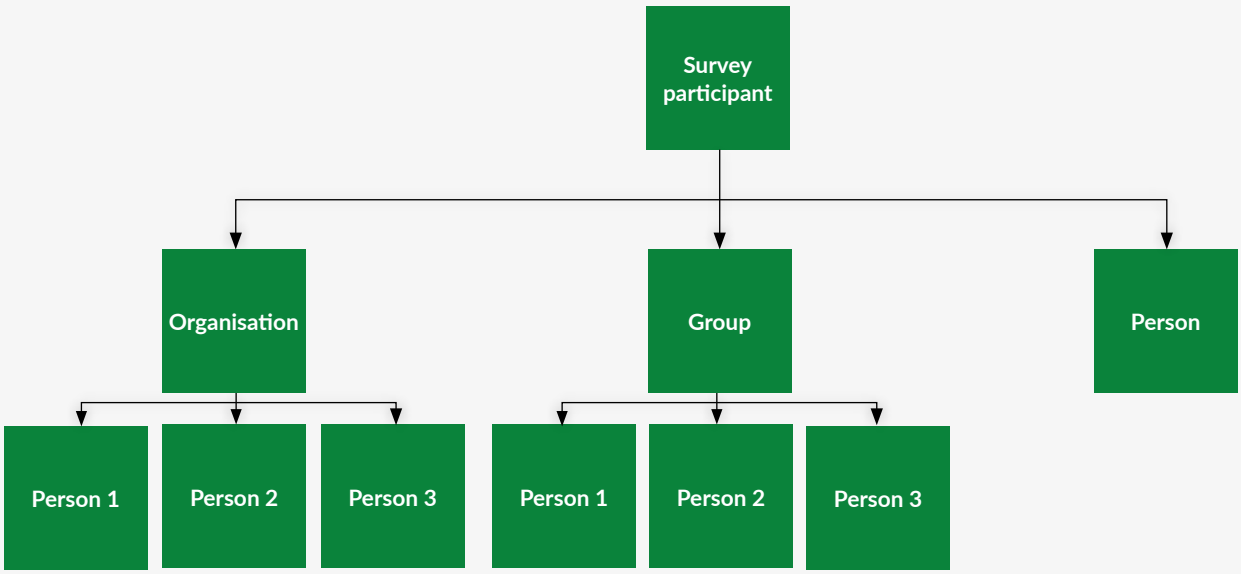

Figure 1: How participants were asked to describe their network – 'Name up to three parties you talk to about environmental farm practices and up to three individuals at each organisation' (if the party you named was not an individual)

The following section discusses several network maps based on the data collected. It is important to note that how an organisation is shown in the network is strongly affected by how many people from it responded to our survey. Organisations that were named by other participants, but did not participate themselves, will appear less significant in the network. This single survey could not capture all relationships that exist for this topic in New Zealand, so this research presents a snapshot in time based on those who responded.

Two network maps were examined:

- The first is at the individual level, where each person who responded and who was named is shown in the network
- The second is at the organisational/group level, where all people from a given organisation or group are put together into one 'party'.

The individual map provided us with more detail about the specific relationships in the network, while the aggregated map showed us how significant various organisations are in the network.

Individuals talking about environmental farm practices

There were 914 individuals identified in the network and 935 relationships between these individuals. In the map, however, for every conversation about a different topic, even between the same two people, we have shown a connection. For example, if a farmer is talking to an agribusiness professional about nutrient management and effluent management, this is depicted as two relationships in the network. This is to demonstrate that people can be having multiple conversations about different topics.

When depicted this way, there are a total of 1,929 connections in the network, meaning that each person is having an average of two conversations about environmental farm practices. The conversations are diverse, both in topic and the type of people involved, organisation and role. This tells us that the network is well established and, at least in the core of the network, there is some redundancy (i.e. if one person left then another could take their place and the network would not fall apart).

The largest group in the network is agribusiness professionals (including consultants, vets and fertiliser reps 25.6%), followed by industry sector organisations (such as DairyNZ and Beef + Lamb 22.3%), government (including local 19.3%), and farmers (14.6%). Researchers and academics make up a further 11.8%. Their percentage representation in the network indicates their relative dominance in the conversation, affected by relative participation in the survey.

We can identify who in the network is an *information seeker*, and who is an *information provider*, based on whether they are contacting others or they are being contacted for information. It was found that the largest group of information seekers about environmental farm practices are farmers, for both the number and diversity of groups they are talking to. Farmers were also approached as information providers from many different groups, in particular from regional councils, fertiliser companies and industry (e.g. DairyNZ). They may be providing data about what is happening on-farm, or information about implementing new farm practices, which is then being fed back into the discussion.

There are a number of farmers who are located on the periphery (outskirts) of the network who may be talking to a significant number of people (consultants, other farmers), but are not connected to the broader discussion about environmental farm practices. The distinguishing

Network stars are often 'brokers', translating and transferring knowledge between groups, which is a critical function for an agricultural network to work effectively.

factor between these farmers appears to be that those on the periphery are largely information seeking, while those in the core conversation (better connected) are also providing information.

This suggests that a two-way exchange of information is a useful model of agricultural extension, to bring farmers into the bigger conversation occurring around this topic. This works on the assumption that individuals in the network core are likely to be sharing new and relevant ideas, which facilitates an informed conversation, promoting positive behaviour learning and change. This may be achieved through using methods like co-innovation or co-design, where decisions about on-farm change are designed with the farmer in the conversation, as opposed to being implemented afterwards.

There are other parties on the outskirts of the network who are also limited in the diversity of the conversations they are having. This includes individuals in some commercial companies and industry groups who are largely having within-house conversations about environmental farm practices. Although the topics they are discussing are diverse, their networks are not. While this may relate to the role these individuals perform within these organisations, such conversations can promote an 'echo-chamber' rather than push the frontiers.

These individuals are important information providers for farmers, so ensuring they have access to varied and topical discussions is important. One potential mechanism to do this may be to link these individuals with 'network stars'. Network stars are those individuals who are seen as authorities, or connecters, in this conversation who lots of people go to for information. These people are often 'brokers', translating and transferring knowledge between groups, which is a critical function for an agricultural network to work effectively.

These individuals can be used to disseminate new ideas, foster collaboration and promote behaviour change. They are 'points of intervention'. What they have in common is that they tend to be connected to a larger and diverse number of people in the network than the average individual and to be connected to other well-connected people. In this network, these well-connected individuals tend to be agribusiness professionals, industry or researchers.

The individuals in these networks have not been identified to protect their identity, but often organisations will be aware who their network stars are without having to conduct a network analysis. Sometimes these individuals are not extroverted or loud about their relationships, but by asking around an organisation 'Who do you see as an authority on this topic?' a network star is likely to be consistently identified. It is important to ensure these individuals are not over-burdened and there are other avenues for communication within a project, organisation or extension setting, as communicating and brokering takes time. This will also ensure that if a network star leaves there are alternative communication paths established and the network will not dissolve.

Organisations and groups talking about farm practices

When the individuals in the network were aggregated into organisations or groups, 139 parties were identified *(Figure 2)*. The larger and darker the circle, the greater both the number and diversity of the connections, both incoming and outgoing. Farmers are clearly the most well-connected. Collectively, they are connected with 57 different parties, including regional councils, technology manufacturing companies and industry.

No farmer who responded to this survey reported being directly connected to the Ministry for Primary Industries (MPI), the Ministry for the Environment (MfE), the NZ Agricultural Greenhouse Gas Research Centre or several large research institutes. This may simply be because they were not named as one of their top three contacts, but it does indicate two things:

- Industry and agribusiness professionals remain most closely connected to farmers, so that the research being developed is transferred out to farmers through these individuals
- Information related to environmental farm practices is mainly being relayed by private companies, where personal perceptions and commercial interests are at play.

As promoting environmentally sustainable farm practices is a topic of public good interest, having private companies as the main information providers in this area may be a barrier to encouraging behaviour change if it does not align with the vision of these companies. This is not to say that farmers are not talking with other parties, government or researchers, but rather that they are not seen as the 'go-to' sources of information in this area. It may also be that farmers are unaware of which individuals to go to within government departments or research institutes to get the information they need.

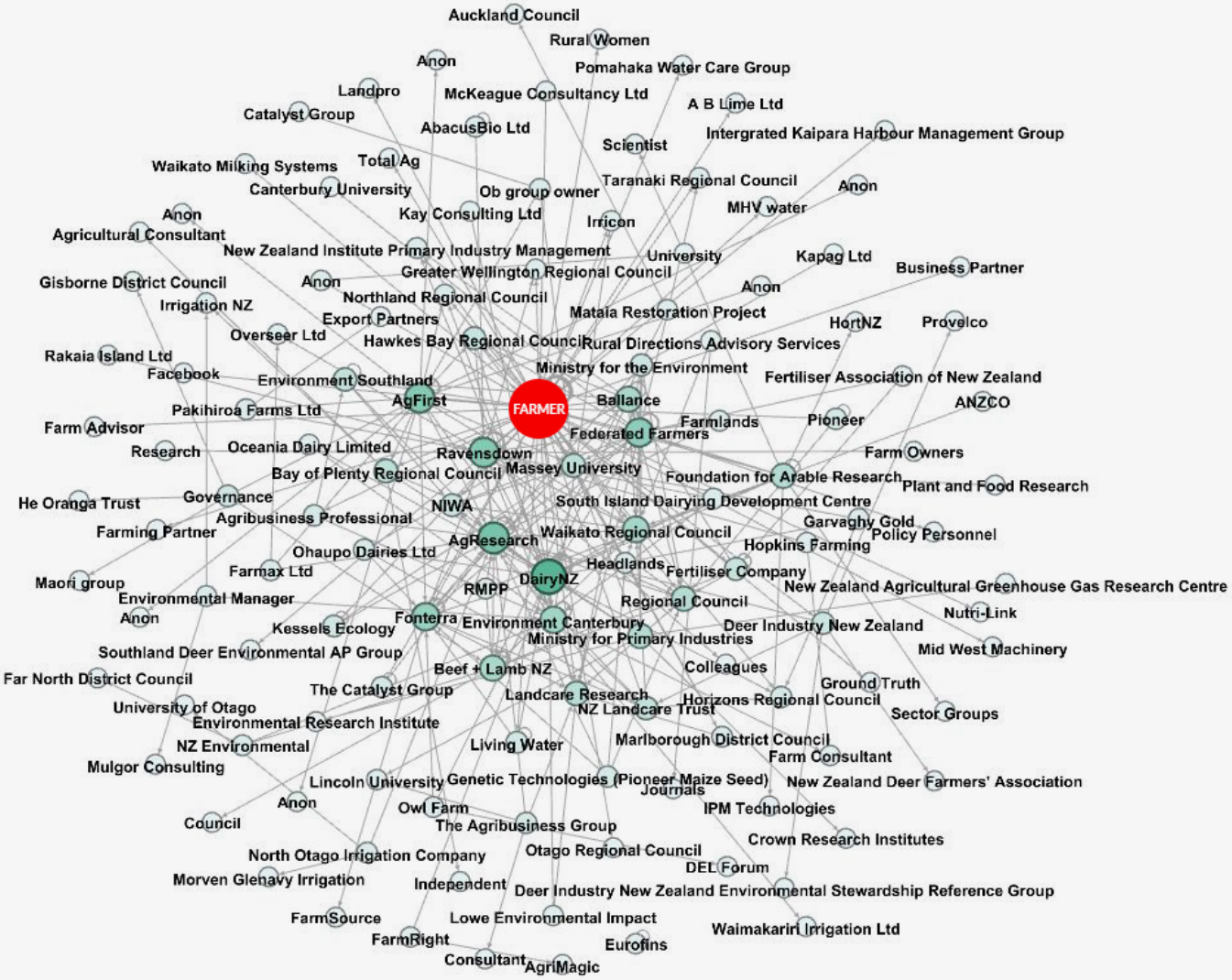

Figure 2: Parties (organisations or groups) talking about environmental farm practices. The larger and darker the circle, the greater the number and diversity of the conversations. The labels used in this map were verbatim from participants so vary in their specificity (e.g. some participants are 'council' vs a specific regional council)

Frequency of communication, trust and usefulness of information

Network members were asked to rate the frequency of their communication, degree of trust, and the usefulness of the information provided for the individuals who they communicated with. Most communication about environmental farm practices occurred moderately frequently (67.4%) (i.e. every few weeks to every few months). Around one-quarter of communication (25.8%) occurred highly frequently, from weekly to daily.

The level of trust in the network was very high, with 82.9% rating that they trusted the person as a source of information to a high or very high extent. The perceived usefulness of the information provided was also high, with 77.5% rating the information provided to them as highly useful or near highly useful. Patterns within the network about frequency of communication, trust and usefulness were minimal. Two farmers within the network tended to communicate with most of their contacts infrequently, which was an anomaly within the network, where most farmers tended to seek advice every few weeks to every few months.

Low-to-moderate levels of trust tended to occur with communication between regional councils, fertiliser companies and farmers. Some farmers also reported moderate levels of trust toward other farmers in their networks. There were no particular patterns in the usefulness of information shared within the network, other than those that tended to see their contacts as providing less useful information also tended to see these people as less of a trusted source of information.

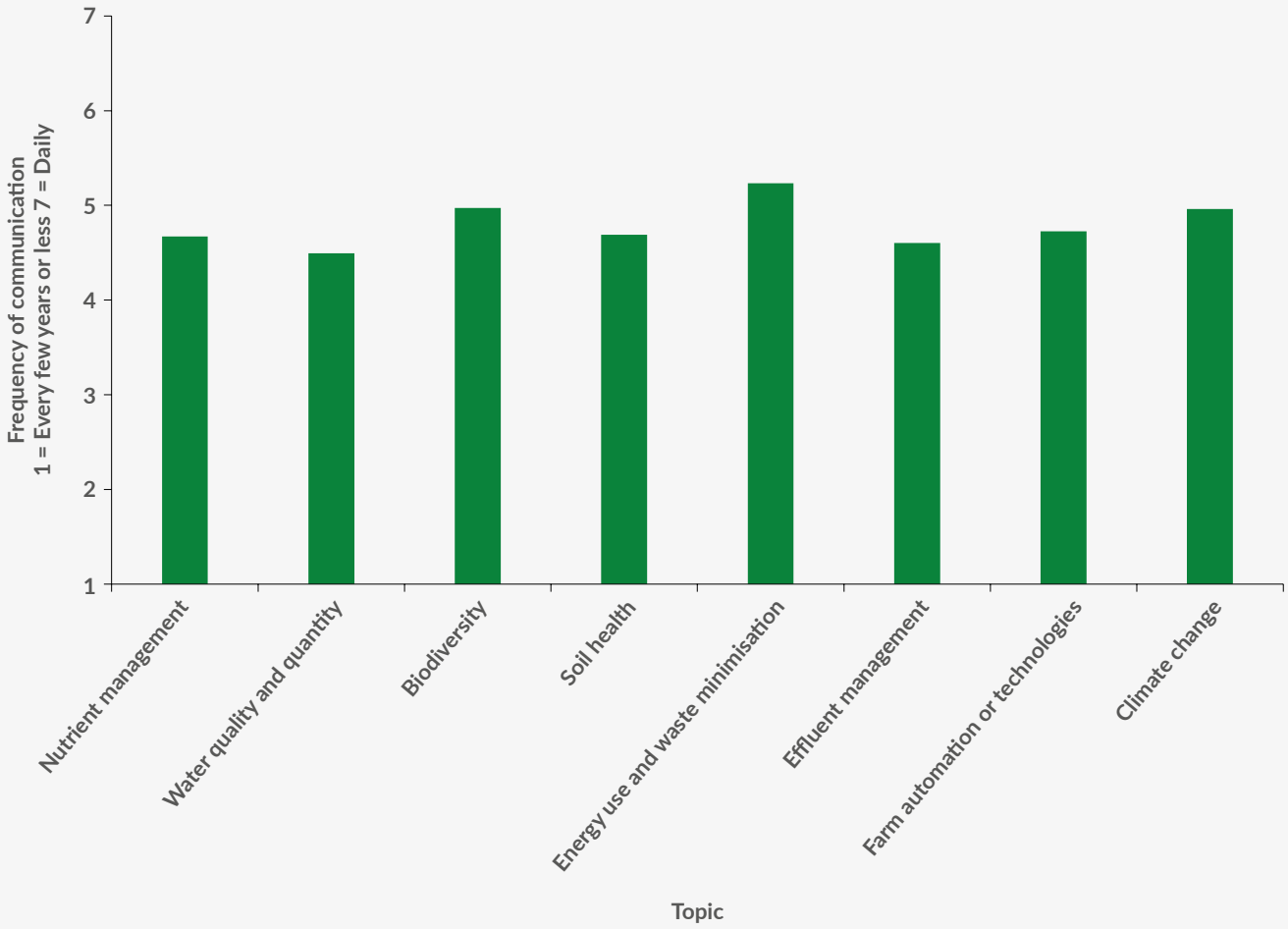

Figure 3: Average frequency of communication about each topic within environmental farm practices

The frequency of communication was similar across the various topics related to environmental farm practices *(Figure 3)*. That is, for each different topic, people sought out information about it equally often. This suggests that people tend to discuss topics of importance with more people, rather than more often. Ratings of usefulness of information and trust in the person as a source of information are highly similar across all topics.

What is the network talking about?

Finally, participants were asked what they were talking about with others in the network within the topic of environmental farm practices and this was broken down into eight categories *(Table 1)*. Participants could tick multiple categories for the topics they discussed. It was found that the most popular topic being discussed was nutrient management and this made up nearly one-quarter (23.3%) of conversations in the network. Next was water quality and quantity (19.9%), with climate change the second least often discussed topic (6.5%).

The conversation about nutrient management in the network is relatively integrated and not a series of isolated conversations, with a slightly greater proportion of industry rather than agribusiness professionals involved. Industry and agribusiness professionals are going to other industry, and councils, for the information. Farmers are also being approached by a significant number of parties about nutrient management, suggesting they may be providing critical information in the discussion.

Conversations about water quality and quantity have a similar proportion of different roles involved, and are fairly well interconnected, although there are pockets of conversation with clusters of people from one group (e.g. industry or agribusiness professionals). Most conversations tend to have at least one government person involved, which makes sense given this is a government priority, and regulatory considerations may be important.

The discussion about climate change within this network is limited and comprised of a series of largely isolated conversations, despite also being a government priority. The exception is several conversations involving industry, although it is clear that there is no known authority or network star in this area, with a vast majority of parties seeking information, in particular, industry and farmers. This would be an interesting network topic to explore in more depth.

The size and structure of the networks of people involved in these conversations suggests that priorities within agricultural extension are focused on environmental issues, which are perceived to be more 'urgent', as opposed to more 'distant' harder to identify and attribute to issues such as climate change.

Individuals have 'go-to' people they talk to about environmental farm practices who they communicate with fairly often, at least every few months, and with one-quarter of relationships at least weekly.

Limitations and future options for this study

As stated above, SNA can only provide a snapshot in time and is limited by the participants who respond to the survey. The focus in this SNA was particularly on the different knowledge-providing organisations within the network. A more rigorous network would include, for instance, a larger sample of farmers or investigate some of the networks around topic areas in more depth (e.g. climate change).

While some of the individual connections may vary according to who responded and how they interpreted the questions, it is the overall picture of the network that is of interest here. Our research was as much about testing the SNA as a tool to 'understand a network' as the results themselves. We have found it to be a useful tool to gather a high-level picture of the extension network. These results have been 'sense tested' with other parties, although we acknowledge there could be potential gaps within the network.

Key conclusions

This SNA suggests that while parts of traditional agricultural extension remain the same, other parts are progressing. One element which appears the same is the transfer of knowledge from next to end users, with industry and agribusiness professionals continuing to play an intermediary role between researchers and government and farmers. On the other hand, this network shows a clear two-way information exchange between farmers and the extension network, where farmers are seen as key information providers.

The position of those farmers who are information seekers and providers as central in the network suggests that this bi-directional information exchange promotes greater connectivity. Assuming this connectivity promotes evidence sharing and a greater diversity of conversation, this may be a useful way to improve the network – encouraging farmers to be active in sharing advice and information in order to increase engagement.

This network also suggests that individuals have 'go-to' people they talk to about environmental farm practices who they communicate with fairly often, at least every few months and with one-quarter of relationships at least weekly. These people tended to be highly trusted and provide information that is seen as highly useful. This suggests that if the current extension network were to recommend new practices related to environmental management on-farm, these would be well received as the relationships are strong. Trust is a critical prerequisite for a successful relationship.

Overall, this research indicates that the agricultural extension network in New Zealand is working well, is relatively well connected, and is functional. Of note is that regulatory considerations appear to promote conversations on environmental topics, as is the case with nutrient management. There is a low level of conversation about climate change within the agricultural extension network, indicating that this topic is not fully normalised in this network.

A strengthened network would involve bringing those on the periphery into the broader discussion, and increasing the multi-directional exchange of information between the different parties. Mapping the networks points to one way this can be achieved – by using network stars as 'points of intervention' to disseminate information and connect different parties.

Acknowledgements

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Penny Payne is a Social Scientist and Helen Percy is a Science Impact Leader at AgResearch Ltd based in Hamilton. Corresponding author: penny.payne@agresearch.co.nz.

Table 1: Which topics are most popular to discuss about environmental farm practices in New Zealand?

TOPIC	PERCENTAGE OF TOTAL DISCUSSIONS IN NETWORK RELATED TO THIS TOPIC
Nutrient management	23.3% (1)
Water quality and quantity	19.9% (2)
Soil health	13% (3)
Biodiversity	9.1% (4)
Effluent management	7.1% (5)
Farm automation and technologies	6.7% (6)
Climate change	6.5% (7)
Energy use and waste minimisation	2.5% (8)

NITA HARDING

NZIPIM members can help spread the word about biosecurity

MYCOPLASMA BOVIS – ERADICATION UPDATE

***Mycoplasma bovis* was first identified in New Zealand almost two years ago. Nita Harding from DairyNZ provides an update on how the *M. bovis* programme is tracking, and the part that farmers and rural professionals have to play in helping protect the industry.**

Eradication programme

M. bovis was first diagnosed in New Zealand in July 2017. The diagnosis was made in a dairy herd in Canterbury and the presenting signs were severe mastitis and arthritis in cows, and associated poor health in calves. As a result, an exotic disease response was initiated, and in May 2018 a decision was made jointly by government and the dairy and beef industries to proceed with an eradication programme.

This decision was made because over a 10-year period the cost of eradication was estimated to be less than the cost of living with the disease for the dairy and beef industries. This is the first time any country has tried to eradicate *M. bovis*, so there is no textbook for such a programme, meaning that New Zealand is learning every step of the way and the approach will need to be regularly refined.

Current statistics

As of early May 2019, nearly a year since the eradication programme was initiated, *M. bovis* has been confirmed on 167 properties and 54 of these are classed as 'active', which means infected animals are still present, or cleaning, disinfection and stand-down has not been completed yet. The remaining 113 properties have been cleared of the disease.

M. bovis has been confirmed on 167 properties

A further 113 properties are under a Notice of Direction, which restricts movement of animals and risk goods off the farm while testing is underway. In most cases, these farms have received animals from an infected farm. There are an additional 299 properties under active surveillance. These are properties where there may be a risk of having *M. bovis* and testing is being carried out. The probability of these properties actually having *M. bovis* is low, but testing is required to ensure no infected properties are missed.

2019 National Plan

In March 2019, the eradication progamme was reviewed, and a new National Plan with three clear goals was developed by the Ministry for Primary Industries (MPI) in conjunction with industry partners DairyNZ and Beef + Lamb New Zealand. Government and industry remain committed to eradicating this disease but also recognise that the impact on farmers, especially those affected, and farming communities is significant and as much as possible needs to be done to reduce this impact.

Therefore, it was important to clearly articulate the aims of the eradication programme within the wider context of the livestock industries in New Zealand. The National Plan has three goals:

Goal 1 – Eradicate M. bovis from New Zealand

Eradication of *M. bovis* is still the aim of this programme, and the best scientific advice is that this is an achievable goal for the country. The alternative to eradication, letting the disease become endemic, would mean ongoing challenges and costs for farmers in maintaining the health and welfare of their stock.

Much has been learned about this disease in the New Zealand setting since July 2017. Our farming systems differ from those in countries where *M. bovis* is common, and there is far less close contact between animals here than in overseas housed systems. However, animals are moved between herds in this country at a much higher frequency and this means the opportunities for a disease to spread can be significant.

Initially, the response to *M. bovis* was based on the measures that would be taken for a disease caused by a highly infectious agent that was able to survive for some time outside its host animal. Experience in the New Zealand context has demonstrated that the *M. bovis* bacterium is spread by the movement of infected animals and subsequent close contact of these animals with uninfected animals, and by feeding milk sourced from cows shedding bacteria in their milk to calves.

Transporting stock – it is important that farms record all animal movements in NAIT

Much has been learnt about the performance of the tests in New Zealand cattle herds, and epidemiologists are now more confident about the interpretation of the tests.

Other possible sources of infection, such as faecal contamination, are a very minor risk in comparison.

To track the spread of the disease it is important that animal movements can be accurately traced in a timely manner. All infected farms identified to date have been linked to other infected farms, although on occasion it has taken time to confirm these links. The National Animal Identification & Tracing (NAIT) system is designed to allow animal movements to be tracked, but this does rely on people in charge of animals entering the information on time and correctly. NAIT and MPI have stepped up both communication about these requirements, and compliance checking activities, to ensure that all records for animal movements are up to date and accurate.

Last year changes were made to the NAIT Act 2012 to allow officers to lawfully obtain information where non-compliance is an issue, and to the Animal Products Act 1999 to create three infringement offences related to non-compliance with certain Animal Status Declaration requirements. Further changes are coming as a result of the NAIT review that was also completed last year.

A large amount of animal testing has been completed since the beginning of the response – over 300,000 tests as of early May 2019. Two tests are used: the Polymerase Chain Reaction (PCR) test which tests for the bacteria itself; and the Enzyme-Linked Immunosorbent Assay (ELISA) test which measures the animal's immune system response to infection. There are limitations to both tests:

- The PCR test will only return a positive result when the bacteria is present in the sample, usually milk or a throat swab. Therefore, if the animal has been infected but is not shedding the bacteria at the time the sample is taken, the result will be 'not detected', reflecting that a negative test result does not necessarily mean the animal is not infected
- The ELISA test result gives a better picture over time of the animal's infection status, as the antibodies developed in response to infection will persist for a period of time. However, each animal will have a different level of immune response, so ELISA tests need to be interpreted on a group or herd basis. For both tests, repeat testing of multiple animals is required to confirm disease status.

Much has been learnt about the performance of the tests in New Zealand cattle herds, and epidemiologists are now more confident about the interpretation of the tests, particularly the ELISA test which measures the animal's immune system response to infection. Animal testing will remain an important tool for the eradication programme.

Many farmers surveyed saw themselves only as responsible for biosecurity, and a number expressed frustration with visitors and contractors and their apparent disregard or ignorance of good biosecurity practices.

Independent oversight of the programme will continue. A Technical Advisory Group, consisting of independent international experts, is in place and will regularly review the programme and progress towards eradication. In addition, there is a Governance Group with an independent chair to oversee the operation of the programme. Government has also committed $30 million to scientific research, across a range of topics, to provide information that will assist with the management and implementation of the eradication programme.

Goal 2 – Reduce the impact of the disease and the eradication programme for everyone affected by M. bovis

The eradication programme has had, and will continue to have, major impacts on the lives of the affected farmers and their families, as well as the wider farming community. The experiences of each farmer will be different due to the type of farming operation, variations in farm management and the time of year affected. Government and industry partners remain committed to doing everything possible to reduce these impacts.

Each farm has a dedicated Incident Control Point (ICP) Manager whose role it is to work with the farmer throughout the process. The ICP Manager is a key information source for the farmer and helps to ensure that programme activities minimise disruptions to farming operations as much as possible. As each farm is different, the plan for managing it is developed with the farmer and decisions are made on a case-by-case basis within the eradication programme framework. This allows some flexibility for decisions such as when a herd will be depopulated once it has been confirmed as infected.

Support networks for farmers and others involved in the response have been strengthened. The Rural Support Trust has played a key role in providing support for farmers since the beginning of the response and continues to do so. Industry organisations such as DairyNZ, Beef + Lamb New Zealand and Federated Farmers have also increased their focus on farmer support.

One key area of support is the assistance provided to farmers for the preparation and lodging of compensation claims. The free DairyNZ and Beef + Lamb New Zealand Compensation Teams (DBCAT) are an example of industry support for farmers, and these teams have facilitated a significant reduction in the turnaround time for compensation claims for affected farmers.

Communication is a key element of impact management. MPI meet regularly with affected farmers to understand how the disease and the eradication programme are impacting on them. There is an ongoing programme of community meetings, regular public updates such as the weekly stakeholder update emails, and media releases.

Both MPI and the industry partners have information on their websites. Feedback from farmers and others, including the farmer feedback obtained by the industry organisations, is sought. This information is used to monitor performance and make improvements to communications and the approach to the eradication programme.

Goal 3 – Leave New Zealand's biosecurity system stronger

One of the key lessons learned in the response so far is the importance of the biosecurity system, and in particular on-farm biosecurity, for reducing the impact of incursions of unwanted organisms on-farm, be these animal diseases, weeds or pests.

A recent DairyNZ survey of farmers found that biosecurity knowledge and, more importantly, implementation of on-farm biosecurity practices, is extremely variable across the country. In general, farmers in regions where there has been more *M. bovis* seem more aware and more active in the biosecurity area than farmers in regions where the disease has had little impact.

Many farmers surveyed saw themselves only as responsible for biosecurity, and a number expressed frustration with visitors and contractors and their apparent disregard or ignorance of good biosecurity practices. Good biosecurity depends on everyone who works in, or interacts with, the industry playing their part. Farmers need to have the whole farm team empowered to carry out good biosecurity, and those who service farmers need to better understand their role.

Farmers who have made biosecurity changes on-farm have done so based on their assessment of risk and on what was practical for their farm system. They also found the changes easier than expected. Some farmers are going to continually assess risk and make more changes as needed, but others are of the view that they have done enough. There is a need to better define biosecurity risks to make this process more transparent for farmers, and in particular for those who who have not adopted any changes. Risk will need to include financial risk to the farm business, as many farmers identified biosecurity as a means of protecting their business now and into the future.

The key barrier to the implementation of biosecurity practices on-farm appears to be farmer knowledge and understanding of the potential risk of biosecurity incursions to the farm, and therefore the ability to assess the value of spending time and effort undertaking

Cleaning boots – on-farm biosecurity practices need to be built into everyday work practices

NZIPIM members are rural professionals who interact with farmers and can play an important role in assisting with the achievement of the goals of the *M. bovis* eradication programme.

biosecurity practices. Structural changes, such as double fencing, are complete when the structure is finished and do not require ongoing effort to implement. Changes that involve a practice change and ongoing attention, such as boot washing, seem harder to maintain and the challenge with these is to build them into everyday work practices.

Those farmers who found a benefit in implementing biosecurity practices mostly stated that they undertook them to 'protect the farm business'. In some cases, this related to various aspects of animal health, but some farmers looked more broadly and were concerned about the long-term sustainability of the farm, the impact this has on the family, jobs for people, and the wider community. It will be important to understand individual farmer's goals when communicating the benefits of biosecurity, especially when biosecurity plans are developed at a farm level.

In a wider context, better biosecurity for the livestock industries is not just a role for farmers and those who interact directly with them. Government and industry need to ensure the systems to support good biosecurity are in place and are working well, and this includes traceability systems, operational capability and underpinning legislation, as well as farm biosecurity plans.

A call to action for rural professionals

NZIPIM members are rural professionals who interact with farmers and can play an important role in assisting with the achievement of the goals of the *M. bovis* eradication programme. Some suggestions as to how to do this include:

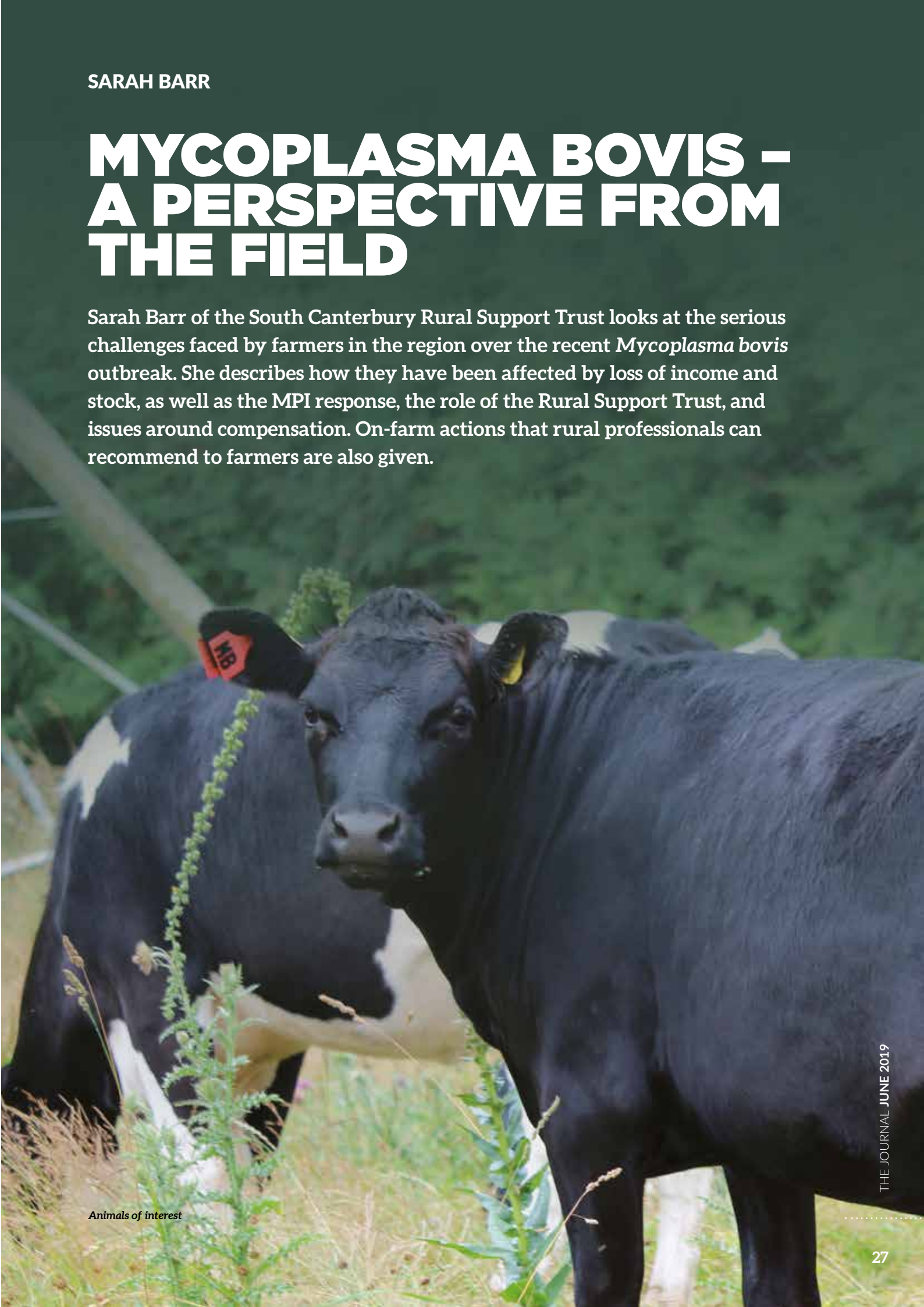
- **Learn about the biosecurity system in New Zealand**
  Keep up to date with the issues. Your conversations with farmers are important, and you will be an important and respected source of information for those you interact with.
- **Consistent messaging for farmers about biosecurity is important**
  Mixed messages can result in inertia on-farm, yet we know that most farmers can make some improvements to their biosecurity practices. Access information from MPI and the industry organisations as they all have good resources freely available on their websites. Attend any local community meetings to get the latest information on progress with the eradication programme.
- **Walk the talk**
  Demonstration of good biosecurity practices goes a long way to better overall implementation. Make it a rule to arrive clean for farm visits and clean up before you leave. Check in with the farmer before going onto the farm, and preferably use a farm vehicle if you need to drive around it. Any equipment used on animals needs to be cleaned and disinfected between farms.
- **Biosecurity 2025 project**
  Under the Biosecurity 2025 project, MPI have an aim to get all New Zealanders to better understand their role in biosecurity – this project is called a 'Team of 4.7 Million'. You are as much part of this team as everyone else – biosecurity really is for everyone, not just farmers.

Nita Harding is a Technical Policy Advisor (Veterinary) at DairyNZ based in Hamilton. Email: nita.harding@dairynz.co.nz.

SARAH BARR

MYCOPLASMA BOVIS – A PERSPECTIVE FROM THE FIELD

Sarah Barr of the South Canterbury Rural Support Trust looks at the serious challenges faced by farmers in the region over the recent *Mycoplasma bovis* outbreak. She describes how they have been affected by loss of income and stock, as well as the MPI response, the role of the Rural Support Trust, and issues around compensation. On-farm actions that rural professionals can recommend to farmers are also given.



Animals of interest

Impact of perception issues

The confirmation of the arrival of *Mycoplasma bovis* in South Canterbury in July 2017 marked the beginning of some of the most emotionally challenging workplace experiences I have ever been through. I was engaged by the South Canterbury Rural Support Trust (RST) to undertake a welfare role in supporting the farmers, staff and families on those farms that the Ministry for Primary Industries (MPI) determined were properties of interest. From the outset it was apparent that *M. bovis* was going to cause a great deal of heartbreak.

While those farms placed under restriction have obviously been impacted, many other farms have also been affected by the eradication response to the *M. Bovis* biosecurity incursion due to perception issues. Indeed, others have also been adversely affected such as livestock agents, agricultural contractors and the trucking sector.

The impact of the perception issues cannot be overstated. Initial knee-jerk reactions, borne out of a lack of understanding, have been tempered somewhat in recent months as the *M. bovis* net widens, and MPI holds public meetings to inform people. However, there remains a great deal of misinformation, lack of knowledge, and subsequent incorrect assumptions about *M. bovis* impacting on normal industry activity.

MPI response

In my view, farmers have largely been left out of the response discussion and have therefore had very little input into designing the response solution. It has also proven to be extremely difficult to continue to run an effective farming business while under the influence of the response activity of MPI.

The lack of understanding, and in many cases a lack of knowledge about the true facts, continues to concern those of us who have been involved in the response since the outset. It is unfortunate that MPI has chosen not to be more proactive and transparent with their communication because this has allowed the misinformation to spread.

Until recently the MPI activity was undertaken via an emergency response model. The Coordinated Incident Management System (CIMS) framework was developed specifically to coordinate, command and control an emergency incident response of any scale. It provides the structure, and the relationships between functions (and between levels of the response), to ensure effective coordination and cooperation within the response.

Communities looking out for each other

One measure of how well clients will get through a *M. bovis* interaction is the level of support received from both their community and their trusted advisor team.

I believe this approach is autocratic and is not conducive to working with others outside of the response team, i.e. farmers. Experience has also shown the opportunity for 'silo-ed' activity to occur within this framework, and members of the response team have admitted this has been prevalent. The effect of this silo activity has led to conflicting information being given to farmers, which has led to greater confusion and frustration.

Having only moved to a business as usual (BAU) programme model late last year – alongside industry partners, DairyNZ and Beef + Lamb NZ – it remains to be seen whether the previous operating model can be overcome by a more inclusive and collaborative approach, both within the response team and with external stakeholders. Certainly MPI has declared an intent to be more transparent and consistent.

Loss of stock and income and social ostracism

Farms under active surveillance or simply in the geographic vicinity of known Infected Properties (IPs) have been negatively impacted. Stock sales and grazing contracts have been cancelled, resulting in a significant loss of income, not only for the farmers involved but in many cases also for stock and grazing agents. Unfortunately, the current compensation legislation only allows for compensation to be paid on losses incurred as a direct result of MPI exercising its powers under the Biosecurity Act 1993 as part of the response.

As time has passed MPI has developed a greater knowledge about *M. bovis*, resulting in clearer guidelines being issued on levels of risk. While it appears contiguous properties (to known IPs) will still be required to undergo testing, MPI appears to now be of the view that *M. bovis* transmission is likely to require sustained animal-to-animal contact, not the cursory contact they once believed. The second high-risk transmission pathway as currently stated by MPI is through the feeding of unpasteurised milk from infected cows to calves.

Loss of stock and/or income is only one aspect of the difficulties. Many have felt ostracised by their communities and have described feeling like lepers. This ostracism has not only been directed to the landowner but to sharemilkers and staff alike. Staff on other farms were told that their friends from the affected farms were no longer able to visit them, nor were they to visit their friends. This is an extreme reaction and totally unwarranted assuming correct precautions are undertaken.

If ever there was a time for the primary sector to work together it is most definitely in responding to *M. bovis*. Every IP farmer I have worked with has felt a strong sense of guilt for others who have been inadvertently impacted by their unwitting actions. Not one has knowingly spread the infection, and the strong moral compass which most farmers operate with has seen many farms under active surveillance undertake a voluntary lock-down while waiting for the outcome of testing. For many farms this has taken months and multiple rounds of testing.

For those whose normal business practice is to trade stock, this has severely impacted their financial bottom line and has also had a major effect on their emotional bottom line. Until you have been through this experience yourself it is very hard to imagine the impact.

Rural Support Trust's role

While the RSTs nationally have been contracted by MPI to assist farmers with their welfare needs, it became apparent very early on these needs were inextricably linked with technical issues related to the management of the disease and its impact on the operation of the farm business. I do not profess, nor do any of my colleagues, to be experts in this technical space. However, a great deal of knowledge is built up through working with a large number of farmers and we are often able to help get answers from MPI or guide clients in the questions they need to be asking. We can also assist in ensuring they retain and gather all data that will be useful as the process progresses. In our experience, once a farmer comes under the direction of MPI they have very little independent control over their business so enabling them with knowledge can be very empowering.

Other networks available to farmers

One measure of how well clients will get through a *M. bovis* interaction is the level of support received from both their community and their trusted advisor team. The RST has worked very hard to build support networks farmer-to-farmer. This has not only been therapeutic for some who have come out the other side, it has also been really useful for those new to the response who don't know what they don't know. The only caveat to be placed on the value of these connections is that as the response progresses new learnings and processes are implemented. That is, what may have been the case two months ago may no longer be correct now.

The trusted advisor team can equally play a role in connecting farmers to farmers. It is imperative that this team operates cohesively and in a coordinated fashion. Regardless of good intentions, the client must remain in control of as much of the process as possible. It needs to

M. bovis calves

be agreed, for instance, what role each team member plays and therefore what actions they are responsible for.

In the same way that we encourage farmers to plan their mitigations and trigger points in escalating drought conditions, we strongly urge this exercise be undertaken in response to *M. bovis*. This is both before involvement and once implicated, if this comes to pass.

On-farm actions that rural professionals should recommend

There are some obvious actions that can be undertaken on-farm:

- **Ensure NAIT records are up to date**
  Many farmers who have already been through the *M. bovis* system have amended their existing approach to NAIT recording beyond the legal requirements. In the case of multiple enterprises, or contiguous properties under single ownership, farmers have set up new NAIT accounts to record stock movements between the two, if there are any. This action also serves to delineate between separately managed blocks. This will not preclude the implementation of MPI's 'Owner-Other Property' testing protocol, but may assist in providing evidence of stock movements.
- **Record internal farm stock movements**
  Another tool that has been successful in mitigating the potential loss in several businesses has been the use of FarmIQ for recording internal farm stock movements. This form of electronic recording has enabled some properties to have boundary re-draws around a portion of the property rather than have the whole property affected. This ability is obviously at MPI's discretion and will rely on the confidence their staff have in the efficacy of the information being provided. There will be other providers of systems similar to FarmIQ who will have similar functionality.
- **Keep records of meetings with MPI and their agents**
  Keeping detailed records of all interactions with MPI and their agents – dates, those present, discussion points and actions agreed – is imperative. People think they will remember everything, but this may be a lengthy and convoluted process. If an Incident Control Point (ICP) Manager is allocated they will also have a record book for each client. It is also important to take photographic records of the notes they record, both from each visit and between.
- **Minimise risk of *M. bovis* when purchasing stock**
  Minimising risks from stock purchases is an area that perhaps still requires a greater awareness. No trading programme will be completely failsafe but there are a number of actions that can be taken to minimise the risk of exposure to *M. bovis*. DairyNZ has a very good resource available on their website (www.dairynz.co.nz/media/5787884/myco-bovis-pre-purchase-checklist-aug-2017.pdf). Regardless of farm type, this is a great resource to use both pre-purchase and also in grazing situations.

For those who are instructed to send animals to slaughter it is strongly urged that an independent valuation be sought as MPI's process only allows for a single valuer.

- **Minimise the number of source properties**
  Minimising the number of source properties, both direct and indirect (ownership previous to current vendor), and having confidence in the history of the animals, both the current property and those prior, is important in determining risk levels. The Vet Council has also developed a Risk Assessment Tool for Dairy Farms, which is available through vets.
- **Maintain robust boundary fencing**
  It is also necessary to maintain robust boundary fencing. If practical, boundaries should be double fenced. However, in many cases this will not be practical so stock movements on boundaries need to be communicated to neighbours.
- **Sensible biosecurity practices**
  Sensible biosecurity practices should now be in place on all farms. The new awareness of the potential for biosecurity incursions should now be part of our everyday thinking. Rural practictioner behaviour will help with embedding sustainable on-farm biosecurity awareness and practice.

Independent valuation

For those who are instructed to send animals to slaughter it is strongly urged that an independent valuation be sought as MPI's process only allows for a single valuer. In the case of a dairy herd, other supporting evidence will come from Minda or similar. Providing as much detail as possible, including all rationale for arriving at a value, will strengthen the case for challenging the MPI contracted valuation. Much of the information required can be prepared in advance of the animals actually leaving the property. This is beneficial to ensure the claims can go in as soon as possible. At this point MPI has advised claims are being paid out, on average, 25 to 30 days from receipt. Meeting this target is in part reliant on claimants being thorough in providing all the details required for a claim assessment.

De-population and re-population

MPI are now offering testing for animals being purchased for re-population. This is not an MPI requirement, but it is a prudent measure by re-populating farmers. We have seen evidence of vendor farms refusing this testing, which is extremely frustrating. Farmers' desire to not become involved in MPI's eradication programme is understandable, but this denial is further evidence of a lack of support from the wider farming community for those who have been found to be infected by *M. bovis*.

Those assisting in the purchase of replacement herds/animals need to be aware that many of these farmers may not have been in the market before for whole herd replacements. We have already seen some unhelpful actions or inactions from those assisting in these transactions.

Compensation

Very early on in the response we in the South Canterbury RST realised that people would need assistance in compiling their claims and pushed very hard for this need to be met by MPI. To their credit, MPI acknowledged this and we built a small team to assist claimants. Late last year MPI reached an agreement with DairyNZ and Beef + Lamb NZ to provide this service via the newly-formed DairyNZ, Beef + Lamb New Zealand Compensation Assistance Team (DBCAT).

All claimants are strongly urged to make use of this free service. The depth of knowledge now available through this team has proved invaluable to many claimants. There is, however, real pressure on this team to deliver for a vast number of clients so we would also urge claimants to include their own team of financial advisors (bankers and accountants) to assist in the compilation of the information required to support claims.

Those clients who use Cloud accounting software have found the transfer of information between those assisting with claim compilation considerably more straightforward. Farmers are encouraged to have their trusted advisor team attend critical meetings with MPI to ensure full understanding and awareness in this team.

As noted, to be eligible for compensation a loss must have been incurred as a direct result of MPI exercising its powers under the Biosecurity Act 1993 as part of the response. The loss must be verifiable, i.e. the farmer must provide proof/evidence of the loss. In our industry, which continues to do much of its business through a 'handshake', we have seen many issues with not being able to provide the evidence in support of compensation claims.

Contracts of all types – service provision (sharemilking, grazing etc) – and stock transactions are essential pieces of evidence. Also, being able to provide evidence supporting what is normal BAU will help in asserting the veracity of a claim and the previous three years of financial statements will go some way towards this requirement.

However, we have had a number of situations where 'deals' (or trades) have been done in the past so there is no financial trail to provide evidence in support of claims. Often we are able to evidence unsupported claims with things such as truck dockets or Animal Status Declaration (ASD) forms etc, but these are much more difficult to get over the line with MPI. It is also important to be aware that claims can only be placed once the loss has been incurred. In the case of loss of income this means a

Field operations

claim can only be placed after a farmer has not received what they would have without MPI's influence. A guide to compensation can be found on the Biosecurity New Zealand website (www.biosecurity.govt.nz/protection-and-response/mycoplasma-bovis/advice-for-farmers-under-controls/compensation/).

Compensation does take some time, both to compile and to process, and there are no definitive answers from the MPI Compensation Team on whether a claim will be accepted or how long it will take. Each claim will be considered on its own merits. Regardless of how straightforward someone might think the claim is there will likely be many questions to answer as the claim is assessed by MPI – the assessors are not farmers.

MPI has moved to making payments of 80% on some claims. There are a number of criteria to be met in order to access this advance on claims submitted, and many claims will not meet the current criteria.

Taxation implications

Finally, rural professionals' clients need to be fully aware of any taxation implications resulting from both compensation payments and valuations of stock destroyed. These compensation payments are made GST exclusive.

M. bovis may give rise to substantial changes in taxable income in both the year that the livestock is sold and the year when compensation is received, and in some cases these may be different financial years. The income equalisation scheme may be an opportunity to transfer income between financial years to allow better management of tax obligations. There may be the option for a deposit with the Inland Revenue Department that could be withdrawn early (including immediately) for replacement livestock or for farm running costs. This would be determined on a case-by-case basis by the Commissioner of Inland Revenue.

It is therefore worth it for farmers to talk with their accountant about the options available regarding the income equalisation scheme as a way of managing taxable income as a result of *M. bovis*.

Summary

The emotional toll the outbreak has taken on many farmers, family and farm staff cannot be overstated. The impact of being caught up in the *M. bovis* response, and loss of control, are immediate and will reach far into the future regardless of the eventual outcome for the property (from both a financial and an emotional aspect).

It is incumbent on those of us who can play a supporting role for these farm businesses to do all we can to minimise the stresses. We need to do our utmost to get these farmers through this situation and with a sense that they are not travelling this path alone, which many currently feel is the case.

Sarah Barr assists rural families, businesses and individuals through succession, business and strategic planning, and volunteers her services to the South Canterbury RST. Email: sarah@ruralcoach.co.nz.

KATE SCOTT

NUFFIELD REPORT – ENABLING BETTER ENVIRONMENTAL OUTCOMES IN NEW ZEALAND AGRICULTURE

Kate Scott, Executive Director of Landpro, was awarded a Nuffield Scholarship in 2018 and travelled to over 16 countries to look at agriculture and the environment. This article is a précis of her full Nuffield report published in March 2019.

Uncertain future

The current world of agriculture is uncertain with challenges of climate change, water quality, animal welfare, the rise of plant-based proteins, and of course feeding an estimated 9.7 billion people by 2050 (UN 2015 Revision of World Population Prospects). However, as global agriculture stands on the cusp of significant change, New Zealand's ability to adapt quickly will define the degree of opportunity available for us to capture. New Zealand must sit in the driver's seat, and we must come together as a sector and as a nation to achieve effective outcomes for both agriculture and the environment.

Punching above our weight

Globally, New Zealand agriculture is punching well above its weight in terms of both its understanding of the impacts of its activities on the environment, but also in its recognition of the need to change. The key to success will be the development of an array of 'change-inducing tools' that can be called upon by the sector to enable better environmental outcomes in agriculture.

While it is certain that we have not achieved all that is needed in terms of reducing the impacts of agriculture on the environment, and there remains much that can continue to be done, compared to many other intensive agricultural nations we have at least started along the path towards finding solutions to reducing the environmental footprint of agriculture.

Kate Scott's Nuffield Scholarship travel took her to California to look at agriculture and the environment; San Luis Reservoir

Irrigation canal, Fresno

Almond orchard, Fresno

Five key challenges

The purpose of this research was to challenge the status quo, encourage conversation and debate, and spark action for transformational change within the agricultural sector in New Zealand. In the report I focused on the ways our agricultural sector, and local and central government, can work to enable better environmental outcomes in agriculture utilising policy and technology tools. My research identified five key challenges that we need to address to ensure we can successfully reduce the environmental impacts of agriculture. We must build momentum and seek to engage broadly in order to have any chance of realising success.

The challenges agriculture faces are numerous and best described in the context of a 'wicked problem', i.e. one which is not easy to define, one which has no easy answer, one which has conflicting and contradictory pieces of the puzzle, and one where the playing field changes frequently.

1. Goal setting

The first challenge is goal setting. My observation is that there is broad consensus on the need to change, but we need clear objectives to guide us on a path to transformational change. Otherwise, how do we go about making this change if we don't know where we are going or how we will measure our success?

This plan must set out long-term ambitious goals that define what agriculture in New Zealand will look like in the future, what we will value, who our consumers will be, and how our communities and our environment will look. We must have a Big Hairy Audacious Goal (BHAG) for New Zealand agriculture.

We need to have all of the issues on our agenda when working through what our objectives and goals will be. The purpose of a goal is to help drive New Zealand towards a more sustainable agricultural framework for the future and to help preserve our position as truly global agricultural leaders. Until we have a vision, any change to our approach remains piecemeal and uncoordinated and is unlikely to reduce the footprint of agriculture in a meaningful and measurable way.

In terms of long-term strategic planning in agriculture there appears to be a lack of overarching guidance documents prepared at a country level. My research has identified that there are many isolated instances of such plans being prepared at a specific state or industry level, but that for the most part there seems to be a lack of country-wide specific long-term agricultural planning.

One of the exceptions to this is Ireland, which developed the Irish Food Strategy in 2010 called *Food Harvest 2020*, and the revised strategy called *Food Wise 2025* Strategy. A guiding principle that *Food Wise 2025* will seek to embed at all levels of the agri-food industry is that environmental protection and economic competitiveness are equal and complementary.

2. Taking a holistic approach

The second challenge is taking a holistic approach. Our path must encompass holistic management that is outward looking. We can no longer continue to look at the challenges of agriculture as isolated component parts, and we cannot define our goals and objectives without bold leadership at all levels.

We must encompass holistic, community-centric and collaborative decision-making. The current decision-making tools such as the Resource Management Act 1991 (RMA) are

We cannot sit back and wait for technology to solve our challenges, as technology will not do this on its own. It is also possible that technology may not eventuate in the way that we need.

often isolated from the principles of holistic management, despite it being an effects-based planning mechanism.

If an RMA framework could be applied to an agreed strategy for agriculture in New Zealand, which had been developed on the principles of holistic management and evidence-based decision-making, then we may well be in a position to reduce the environmental footprint of agriculture within agreed tolerances relating to the impacts on the economics of farming. It is, however, my belief that an environmentally sustainable business will also be an economically sustainable business. We must recognise agriculture as a critically important New Zealand and global enterprise, but it is about achieving the three pillars of sustainability – Environmental Prosperity, Economic Prosperity and Social Prosperity.

A holistic approach supported by an agreed strategy will ensure a balance between environmental, economic and social indicators. However, engaging with all New Zealanders will be critical to solving the challenges that we face. In this case engagement with all of New Zealand is about overcoming the perception that farming is bad for the environment, rather than requiring each and every New Zealander to actually participate. This links to my first recommendation about the need for effective engagement and informed robust conversations, which can (and should) provide a platform for sharing the good news stories about agriculture and the environment.

However, the New Zealand agricultural policy space is lacking examples of a wholly holistic approach, but in my view it should be moving in that direction. To elaborate on what a holistic approach means, in my Nuffield report I put forward the concept of New Zealand agriculture as a tree. Essentially the tree represents New Zealand agriculture, with all of the branches representing all the different aspects of agriculture that need to be considered, i.e. economic, social, science, environmental etc. The fruit our tree bears is dependent upon all of these things working together, and if one of our 'branches' gets too big or out of balance with the others it might break or bear less fruit. To make the tree grow strong we need to take care of the tree from the ground up and not from the top of the tree down.

3. Drive evidence-based decision-making

The third challenge is driving evidence-based decision-making. This must play a lead role in shaping our goals and objectives and must inform the debate that we need to have about the future of agriculture and the environment. A good example of citizen-led evidence-based decision-making comes from an Irish example, known as the 'Citizens Assembly'. The Assembly strives for 'rational and reasoned discussion' and uses a panel of experts drawn from across the political spectrum to guide the deliberations. The discussions aim to build consensus on contentious issues through informed debate.

A process of this nature has the potential to provide a forum to help define the aspirational goals that we set to achieve and enable a consensus to be reached on the direction that we need to take. It will also lead toward a process of identifying what we value and its importance. This challenge is also linked to enabling technology, as data and the interpretation of data will become essential for evidence-based decision-making.

This approach is starting to gain some traction within a New Zealand context, for example, the Ministry of Business, Innovation and Employment (MBIE) Vision for Science System 2025 which sets out a long-term outcome that 'New Zealand has a highly dynamic science system that enriches New Zealand, making a more visible, measurable contribution to our productivity, and wellbeing through excellent science' (MBIE, 2015).

4. Enabling technology

The fourth challenge is enabling technology. We cannot sit back and wait for technology to solve our challenges, as technology will not do this on its own. It is also possible that technology may not eventuate in the way that we need. We must therefore continue to encourage innovation and find new tools that help guide our decision-making and enable better environmental outcomes.

Globally there are challenges with policy not readily enabling technology tools to be recognised or implemented. There are many examples of new developments that fall within the growing global ag-tech space, such as satellite-based crop or pasture monitoring, or the application of in-field sensors and machine learning to make informed on-farm decisions.

This space is developing quickly, but currently remains largely focused on precision ag tools that enhance production outcomes or time/cost savings. There is much less focus on the application of technology to overcome the environmental hurdles that agriculture is facing, compared to the focus on addressing the productivity aspects of precision ag.

Sensor technology in an agri-environmental space remains under-developed, but provides significant future opportunities for reducing the environmental footprint of agriculture. Currently, there are challenges in applying technology to solve agri-environmental challenges. Policy and regulation do not always enable technology uptake because they are reactionary in nature and they don't anticipate technological changes as a solution when they are developed.

A wetland treatment system in Shrewsbury in the UK which Kate Scott visited as part of her Nuffield Scholarship

Take, for example, the challenge of nutrient losses to waterways as this is a very real problem that New Zealand is having to address. Imagine a world where we can put nutrient sensors into aircraft (or perhaps drones), and where we can map where actual nutrient losses are occurring either at farm scale or catchment scale in close to real time and on a regular basis.

In a scenario where we can monitor where actual losses are occurring, we can enable targeted mitigation and remediation. This will not only help improve our natural environment, but will mean the cost of remediation and mitigation is applied at the actual source rather than a broad, less specific, more generic mitigation approach.

Information and data are the currency that will transform agriculture from reactive to revolutionary, and we must adopt these now at speed and at scale. We will need to enable technology to turn data into opportunities. For example, the Internet of Things (IOT) technology will enable us to collect more information, store it and use it to inform decision-making.

5. Outward-looking policy

The final challenge is driving a shift to outward looking policy. The answer lies in redefining our approach to policy. It must be all-encompassing and consider that the whole is greater than the sum of the parts. This requires a shift from a reactive regulatory approach to a proactive regulatory approach, where regulation and policy is the backstop rather than the front door.

We cannot avoid the need for regulation, but we need to find a policy and regulation approach which is more agile. For example, policy is often backwards looking and does not easily allow for the use of technological advances as a tool for solving challenges, as such approaches were not anticipated at the time of writing policy and regulation. Technology and policy operate on two different time-scales (technology is fast and policy is slow), and we need to find a middle ground that enables us to quickly adopt in both the technology and the policy space.

By working more collaboratively between the agricultural sector and regulators, and by putting more emphasis on implementation as opposed to just compliance, it will also empower farmers to think beyond regulation as well. We need to move towards monetising our sustainability, to become the world's most sustainable agricultural nation whilst remaining profitable.

Setting high standards

We will be able to meet the demands of our communities and our consumers by setting ourselves high standards and consistently meeting these. To do this we need to address these five challenges:

1. A Clear Vision vs A Vague Plan
2. A Holistic Approach vs Working in Silos
3. Evidence-based Approach vs Thought-based Approach
4. Uptake of Technology vs Maintenance of the Status Quo
5. Enabling Policy Incentives vs Policy Punishment by Rules.

The challenge is that all New Zealanders need to get on board with making bold changes for the future of the country, and New Zealand agriculture, so that changes in policy and technology can create an environment where inspiring goals can be achieved through ground-up collaboration across all stakeholders.

Kate Scott is Executive Director of Landpro based in Central Otago. Email: kate@landpro.co.nz.

IAN WILLIAMS

THE IMPORTANT ROLE OF HYBRID MAIZE IN NEW ZEALAND FARMING

This article looks at the key factors that have driven increased maize yields over recent times. It also covers how maize, and farm systems based on maize, will help farmers meet some of the challenges associated with farming in New Zealand.

Over the last 20 years maize has become an increasingly important crop to New Zealand agriculture and will continue to grow in strategic importance into the future. In the right conditions and on high-yielding ground, some commercial maize growers are now achieving yields of over 20 t/dry grain/ha and 30 tDM maize silage/ha. These kinds of yields, which were considered potentially achievable 20 years ago, are now being achieved by some of the best growers on some of the better ground. So what does the future hold for maize?

The maize plant and its yield

Since the earliest records of maize (*Zea mays*) being cultivated by indigenous people in Southern Mexico 10,000 years ago, to today, maize has become an increasingly important crop both globally and in New Zealand. Every year around 200 million ha of maize is grown globally. To put this figure in perspective, around 65,000 ha of maize is grown annually in New Zealand.

With the exception of Fiordland, maize is now grown in all farming regions of New Zealand. Average yields range from 18-27 tDM/ha for silage and 11-15 t/ha dry grain, depending on the season and region. The wide range in silage yields reflects the type of ground maize is grown on. Long-term, maize silage yields on repeatedly cropped ground are often around 18-20 tDM/ha, whereas maize silage grown on-farm is often recorded yielding between 22-27 tDM/ha.

Maize grain is nearly always grown on continuously cropped areas. Maize is a high-yielding, deep-rooting C4 plant, which has high nitrogen use efficiency (NUE) (52 kg dry grain/kgN) and summer water use efficiency (WUE) (47 kgDM/mm water). To give these figures some context, pasture has a WUE of 17 kgDM/kgN and an NUE of 24 kgDM/mm.

Between 1990 and 2017 maize grain yields in Pioneer NZ trials increased by 156 kg dry grain/ha/yr *(Figure 1)*. Maize silage yields in similar trials increased by 186 kgDM/ha/yr between 1996 and 2018 *(Figure 2)*.

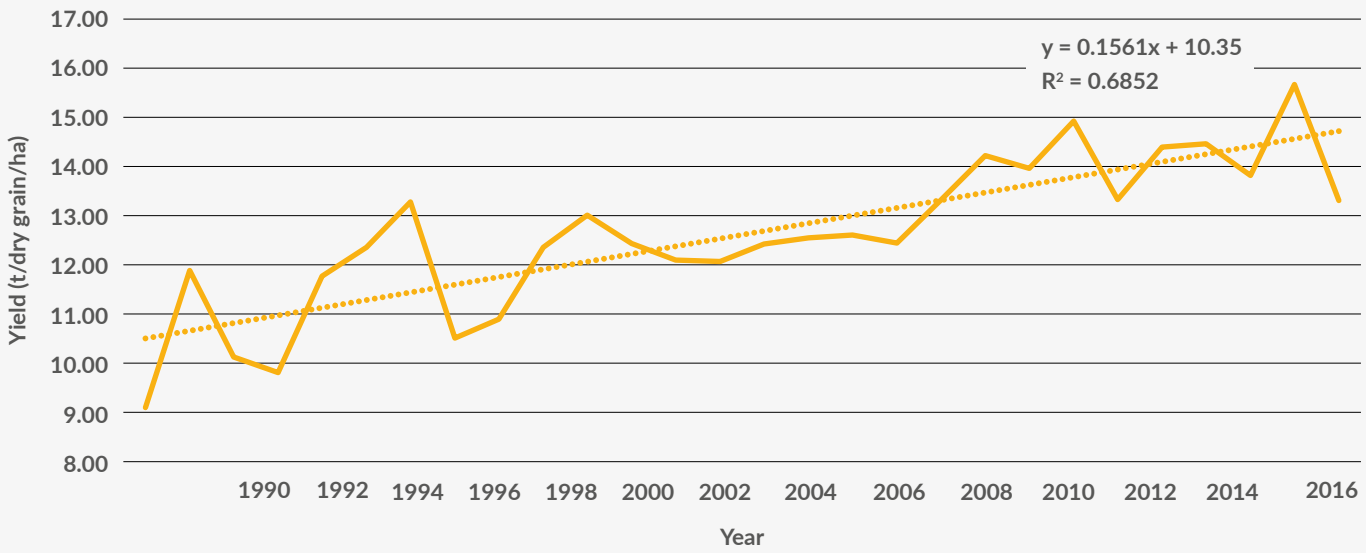


Figure 1: Maize grain yield (t/dry grain/ha) from Pioneer NZ trials 1990-2017. *Source: Pioneer NZ maize trialing programme*

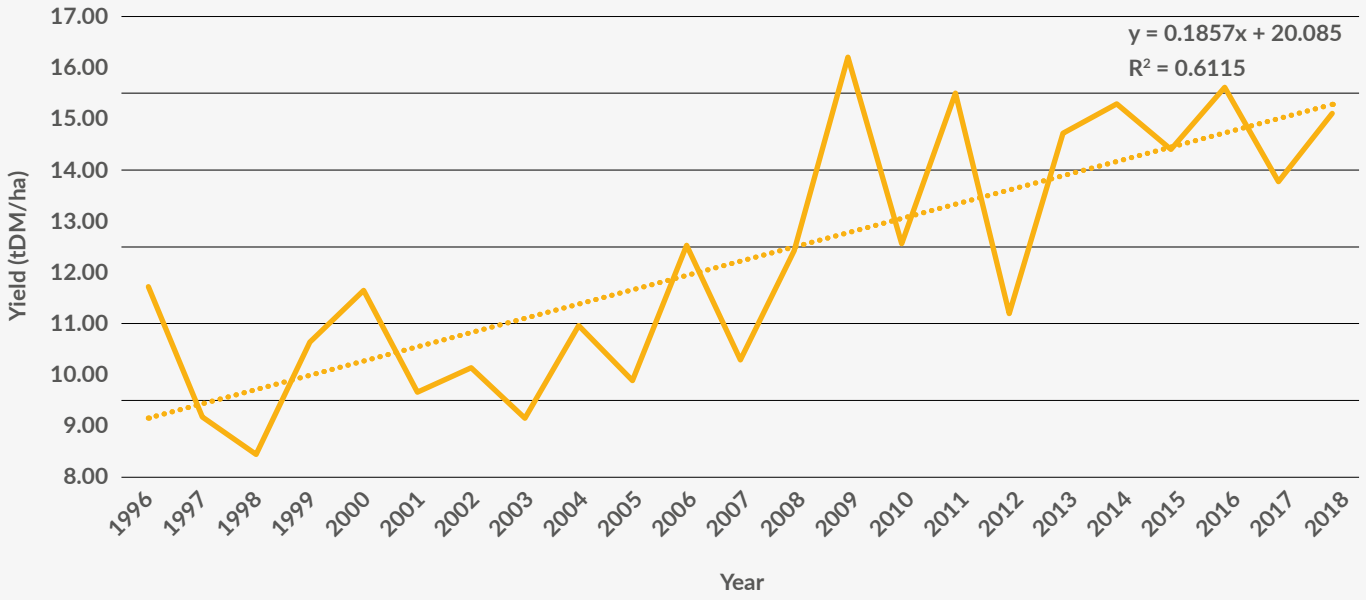


Figure 2: Maize silage yield (tDM/ha) from Pioneer NZ trials 1996-2018. *Source: Pioneer NZ maize trialing programme*

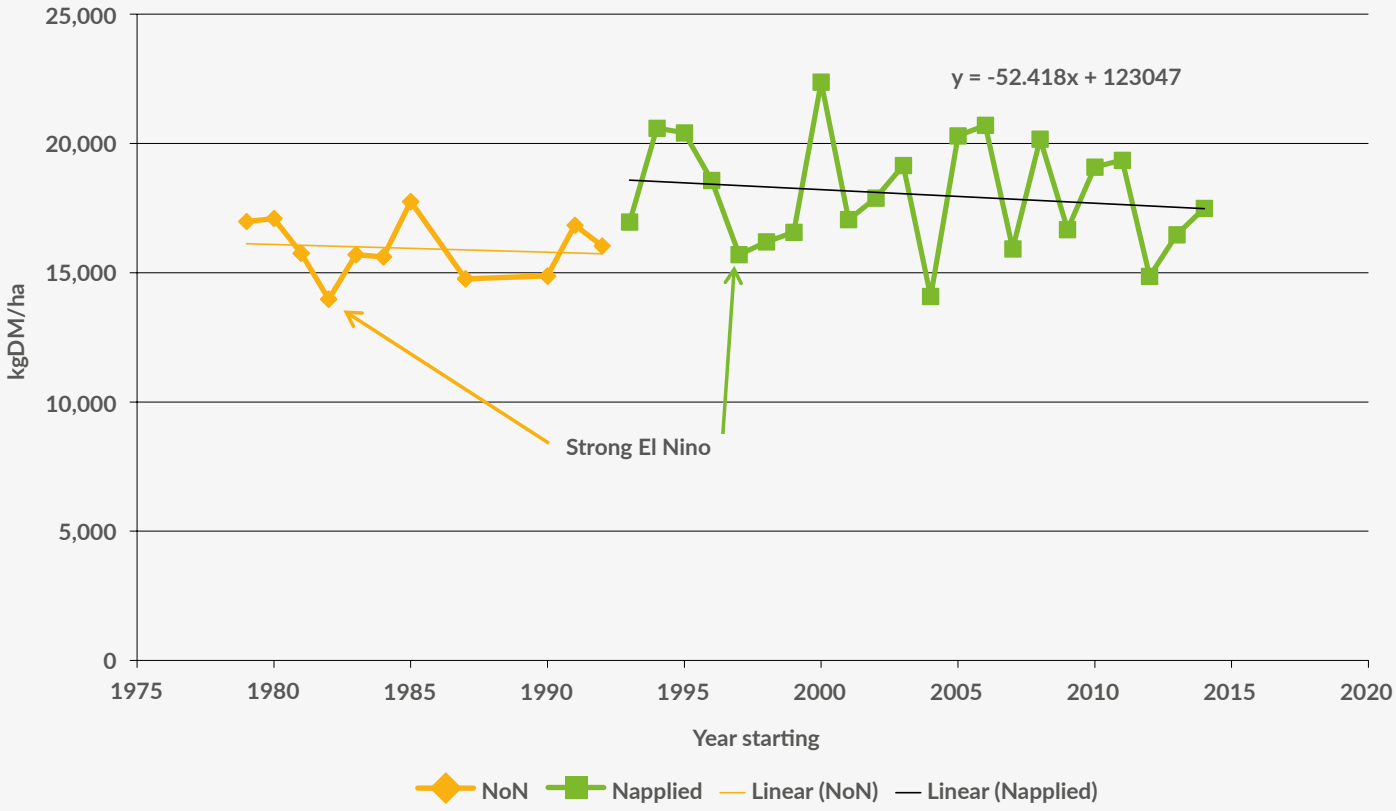


Figure 3: Annual net herbage accumulation (kgDM/ha at Ruakura No. 2 Dairy and Scott Farm 1979-2015)
Source: DairyNZ

This increase in maize yield contrasts sharply with the trend in pasture yield over a similar period of time. While maize yields have been trending up, pasture yields have been largely static or falling. A good example of this is the pasture yield at DairyNZ's No. 2 Dairy and Scott Farm *(Figure 3)*.

What has driven maize yield increases?

While most of the maize seed that is planted by New Zealand farmers is produced locally, the genetics of that seed are sourced from global maize seed companies. Maize seed companies in this country source hybrids from offshore markets with similar growing environments, followed by testing and evaluating their suitability to local conditions. As a result, the New Zealand maize industry has benefited from the genetic gains in yield being achieved through the very substantial international maize breeding and development programmes of global seed companies.

Maize yield increases have been driven by six factors:

1. Hybridisation

Hybridisation of maize first took place at an experimental level at the beginning of the 20th century. The first recorded commercialisation of hybrid seed occurred in 1924 when Henry Wallace, who later became the US Secretary of Agriculture, sold a few bags of hybrid seed to neighbouring farmers. Up to that point, the maize seed that farmers had planted was open pollinated. The adoption of hybrid seed hybridsation was extremely rapid. In Iowa, for example, the proportion of hybrid seed planted went from less than 10% in 1935 to over 90% four years later.

Not only has there been a lift in yield through increased hybrid vigour, the process of hybridisation has allowed breeders to focus on key genetic factors affecting yield. While some farmers in Africa and Asia still use open pollinated seed, all the maize seed sold and grown in New Zealand is hybrid seed.

2. Global investment in maize research

Maize is widely cultivated, and global grain production was reported as 1,132 million tonnes in 2017, more than wheat and rice (757 and 491 million tonnes, respectively). While maize is considered a staple part of the diet in many African and South American nations, it is a critical part of food and energy production in the US and the EU.

As a result, more than NZD$2 billion is estimated to be spent by the US annually on maize research alone. To put this in perspective, the total estimated annual spend on all agricultural research in New Zealand is estimated at around $NZD350 million. Of this total amount, the spend on pasture research is estimated at around $NZD50 million per annum.

3. Rapid genetic gain

Because the growing season for maize is typically around five to six months long, the speed at which a maize plant can be grown, harvested and evaluated means new, superior performing hybrids can be quickly identified and introduced to growers.

The scale of the breeding programmes of the largest international seed companies means rapid gains can be made to identify and develop superior performing hybrids. For example, Pioneer Hi-Bred International annually conducts up to one million initial hybrid crosses. All these initial crosses are predictive, i.e. virtual not actual, based on a series of computer models and statistical analysis.

Of these initial 'predicted' crosses, around 120,000 actual test crosses subsequently take place at an individual plant level. Evaluation of the expression of specific plant performance characteristics then takes place in large automated glass houses. The selection process is continuous so that between 120 to 150 hybrids are released commercially in maize growing markets around the globe every year.

4. Plants better able to handle stress

US researcher, Donald Duvick, estimated in 2005 that between 50-60% of the gain in maize yields has been due to genetic gain. The principal area of gain has been the ability of modern hybrids to withstand stresses in the field. Stress on yield comes in many forms and one such stress has come from maize being planted at higher populations. Research has shown that while higher populations tend to drive higher yields, they also cause more stress on the plants.

In 2018 another US researcher, Yarad Assefa, and some colleagues published a paper on the impact of populations on yields over time. While hybrids commercialised from 1987 to 1991 optimised yields when planted at around 70,000 plants/ha, hybrids commercialised from 2012 to 2016 optimised yield when planted from 85-105,000 plants/ha *(Figure 4)*.

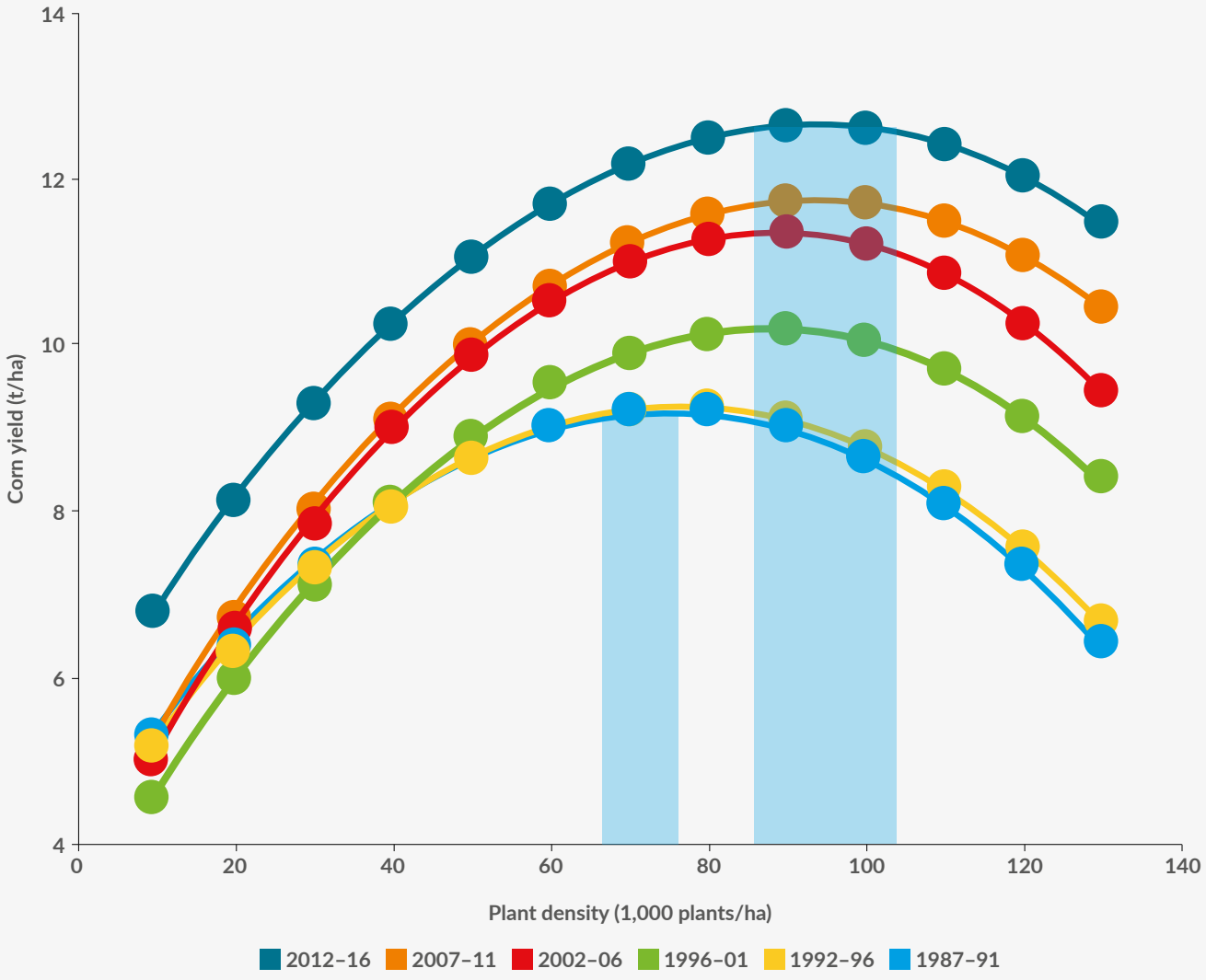


Figure 4: Agronomic optimum plant density (averaged over all Pioneer® brand hybrids) over six five-year time periods from 1987–2016

Source: Jeschke et al., 2018

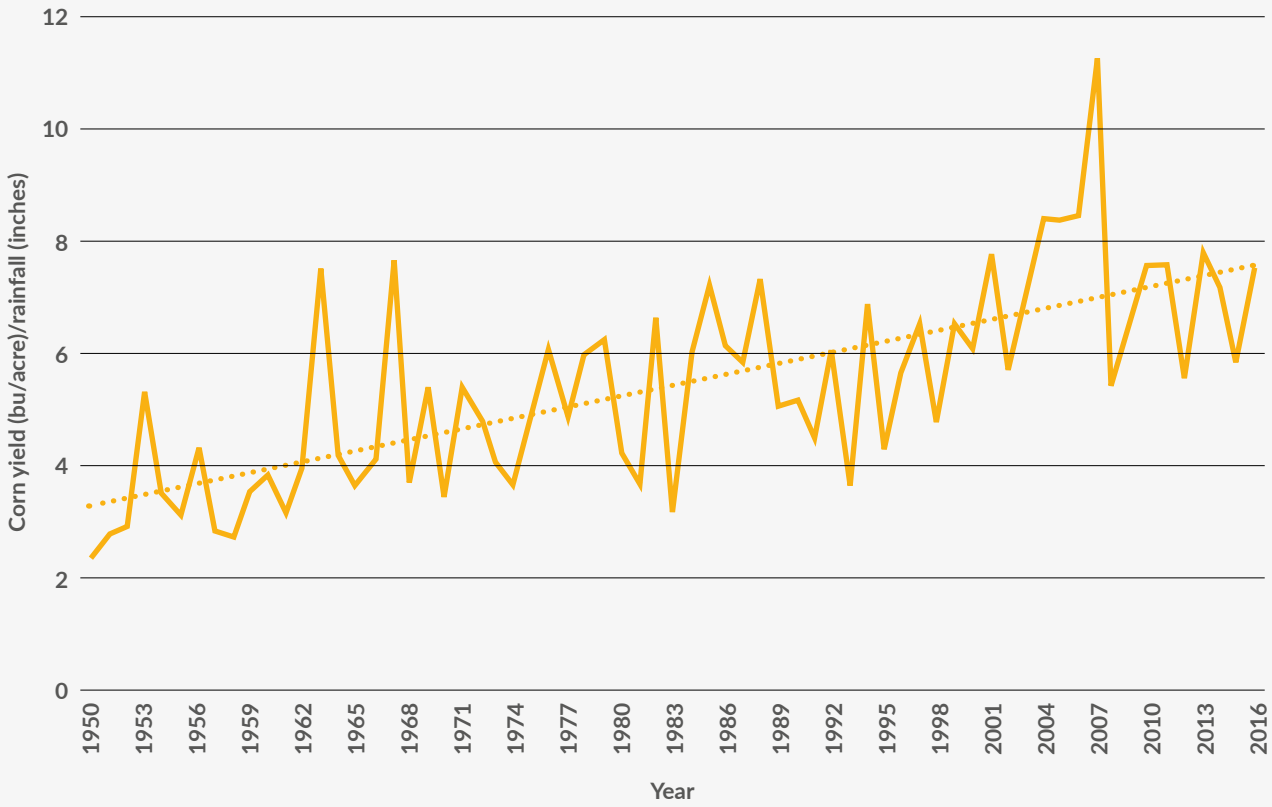


Figure 5. Corn yield per inch of growing season precipitation (April-September) from 1950-2016 in Champaign County, Illinois (yield data: USDA-NASS; rainfall data: National Weather Service).

Source: 'Water, Soil Nutrients, and Corn Grain Yield, Crop Insights', Pioneer Hi-Bred International (2017)

With water becoming increasingly scarce, and global climates more variable, maize breeders have gone to considerable effort to increase drought tolerance.

5. Plants able to produce more from less

Growing the same amount of yield with less inputs is one of the key objectives for maize breeders and one such example is water. With water becoming increasingly scarce, and global climates more variable, maize breeders have gone to considerable effort to increase drought tolerance. This is expressed as WUE and the result of this breeding focus has been a marked improvement in WUE. This is clearly evident in a data set from Illinois in the US *(Figure 5)*.

With increased pressure from agriculture coming on the environment, maize breeders are also focusing on improving the efficiency of fertiliser use. As with the focus on WUE, breeders have achieved impressive gains in NUE *(Figure 6)*.

Nitrogen application rates per hectare have largely stabilised since 1985 at around 150 kgN/ha. US grain yields, on the other hand, have risen from around 7 t/ha to 9.7 t/ha. NUE has risen from 38 kg grain/kgN applied to 52 kg grain/kgN applied. This is an impressive 37% increase in NUE.

6. Improved agronomic practices

With 50-60% of yield gains being achieved by growers attributed to gains in the genetic merit of the maize plant, the balance of the gains is due to changes in how the maize crop is being grown and harvested. This includes improved practices like greater weed and pest control, a better understanding of the rate and timing of fertiliser, the strategic use of irrigation, tillage practices to reduce compaction, and an increase in minimum or no-till cultivation to preserve or even enhance soil organic matter.

In recent years, a great deal of effort has gone into evaluating the use of break crops such as annual ryegrass, oats and tillage radish to reduce the amount of N lost over winter, break up any compaction areas, and help maintain soil organic matter.

What does the future hold?

Reduced greenhouse gas loss

With New Zealand aiming to reduce greenhouse gas emissions to net zero by 2050, and hold global warming to a maximum of 1.5°C over the same period of time, all forms of farming including crop production practices

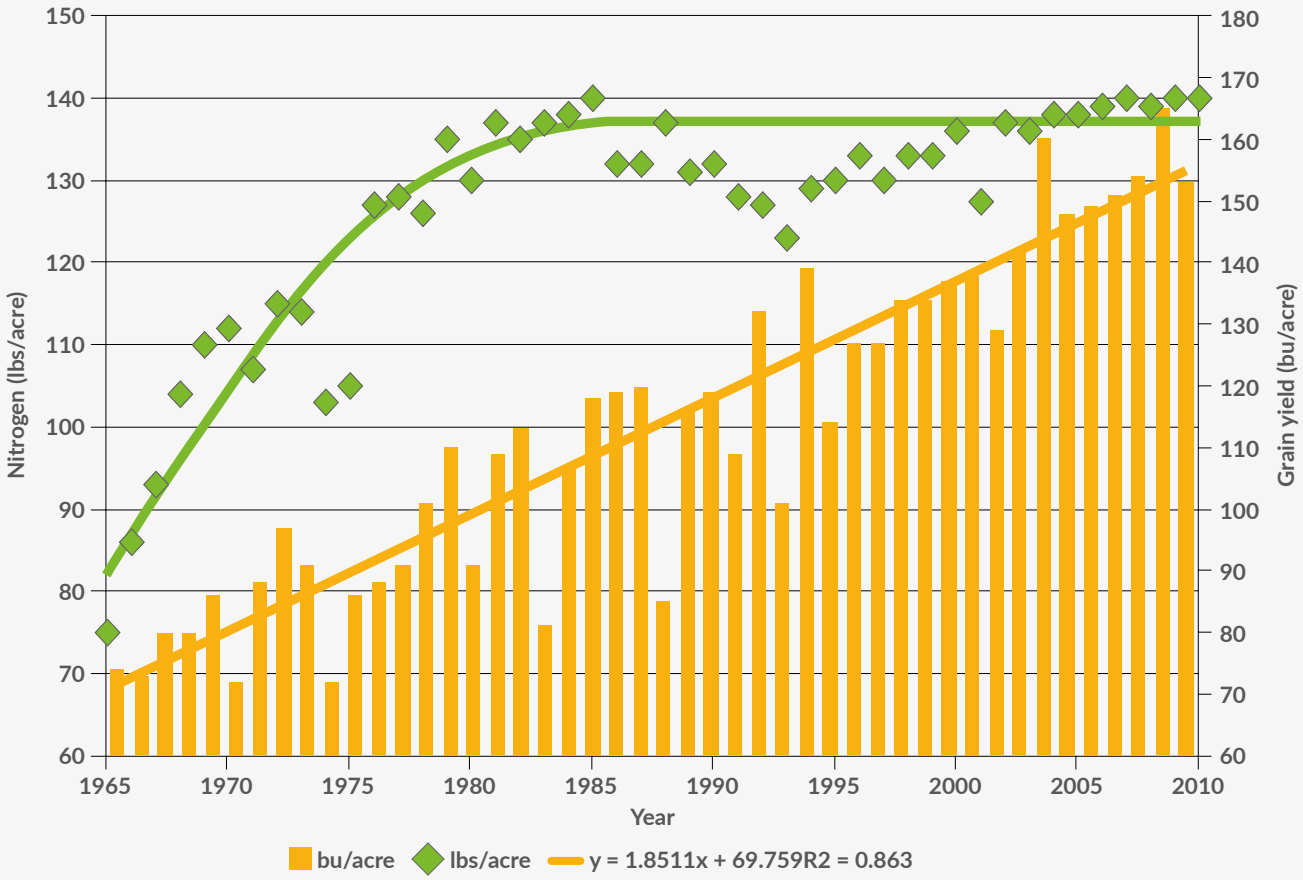


Figure 6. Historical grain yields and N application rates on corn acres in the US
Source: 'Nitrogen Uptake in Corn, Crop Insights', Pioneer Hi-Bred International (2014)

have come into focus. Maintaining soil carbon to prevent losses through CO_2 will become increasingly important. US data from the 2012 census found that crops grown under no tillage or minimum tillage systems accounted for 52% of all the area grown in crops. The loss of carbon associated with cultivating pasture paddocks to grow crops will likely result in more farmers using no-till or minimum-till practices.

Improvement in fertiliser and water use efficiency

A number of regional councils have either recently notified changes to their regional environment management plans or are in the process of doing so. These plans are particularly focused on reducing the impact of agriculture on soil and water quality in their region. Many regions have reached peak water allocation and a number of regions will require significant reductions in the amount of N, phosphorus (P), soil and pathogens entering waterways.

As mentioned, the effort international maize breeders are placing on raising NUE and WUE means that maize silage and grain will become increasingly important parts of New Zealand's environmentally friendly farming systems of the future. As one of the most water and N-efficient plants, maize will allow farmers to grow large amounts of high quality, low cost feed with reduced environmental impact.

Dairy systems based on pasture and maize

Because maize silage is a low protein feed (7-8% crude protein), feeding maize silage in pasture-based systems reduces overall urinary N content resulting in less N leached from urine patches. It also enables cows to be stood off paddocks on feed pads and fed maize silage when paddocks are too wet. This increases effluent capture, and there is less N lost through nitrous oxide (N_2O), less pasture damage through pugging, and less associated losses of P and sediment.

Concluding comments

The size of the global maize research and breeding programmes, and then trialing hybrids produced by these programmes locally, means that New Zealand farmers will continue to see increased maize yields. The associated increases in water and NUE are also likely to mean that maize will continue to be used to meet some of the challenges faced by New Zealand farmers associated with meeting higher environmental standards. As a C4 plant, maize will be increasingly important as we head into a warmer New Zealand associated with climate change.

Acknowledgements

Thanks are due to colleagues in our Pioneer NZ team for their help with the article.

Ian Williams is the Forage and Farm Systems Specialist at Pioneer Brand Products based in Hamilton.
Email: i.williams@genetic.co.nz.

LEE MATHESON

As a born and bred Wellingtonian and former financial markets trader, NZIPIM Board Member Lee Matheson has trod an unconventional path to his current role as Managing Director of Perrin Ag in Rotorua and a career as an agribusiness consultant.

Massey start

Lee grew up in Newlands in Wellington's northern suburbs and was intent on a career in medicine or veterinary science. However, an opportunity to assist with TB testing on a deer farm on the outskirts of the city, followed by an introduction to an extended family who farmed sheep and cattle in the Wairarapa, put paid to all that. School holidays spent pressing wool, fencing, drenching sheep and feeding out, much to the amusement of his urban friends and the distress of his teachers, soon transitioned to enrolment at Massey University in 1997, with a view that he would never wear a suit, never work in and office and never work in Wellington.

Lee did his best to ensure the latter never happened, eventually becoming Chair of the Massey University Young Farmers Club, chairing a Regional YFOTY Final Committee, relief milking at the No. 4 Dairy Unit, and spending summer practicums in the South Island high country and on Horowhenua bull beef farms. He subsequently graduated with a Bachelor of Applied Science (Rural Valuation and Management) and then Honours (First Class) in Plant Science.

From banking to farm consultancy

Undecided about staying on for further postgraduate study, a phone call from a good mate about an interest rate trading role at the National Bank of NZ (NBNZ) Treasury ('It looks insane – I think you'd love it') resulted in his applying for and ultimately getting a job with the suit, in the office and in the city he had vowed never to be in. After 11 months, Lee took on the role of the NBNZ dealing room's bank bill trader, which, excluding a short four month stint trading bonds for the bank at night, he held until the merger with ANZ in 2004.

Lee then switched roles to trade Forward Foreign Exchange at the ANZ Investment Bank until mid-2006 when a lifestyle change beckoned. The work hard, play harder existence he had enjoyed over the previous five-and-a-half years was losing its shine and a new challenge was needed. Within three days of replying to a job advert that had already closed, Lee found himself in Rotorua being offered a role as the third farm consultant at the small firm of Perrin Ag Consultants owned jointly by John Perrin and Trudy Laan.

The importance of ensuring necessary change enhances and strengthens rural communities, and not just aggregate GDP, is an issue that Lee fears is often overlooked by policy-makers.

Today, Lee finds himself in the role as Managing Director of Perrin Ag, leading a team of 13 advisors and three business support specialists located in the Waikato, Bay of Plenty and Manawatu. Still 'on the tools' as it were, his time is getting close to a 50:50 split between working 'in' the business and working 'on' the business, a transition he has found both enjoyable and extremely challenging.

Domestic and international farm advisor

Lee, wife Haidee and then six-week-old son Jake sold their lovingly restored character home in Trentham and moved to a do-up on four-and-a-half acres in Ngakuru, 25 km south of Rotorua. Partnership in the firm followed 20 months later and the scene was set for what has gone on to be a varied and successful domestic and international career in the farm and agribusiness advisory sector, not always well juggled around the challenges of being a husband, Dad to three kids (now 13, 11 and 9) and owner of a life-sentence block.

Within his role in the firm, Lee has been fortunate to have the opportunity to deliver multi-year extension work in Chile, complete due diligence on the purchase of an ex-Soviet agricultural co-operative, help raise equity for and establish dairy farms in North China, complete investment analysis for dairy farms in coastal Oregon, travel to South Africa to assess the feasibility of public-private partnerships in agriculture, and help design farm management systems for water buffalo dairy farms in northern Brazil.

Not only have these experiences enhanced his advisory capability, they have provided a rich mix of experiences, including getting taxi-jacked in Moscow, being served endangered species, winning drinking games with Chinese officials, and gaining the ability to order beer in over five languages.

Māori farming and post-settlement entities

In between international sojourns, Lee has worked extensively with a significant number of the Māori farming and post-settlement entities in the wider Rotorua and Bay of Plenty regions, including supervising the farming operations of Kapenga M Trust when they won the Ahuwhenua Trophy for the second time in 2012. In the last 10 years, the rapid emergence of the awareness of environmental externalities from pastoral farming has also seen his skillset evolve around the intersection of farm gate economics and policy settings, with particular focus around Variation 5 in Taupō, Plan Change 10 in Rotorua and latterly Plan Change 1 in the Waikato.

Huge rate of change

Lee is passionate about the opportunities available for both people in the wider rural professions and the primary sector, but would caution against expectations that the volatility and rates of change experienced by agriculture will subside any time soon. He notes that change has always been a constant for New Zealand farmers and growers and is one of the driving forces behind the innovation and entrepreneurship that we normally associate with the sector. For him, the rate and nature of change we are seeing is unprecedented and is going to challenge the current generation of people working in the primary industries to an extent not seen before.

View of the future

Lee's view of the future for the pastoral sector is one where farming is embraced as being more integrated in its approach to land management and the leveraging of natural and cultural resources to generate economic and social prosperity for the rural communities that farming creates and supports. He believes it is also going to need farmers to engage with their consumers, take a more active involvement in their supply chains and view their businesses through a wider lens – one that truly extends beyond their farm or orchard gate.

For him, we need to move away from the assumption that customers should simply pay us handsomely for what is most convenient for us to produce. Lee says we need to focus on a business framework where we work with consumers whose values and aspirations align with ours, to deliver what they want at a price point that recognises the value of what we create.

He believes that achieving this vision is going to require us to attract and develop the best talent to the sector, a preparedness to experiment with new technology and ideas on-farm, and to generate better information from the data and knowledge we already have. It might also mean walking away from infrastructure and industry paradigms that constrain innovation or stifle new investment.

Lee feels this challenge is not going to be made any easier by the tight capital position of many farming businesses (and some of their co-operatives), a shortage of talented and passionate people, and a political environment that appears to have little empathy for how hard some of this change is going to be for our farmers and their communities. The importance of ensuring necessary change enhances and strengthens rural communities, and not just aggregate GDP, is an issue that Lee fears is often overlooked by policy-makers and is something that needs to be overtly considered when central and regional government set the policy agenda.

Cactus used as a cut and carry protein source for the buffalo in their feed ration on a water buffalo dairy farm in Natal, Brazil

On the positive side of the ledger, Lee believes the increasing role of Māori and women across and within the primary sector needs to be recognised and celebrated, with the increased diversity of thought, talents and values an important resource for the sector to draw on.

Lee is also convinced change needs to happen across the value chain, not just on the orchard or on-farm. He believes the major industry good bodies, co-ops and processors are making small steps towards this new paradigm, but is concerned that the level of urgency and strength of messaging is not strong enough at times.

Perrin Ag initiatives to help ag sector

Rural professionals are not exempt either. Lee and his colleagues at Perrin Ag have embraced this vision and are doing what they can to help lead the way forward. An annual scholarship offered by Perrin Ag to support tertiary level agricultural science and commerce students is now its fourth year and its equivalent award specifically for Māori in the same fields is in its seventh year.

The firm is also currently training two graduate consultants, it has developed specialist supply chain advisory and applied research capacity, and has a range of client relationships up and down the agri-value chain. Strengthening rural communities is also a focus for both Lee and the rest of the firm's team, with Perrin Ag holding its third annual Charity Quiz in September this year, and many of the team being regulars on the BBQ and in the judging rings of the ag days in their client's schools and dog trial events.

NZIPIM roles and member diversity

With a strong passion for the farm consultancy profession, Lee is also one of the elected North Island directors on the Board of NZIPIM, with his current term due to finish in 2020. As one of the two Registered Members on the Board he also sits on the NZIPIM Disciplinary Committee. A role that he is pleased he hasn't yet had to actually fulfil, he credits this to the high ethical standards of the Institute's members and their professional competencies.

Lee believes that strong farm systems capability, and a strong ability to connect and communicate with farmers and growers, must be at the core of a successful agribusiness advisory practice. But with the farm and orchard ecosystems expanding beyond traditional production-related boundaries, specialist skillsets and a preparedness to collaborate with others is essential. The growth in the diversity of membership of NZIPIM is evidence of this broadening in the definition of who we consider to be rural professionals and the services and advice that farmers and growers need.

Where to next?

So where to next for Lee? A desire to complete a PhD sits not-so-quietly in the background as something akin to unfinished business, but with the challenges of running a rapidly growing business and being an unpaid Uber driver for three soon-to-be teenagers he is realistic it will be a few years yet before he can make room for such an undertaking. In the meantime, the challenge of empowering, enabling and engaging with his growing number of colleagues at Perrin Ag and the excitement of helping clients achieve their aspirations is expected to keep him busy enough. J

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