IrrigationNZ news

SPRING 2019

The future of water management under Essential Freshwater

IRRIGATION NEW ZEALAND

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IrrigationNZ news

Editor: Allanah Jarman
Phone 03 341 2225
Email admin@irrigationnz.co.nz

Advertising:
Phone 03 341 2225
Email admin@irrigationnz.co.nz

Administration & Subscriptions: Eleonore Dumaine
Phone 03 341 2225
Email admin@irrigationnz.co.nz

Irrigation New Zealand
Lincoln Research Centre
Corner Springs Road & Gerald Street
PO Box 69119, Lincoln 7640

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IRRIGATION NEW ZEALAND

www.irrigationnz.co.nz

A message from IrrigationNZ's new Chair, Keri Johnston

Welcome to the spring edition of our magazine. I would like to take this opportunity to tell you a bit about me. I am a woman of many hats. I am a mother of two teenage daughters, a farming partner, an environmental engineer and consultant, a netball player and coach, a horse rider, an avid reader, a trustee on my daughter's school Board of Trustees, a member of my local catchment group, and a business owner. A diverse CV with an equally diverse set of skills.

Many of you will know me in my role as an environmental engineer and consultant. This puts me at the coal face of working through and addressing the many issues facing our membership – unworkable policy; changeable policy leading to uncertainty; frustration at the lack of understanding of farm systems and irrigation in a policy setting; and the tension that exists between the sustainable development of land for food production, environmental degradation, and social, cultural and economic values.

But as well as this, I am a farming partner. I was raised on a sheep and beef farm in North Otago, and now with my husband, farm 440 hectares between two farms in South Canterbury. We are now mainly beef finishing, but still have a few dairy grazers as well. Our home block is partly irrigated from two deep groundwater bores. With the many challenges being thrown at the wider farming sector, we too are working our way through the plethora of regulations that we face. The two roles are a dynamic combination.

As Chair, I am looking forward to working with the other board members as we lead the direction of IrrigationNZ in the form of our newly adopted strategy. At the heart of our strategy is the vision "Irrigation for a thriving and sustainable New Zealand" and our mission "Creating an Environment for the Responsible Use of Water for Food and Fibre Production."

Our vision, mission and strategic priorities must now become embedded in our organisation, with our people focused on delivering the strategy for the benefit of our membership. We also need to ensure that we have regular, honest communication with our membership to ensure that there is a good understanding of the rationale for our strategy and what our performance actions are. It also allows members to provide feedback on the matters they consider to be important and any issues which require addressing. Ultimately, our membership is at the heart of everything we do.

We are entering a time of impending change with the government reviewing the Resource Management Act and embarking on Freshwater Reforms. This will undoubtedly create anxiety and amplify the feelings of uncertainty that many in our sector are already feeling. The IrrigationNZ team will be working proactively to get in front of these, representing the views of our sector to influencers and decision makers, and communicating regularly with our members about our advocacy activities, and the outcomes of these.

It is an exciting time for IrrigationNZ with new appointments in the roles of Communications Manager and General Manager soon to occur. Watch this space!

The board is undertaking a review of IrrigationNZ's funding model. This review is necessary if we are to ensure that the future of the organisation is sustainable, but also sets us up for success by enabling strong governance, management and the implementation of our strategy. Input from our membership will be vital and we will be undertaking this piece of work in the coming months.

The success of any organisation stems from its board. The board steers the organisation towards meeting its vision, ensure its financial stability and are its public face. Our AGM is in November, and there will be vacancies on the board. Our constitution now also allows for independent directors and we will also be embarking on a process of advertising for these. Therefore, I encourage you to think about possible candidates for both the elected and independent director roles, and please don't hesitate to contact me if you have any questions.

Until next time,

Keri Johnston
Chair of IrrigationNZ

Balance to ensure wellbeing – and that includes for farmers too

A wise man once said to me "the only thing that surprises me is that you're surprised." I would suggest that the same can be said about the Action for Healthy Waterways discussion document that was released by the Government on 5 September.

Last year, the Government announced it would be making significant changes to the policy and regulatory framework for freshwater in Aotearoa, to include amending the National Policy Statement for Freshwater Management (NPSFM) and developing new National Environmental Standards. The areas and issues to be addressed were clearly set out, and specialist advisory groups were established to provide advice to the Government on the development of a new framework.

So, we knew changes were coming.

IrrigationNZ is broadly supportive of the end the proposals seek to achieve – good water quality (both urban and rural), protection of endangered freshwater species, protection of wetland and stream habitats, and supporting the mana and mauri of waterbodies. However, we do have concerns as to how those ends are achieved and the implications for water users and their communities. We need balance to ensure we maintain wellbeing in all its aspects.

Although the first NPSFM was promulgated in 2011, its implementation by regional councils has been inconsistent around the country, from strict and complex regulatory requirements in some regions to little change to these rules in others.

The Government has sent a clear signal that changes in planning need to happen more quickly, and that it wants rules to be imposed swiftly, in order to prevent ecological harm in the short term. Therein lies the rub.

Many of the issues we are trying to grapple with around freshwater have not developed overnight. Complex biophysical processes that vary from catchment to catchment, combined with human activities that change natural functioning, all contribute to the outcomes we see in waterbodies. Some of these activities are recent, but some have been occurring over many decades, and the implications of those actions were not always well understood when critical decisions were made.

Farming and infrastructure developments are long-term activities with multi-decadal investment timelines. Some of the new regulatory changes will be required to be implemented immediately or by 2025, meaning some will have to implement changes to their systems much more rapidly than they might otherwise have been planning for. There are also virtually immediate rules limiting land-use change, intensification and irrigation development that kick-in at a very small scale – only ten hectares – which is the size of a paddock for some large farms.

However, the changes themselves are not that surprising. As users of a shared community resource, many within the irrigation sector have been working hard to manage their environmental footprint through the use of farm environment plans, water quality monitoring, riparian management, and water supply agreements within irrigation schemes, which require good performance in order to receive water. We want to ensure that there is consistency and certainty for our sector, and that rules developed under this framework (and others also being consulted on, including around biodiversity and protecting highly productive land) are fit for purpose, implementable, and achievable.

As we face an uncertain climate future, we need to ensure our policy and regulatory settings do not limit our future options. We know that water availability is going to change – droughts will become more frequent and prolonged, and rainfall will occur in less frequent, but more severe events. Water storage and how our resources are allocated are likely to be just as important in protecting community and ecological wellbeing as the setting of water quality attributes and limits. We need to be planning for these future options now.

The Government has called for feedback on the discussion document, and I encourage our members to take the time to read the proposals, and attend the public information meetings being held by the Ministry for the Environment to get a good understanding of what this means for their community and their catchment.

If we can make good decisions for our catchments and communities now, that allow flexibility whilst protecting our unique species and waterways, we can ensure our water resources continue to provide us with the range of values we have always enjoyed.

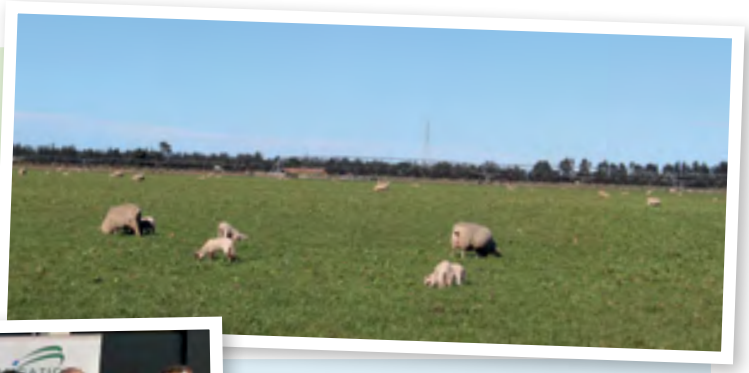
Elizabeth Soal
Chief Executive, IrrigationNZ

You can read more about the Essential Freshwater proposals on page 14.
Submissions close on 17 October 2019.

IrrigationNZ: out & about

SPRING IS HERE – TIME TO CHECK YOUR IRRIGATION SYSTEM!

September brings longer days and warmer weather. Now's the right time to check your irrigation system is ready for the coming season. Check out our tips on page 37 to ensure your system is ready to go this spring.

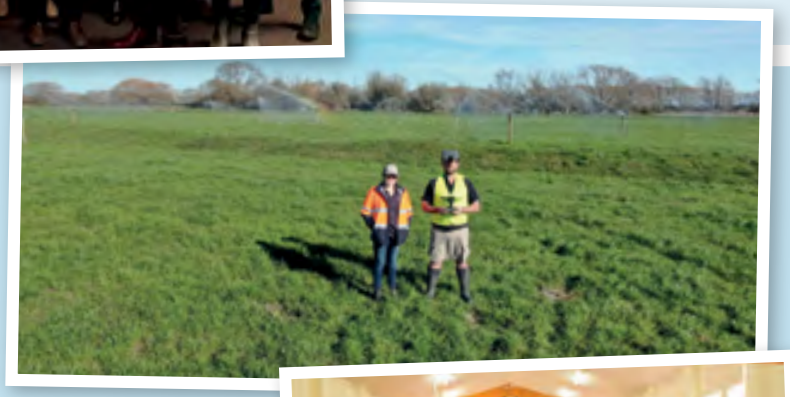


CONGRATULATIONS TO OUR IRRIGATION DESIGN GRADUATES

On July 17, New Zealand Certificate in Irrigation Design students celebrated their graduation at a ceremony held in Christchurch. You can read more about our new graduates on page 12.

MORE ONLINE TRAINING IS IN DEVELOPMENT

We're working on more online learning modules for irrigators. The new online training will provide a series of short videos explaining and showing people how to do a bucket test on different types of irrigation systems. You can read more about this on page 47.



INZ IN WELLINGTON

With so much happening around water policy at the moment, IrrigationNZ's Chief Executive Elizabeth Soal was at Parliament in late August to discussing water policy issues and how they affect the irrigation sector with Agriculture Minister Damien O'Connor, National MPs and key government officials.

SAVE THE DATE FOR THE INZ CONFERENCE & EXPO: 7–9 APRIL 2020

Find out more about the upcoming IrrigationNZ Conference & Expo in Christchurch on the feature pages within this issue, from page 28.

IrrigationNZ Annual General Meeting

SAVE THE DATE: THURSDAY 21 NOVEMBER 2019

IRRIGATION NEW ZEALAND

Healthy thinking for better farming

By Hugh Norris, Farmstrong wellbeing advisor.

There's a lot going on at this time of year. Milking, mating and the irrigation season has started, with added stresses from post calving and fluctuating weather. With all these added pressures it's easy to fall into some bad thinking patterns.

All of us can probably remember a time when we lost our temper and ended up unintentionally breaking something or even hurting ourselves or someone else.

Recently I heard a story about a farmer who was under time pressure to load his cattle and lost his temper when the last one didn't fit in. He was fired up and slammed the gate shut. The only problem was, he didn't remove his hand and ended up breaking his arm. An extreme example, but it does show how strong emotions like anger and frustration can end badly.

It's understandable that occasionally we have a short fuse or feel negative, but is it useful and productive? According to psychologists, angry and negative emotions make us less:

- effective at coming up with creative solutions to problems
- productive
- able to relate and get on with people
- able to change the way you think.

THE NEGATIVE THOUGHT CYCLE

When we notice something negative happening, or even when we think about something going wrong, it triggers an emotion. The emotion might be frustration, anger or sadness and will lead to a certain behaviour, for example lashing out, berating others, or withdrawing socially. These behaviours can be unhelpful and can drive our negative thinking further, creating a downward negative spiral where negative thoughts, emotions and behaviours reinforce each other.

Can we change the way we think and behave to be more positive, while also acknowledging our difficulties and challenges? This is possible with a technique called *Catch it, Check it, Change it.*

CATCH IT

When you get upset about a situation, imagine standing outside yourself and hitting the pause button. Take a deep breath then see if you can catch your thought, notice the emotion you are experiencing, and any impulse to behave in a certain way.

CHECK IT

Then examine the thought and decide if there is a more positive interpretation without denying the reality of the situation. Try to be curious about what's going on, rather than assuming you have all the facts. We often decide that the thought we're having is the one and only reality, whereas almost always there are a number of interpretations about what's happening, or what someone meant by what they said.

CHANGE IT

We can then change the thought to a more positive interpretation, or at least reserve judgement. More positive thoughts will lead to easier emotions and calmer behaviours, which will help you problem solve better. If you do discover that the situation is the worst possible scenario, at least you have given yourself breathing space.

Applying the above technique helps us get better at understanding how our thoughts affect our emotions in the long term and help ensure we're less prone to depression, anxiety and angry outbursts.

WHAT ELSE CAN YOU DO TO HELP WHEN STRESSED?

A good coping mechanism for stressful situations is to take five or six deep breaths. This stops us acting and thinking impulsively and calms our nervous system leading to better choices about what to do and say next. Taking a short walk has a similar effect.

Farmers are often pragmatic problem solvers. However, sometimes the problems become overwhelming. This is when we need to look carefully at our thoughts, emotions, behaviour cycle and talk with people we trust about what is going on.

Farmstrong is a nationwide wellbeing programme for the rural community, with the aim to help farmers live well to farm well. For more wellbeing tips, farmer to farmer stories and how to look after the most important asset on the farm, head to www.farmstrong.co.nz

FARMSTRONG
Live Well Farm Well

Sam Whitelock, Farmstrong ambassador.

Consultation on Essential Freshwater reforms

By David Parker, Minister for the Environment.

New Zealanders want to be able to swim, fish, gather shellfish, and enjoy our local rivers, lakes and estuaries as our parents and grandparents did. But we know that the land use decisions we have made over the years have contributed to the degradation of our waterways. This Government is committed to stopping things getting worse, making a noticeable improvement within five years, and restoring freshwater to a healthy state within a generation.

The direction of travel is clear, so we are proposing new requirements to make real change on the ground, as quickly as possible. We won't be able to resolve freshwater quality issues overnight, but we need to start heading in the right direction now.

Many people, including irrigators, farmers, and growers are already doing the right thing and are making changes to reduce their impact on freshwater and the environment. However, their efforts are undermined by those that do not. We want to acknowledge the positive efforts and follow their example wherever we can. But this package is about making sure everybody contributes.

As this issue goes to print, the Government is consulting on the package of proposals that I believe will clean up our freshwater. The final reform package must be sufficient to halt the decline of freshwater, but also needs to be practical and enduring. This means it must be science-based, predictable, understood by the public, and underpinned by effective regulation and enforcement.

The package of proposals is about protecting our environment (and the clean green brand that is so important to our exports and tourism). At the heart of the proposals lie the following objectives:

- using Te Mana o te Wai as the framework for freshwater management (which puts the needs of the water itself first, then essential human health needs, followed by consumptive uses)
- better providing for ecosystem health (water, fish and plant life)
- better protecting wetlands and estuaries
- managing high-risk farming activities and limiting further intensification
- supporting improvement of farm management practices, for example through farm management plans.

The package includes a rewritten National Policy Statement for Freshwater Management and a new National Environmental Standard for Freshwater Management. Together they will direct councils to improve freshwater management (both reducing contamination and increasing protection), and limit certain activities that lead to contamination of freshwater.

The final impacts of the proposed changes will depend on which proposals are implemented after consultation. The impacts will also be influenced by: the catchment in which an activity is based; the farm type and existing practices; topography; and whether the regional plan has implemented the existing NPS.

In the 2019 Wellbeing Budget the Government committed $229 million over four years to support moves to tackle the environmental issues that New Zealanders in rural and urban areas care about. This includes supporting the primary sector, as a cornerstone of our economy, to both transition to more sustainable land use and increase the value of its exports. Assistance to farmers will go hand-in-hand with the new rules that will have to be met, and will be enforced.

New Zealand has a bright future, but we must take action now to safeguard and improve our environment. If, with all our advantages, New Zealand can't overcome its environmental problems then the world won't.

The package being consulted on is comprehensive, and I am pleased to share it with New Zealand. A real strength of the discussion document is that it includes the views of the independent groups who have been advising the Government on the proposals over the last year. Please take the time to read the detail and then provide your feedback via the Ministry for the Environment's website.

Additionally, this package is just one of the policy work programmes in place that collectively aim to protect our environment and transition New Zealand to a sustainable, low emissions future.

It will take a generation to make that transition and we need to keep building on the efforts that many New Zealanders are already making at home, at work and on the farm. We all need to roll up our sleeves and fairly share responsibility.

Andrew Booth, Jacinda Ardern and David Parker discuss the exemplary work the Booth family have done as part of the community effort to help clean the Kaipara Harbour.

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Much more than just a cup of coffee

By Jeremy Dufour, Olam International's Environmental and Social Manager, Plantations and Farming, South and East Africa.

Like millions, I am addicted to my morning injection of caffeine – don't count on me before my first cup! Working in the coffee sector, I know well the 'behind the scenes' of this morning brew. But have you ever stopped to reflect on what's in this dark juice? Many speak of the positive social benefits of buying certified coffee, or like the story of the farming community behind your preferred Ethiopian or Colombian brew. But what about its water footprint?

A barista uses about 217ml of water to make a latte and only 36ml for an espresso – and that might seem like it. But in fact, it takes about 18,900 litres to produce one kilogram of roasted coffee (www.waterfootprint.org). We can easily forget it sitting comfortably in a cafe, but water plays a crucial role in global food security – it is essential for crop production.

On one hand, agriculture is already responsible for 70 percent of the consumed fresh water worldwide, which is expected to rise to 89 percent by 2050. On the other hand water scarcity is already an issue in many coffee producing countries. Such statistics should cause us concern and the successful companies of tomorrow will be those planning operations and investments with water at the centre – capturing its real cost fully in their business plans, modelling future availability and collaborating with local stakeholders for equitable access and usage. At Olam International Limited (Olam), a global leader in the agro-commodity sector (www.olamgroup.com), we are already well aware of this water risk and we make every single drop of water count across all our plantations, including our two large coffee plantations in Tanzania and Zambia.

Nestled in the hills of the Southern Highlands of Tanzania, Olam started Aviv Tanzania Limited from scratch in 2011, transforming an old cereal farm into the largest coffee plantation in the country. Up to 60,000m^3 of water is pushed daily through more than 2,800km of drip lines (thanks to Israeli and South African irrigation expertise) to fully irrigate 1,025 hectares of Arabica coffee trees. This represents about 20 litres of water per tree per day, making Aviv the largest water user in this part of Tanzania, pumping water directly from the mighty and emblematic Ruvuma River.

Coffee bearing trees irrigated at Aviv coffee farm. *(Photo courtesy of Olam International Limited)*

Naturally, with such a water footprint, we got our stakeholders' attention. So, we decided to lead the way in sustainable water resource management in a country with very young legislation (the Tanzania Water Resources Management Act celebrated its 10-year anniversary in 2019).

We ensure our operations are exemplary for the country, so that economic development is not jeopardising the water security of other users and healthy riverine ecosystems. This was possible through dedicated implementation of the Alliance for Water Stewardship (AWS) Standard. In 2016, we became the first coffee plantation to demonstrate the principles of water stewardship, making Olam the first company in Africa and the first agri-business globally to achieve AWS certification. This approach strengthened our efforts to adhere to global best practice and helped to ensure long-term water security for more than 50,000 people living in the Upper Ruvuma River Basin.

We took a proactive approach to the four outcomes of water stewardship: good water governance, sustainable water balance, good water quality status, and supporting important water-related areas[1]. Amongst many other initiatives, some activities stood up in illustrating our commitment to water

Sunset at NCCL centre-pivot irrigated coffee fields. *(Photo courtesy of Olam International Limited)*

stewardship, such as the construction of a large water reservoir of 1.5 million m^3 capacity to feed our two large water pumps, while securing water availability for downstream users and ensuring minimum environmental flows during dry months.

In Zambia, Olam opted for centre-pivot irrigation, which is more appropriate to local agro-climatic conditions and locally available water resources. Since 2012, Olam's subsidiary Northern Coffee Corporation Limited (NCCL) has refurbished five old coffee farms, totalling an area of 2,230 hectares of Arabica coffee. We have installed more than 40 centre-pivots ranging from 12 to 80 hectares. Such technology comes with a lot of challenges, such as building capability within the local (relatively uneducated) workforce to operate these machines.

But our commitment to the principles of water stewardship is intact, guiding our decision-making and mitigating some water scarcity risks, for example through a new 12.5 million m^3 dam, flooding 550 hectares of land to supply one coffee farm with 45,000m^3 of irrigation water daily. Once again, collective management of water resources with neighbouring communities is critical and NCCL intends to comply with the AWS Standard by the end of 2021.

Panoramic view of Aviv coffee farm and its artificial water reservoir.
(Photo courtesy of Olam International Limited)

Last year, Olam redefined its purpose to be 'Re-imagining Global Agriculture and Food Systems' and demonstrating water stewardship is undeniably a part of this – it is essential for irrigated coffee production. But still too few around the world are taking active steps in managing water in an equitable and sustainable way – before it is too late.

So, next time you sip a delicious coffee, remember the efforts made by Olam in Africa in managing its water resources in a way that offers you a more sustainable brew.

1. The Alliance for Water Stewardship released its revised AWS Standard in March 2019, now identifying 5 outcomes to water stewardship adding safe water sanitation and hygiene for all to the list (for more info: www.a4ws.org).

Congratulations to our Irrigation Design Graduates

In July our most recent New Zealand Certificate in Irrigation Design students celebrated their graduation at a ceremony held in Christchurch.

New Zealand is the only country in the world to have a national qualification in irrigation design.

"IrrigationNZ is proud of our graduates from this important course – which will become critical as farmers and businesses increasingly need state-of-the-art irrigation systems to demonstrate efficient and sustainable use of our shared water resources," says IrrigationNZ Chief Executive Elizabeth Soal.

"The qualification recognises the specialist skills needed to design technically efficient and environmentally sustainable irrigation systems.

"The rigorous course not only tests the students' ability to design the infrastructure, but challenges them to identify and mitigate any potential impact it may have on the environment."

Students work through designing systems from beginning to end as part of the qualification – starting with identifying customer needs, environmental impact, integrating technologies then designing an highly efficient irrigation system.

Seventeen individuals graduated at a ceremony in Christchurch in July, and Karla Brown is one of the two women who are the first female graduates to complete the qualification, which has been running since 2016.

"This course serves to benefit both suppliers and customers in ensuring that all systems being installed are mechanically, environmentally and economically efficient."

Karla is a Mechanical Engineer who is originally from South Africa. She had been working for Ray Mayne Hose and Fittings for a year before she joined the New Zealand Certificate in Irrigation Design course.

Karla says that doing the course has given her a more structured approach to irrigation design and equipped her with a comprehensive understanding of the multi-faceted irrigation industry.

Karla says she would recommend that others working in the industry undertake the course.

"The course merges the theoretical knowledge and practical experience of each individual. The workshops provide a platform for discussion between industry professionals and the course material sets a minimum standard for overall best design practices. This course serves to benefit both suppliers and customers in ensuring that all systems being installed are mechanically, environmentally and economically efficient."

Kate Jones also graduated recently. She

Karla Brown is one of the new graduates.

grew up on a mixed cropping and dairy grazing farm near Hinds and helping with irrigation was always part of the school holidays, shifting the Southern Cross travelling irrigator or setting clocks and dams on the border dykes.

"After completing a Bachelor of Environmental Management at Lincoln University an opportunity came up to start as a junior designer at WaterForce Cromwell where I worked on a variety of landscape, viticulture and horticulture designs and installations," she says.

Kate later returned back to Ashburton with a desire to design centre pivot systems and has

NZ Certificate in Irrigation Design Graduates.

worked for PGG Wrightson Water as a Sales and Design Engineer for the past six years.

"For me the Certificate of Irrigation Systems Design is an important validation of ten years of experience as an industry benchmark," she says.

Congratulations to our 2017 and 2018 graduates:

- *Kurt Brocklebank (WaterForce)*
- *Karla Brown (Ray Mayne)*
- *Scott Collie (PGG Water)*
- *Phil Darragh (PGG Water)*
- *Simon Davis (Kirk Irrigation)*
- *Matthew Donald (WaterForce)*
- *Rasmus Erasmus (Sustainable Water)*
- *Mitchell Flack (WaterForce)*
- *Samuel Franklin (WaterForce)*
- *Jake Harrison (Carrfields Irrigation)*
- *Kate Jones (PGG Water)*
- *Daniel McLaughlin (WaterForce)*
- *Douglas Mercer (PGG Water)*
- *James O'Brien (PGG Water)*
- *Robert Shelton (Country Lane Landscapes)*
- *Stephen Smith (WaterForce)*
- *Rex Winks*

Design graduates at a training module in early 2019.

BECOME A QUALIFIED IRRIGATION DESIGNER

The next New Zealand Certificate in Irrigation Design course starts in January 2020, with applications for the course closing in early December. The 18 month qualification is suitable for those who work in the irrigation industry and involves on-the job assignments as well as attendance at modular training sessions. For more information about the certificate see www.irrigationnz.co.nz under the 'Events and Training/Service Industry' link.

Irrigation events and training

IRRIGATION OPERATOR AND MANAGER TRAINING, ASHBURTON

This event takes place on Wednesday 25 September from 10am–4.30pm. To find out more visit www.irrigationnz.co.nz/events

This course provides a mix of classroom learning and in-the-paddock practical application which will give you the confidence to know:

- what good irrigation management practice is
- what steps to take to achieve good irrigation management practice and meet Farm Environment Plan requirements
- how to operate your irrigation system correctly
- when to irrigate and when you shouldn't waste time and money switching your system on
- how to manage your irrigation systems to keep them operating well
- what technology is useful and practical to help make irrigation decisions.

We also cover the following topics. You'll have the opportunity to ask questions and identify solutions to meet your unique situation.

- Irrigation regulation – what you need to know. How do the RMA, consents and plan rules fit together and affect you?
- Irrigation scheduling – develop your knowledge of soils, water and climate to understand how to schedule irrigation applications. This includes an explanation and demonstration of the tools available to help scheduling.
- Operation and maintenance – the safety and efficiency of your irrigator and your staff depends on maintenance and correct procedures being followed. We explain how to develop procedures to suit your farm. After an 'irrigator walk' we begin building an operations and maintenance manual specific to your property.

Photo courtesy of Ashburton Guardian.

- Irrigator performance assessment – data collected during the 'irrigator walk' is analysed using tools to check irrigator performance. This is a practical application you can use on your farm.

Take home resources and an irrigation toolkit, including a suite of resource guides, is provided to take home for use amongst your team.

The future of water management under Essential Freshwater

Major changes to New Zealand's freshwater management regime have been proposed in a new consultation package the government released on 5 September.

The proposals have two main objectives:

- to stop further degradation of waterways and start making immediate improvements so that water quality is improving within five years
- to reverse past damage and bring waterways and ecosystems to a healthy state within a generation.

The government plans to address water allocation issues – and consider all interests, including Māori and existing and potential new users – through a separate reform process.

NEW LEGISLATION AND FRESHWATER PLANNING PROCESS

The Government is planning to reform resource management legislation in two stages. Stage one will see the introduction of a Resource Management Amendment Bill, later this year, to reduce complexity, restore public participation opportunities, and improve Resource Management Act (RMA) processes. Stage two is a comprehensive review of the RMA. A panel of experts will lead the review and will deliver a plan for resource management reform by mid-2020. The review will address urban development, environmental bottom lines, and effective participation, including by Māori.

The government has signalled it wants to include a requirement in the Resource Management Amendment Bill that councils must have new plans in place that are consistent with Te Mana o te Wai, no later than 2025 that fully give effect to the new National Policy Statement (NPS) on Freshwater Management. Te Mana o te Wai, "the mana of the water", refers to the importance of prioritising the health and wellbeing of water before providing for human needs and wants.

Proposals for a new NPS are part of the consultation package just released by the government. Government-appointed freshwater commissioners would form a panel with local councillors, and tangata whenua-nominated representatives to consider council plans, hear submissions and make recommendations. There would be restricted appeal opportunities.

Under this proposal, councils would still be responsible for developing their plans in consultation with local communities, notifying plans for submissions and would make a final decision after receiving the recommendations of the freshwater hearing panel.

As part of changes proposed to the NPS on Freshwater Management, the government is proposing to broaden the criteria to be considered when making decisions that impact on waterways to include:

- aquatic life – including microbes, invertebrates, plants, fish and birds
- habitat – including bed, banks and margins, riparian vegetation, and connections to the floodplain
- water quality – the physical and chemical measures of the water, such as temperature, dissolved oxygen, pH, suspended sediment, nutrients and toxicants
- water quantity – the extent and variability in the level or flow of water
- ecological processes.

CHANGES IN FRESHWATER DECISION MAKING

Changes are proposed to strengthen the requirement to identify and reflect Māori values in freshwater planning.

Regional councils would be required to enable and support tangata whenua to develop attributes that represent mahinga kai values specific to their local catchments. Regional councils would also be required to provide for mahinga kai values in waterways.

The discussion document also identifies a number of new attributes to be monitored and maintained or improved as indicators of ecosystem health:

- nutrients (nitrogen and phosphorus)
- sediment
- fish and macroinvertebrate numbers
- lake macrophytes (the amount of native or invasive plants)
- river ecosystem metabolism
- dissolved oxygen in rivers and lakes.

New rules are also planned to stop any further drainage or development of wetlands, as well as stricter management of land use in areas where drinking water supplies are sourced to prevent contamination.

NEW NUTRIENT REQUIREMENTS

The consultation proposes introduces a requirement for nitrate losses to be halted at current levels within five years in at-risk catchments

where future nitrate loss requirements are not already in place.

These requirements would apply in these catchments:

- Northland: Waipao Stream (in the Wairoa River catchment)
- Bay of Plenty: Upper Rangitaiki River (upstream of Otangimoana River confluence)
- Waikato region: Piako River, Waihou River
- Hawke's Bay: Taharua River (in the Mohaka River catchment)
- Taranaki: Waingongoro River
- Wellington: Parkvale Stream (in the Ruamahanga River catchment)
- Tasman region: Motupipi River
- Southland: Mataura River, Oreti River, Waimatuku Stream, Aparima River, Waihopai River.

Regions and catchments that have rules or proposed rules to reduce nitrogen leaching – Canterbury, Otago, the Tukituki catchment in Hawke's Bay, Manawatu and the Waikato/Waipa catchment in Waikato – are excluded from this proposal. However the Ministry for the Environment will closely monitor these areas and the government says it reserves the right to extend the new requirements to these catchments too, if councils do not achieve nitrogen reductions within five years.

A new bottom line for nitrogen in rivers is also proposed as an annual median of 1 milligrams per litre of dissolved inorganic nitrogen (DIN). A bottom line for phosphorus in rivers of an annual median of 0.018 milligrams per litre of dissolved reactive phosphorus (DRP) is also proposed.

The government is seeking feedback on whether to include these new targets in the National Policy Statement for Freshwater Management and says it will not make a decision until more analysis has been undertaken on ecological benefits, as well as the impact on communities and individuals.

Reaching the proposed new bottom lines across the country would mean significant restrictions on nutrient run-off in some lowland agriculturally-dominated areas, beyond the existing limits, especially in parts of Waikato, Canterbury and Southland. In lowland areas of Canterbury, many farms would have to reduce their nutrient losses by more than 50 percent to meet the new targets, and some farms would need to reduce their nutrient losses by 80 percent or more.

IRRIGATION DEVELOPMENT AND INTENSIFICATION

Restrictions on agricultural intensification are proposed to apply from June 2020.

The new restrictions would apply to areas of 10 hectares or more of:

- new irrigated land and
- new forage cropping areas.

A resource consent would be needed to irrigate more than 10 hectares of unirrigated land, and this would only be granted if there is evidence it would not increase nitrogen, phosphorous, sediment or microbial pathogen discharges above the property's 2013–18 baseline average.

The restrictions will apply until councils have introduced new water plans which must be in place by 2025. The government says that these plans should prevent intensification beyond what is sustainable.

MINIMUM FLOWS

Proposed changes would clarify current requirements for setting minimum flows so that:

- objectives for freshwater quantity state the desired ecosystem health outcome
- minimum flows and allocation limits clearly relate to achieving those objectives.

For aquifers connected to rivers and lakes, councils would also be directed to set water levels and allocation limits to achieve objectives for groundwater and surface waterbodies.

WATER METER REQUIREMENTS

The government is proposing to amend regulations to require the use of telemetry for water consents. The requirement would be rolled out over time, starting with consents of 20 litres per second or more two years after the regulations come into force, with the new requirements applying after six years for smaller consents.

FISH PASSAGE

There are existing voluntary guidelines for planning and designing new structures, and providing fish passage and an online assessment tool developed by the NZ Fish Passage Advisory Group, available on the Department of Conservation website.

The government is proposing that regional councils would be required to provide for fish passage in line with these guidelines in plans and consents. Some types of new structures less than four metres high including weirs, culverts and tide flap gates would be required to meet minimum design standards in the guidelines. Councils may also be required to identify existing structures which must be upgraded to meet the guidelines and prioritise their upgrading.

WINTER GRAZING

The government is proposing that winter grazing would only be allowed if farmers meet new standards. Two options are proposed for the new standards – either nationally-set standards which require that farms have a resource consent or the current industry-set standards.

Farmers would have six months to comply with the new standards after the regulations take effect.

OTHER CHANGES

Other changes proposed are:

- requiring all farms to have a farm plan with a freshwater module which covers how contaminant losses, and risks to threatened and wildlife species would be mitigated
- introducing more stringent stock exclusion rules. This would include wider setbacks from waterways, and fencing or control of stock for waterways under a metre wide
- introducing new controls on feedlots.

Continued Over

REACTION FROM SCIENTISTS

"The proposed regulation of some farm practices such as fencing and grazing of winter forage crops goes some way towards correcting what was missing in existing policy documents," says Professor Richard McDowell, chief scientist, Our Land and Water.

"We will have to see the result of consultation and assessments of what's practical to see if they go further. For example, we know the majority (77%) of contaminant loads come from small streams, but fencing them off may not be the most practical nor sensible when other mitigations in headwaters are probably more cost-effective. We also know that 10% of a farm in winter forage cropping contributes 30–40% of the nutrient load, but suspect that this proportion may be greater if winter forage cropping is practiced on floodplains."

"It's encouraging to see regulation will be implemented (in part) through a mapped farm environment plan, while taking action across a whole catchment. We know that identifying critical source areas on a farm and targeting them with practices to mitigate contaminant loss is much (six to seven times) more cost-effective than an untargeted approach. We've also recently calculated that if all known mitigations are implemented nationally by 2035, we will reduce nutrient and sediment losses by 30% to 60%."

"New Zealand has some persistent problems with water quality and ecosystem health in freshwater environments. These are wicked problems in the sense that they have multiple causes, occur in complex and dynamic environments and involve trade-offs between ecological, social, cultural and economic values," says Dr Scott Larned, Chief scientist freshwater, NIWA.

"Reducing contaminant concentrations will require changes in land use practices. However, several challenges must be addressed before we can specify the land-use changes required with certainty. One of the challenges concerns gaps in our knowledge of land-use effects. These gaps are acknowledged in the Essential Freshwater package, along with the need to improve understanding through targeted science investments.

"A closely related challenge concerns long time-lags between land-use activities and adverse effects in freshwater ecosystems. In many catchments, contaminants generated by land use move through groundwater for decades before reaching rivers and lakes where their effects are observed. In these cases, the land-use regulations proposed in Essential Freshwater may have no detectable benefits for generations. This time-lag problem is recognised in Essential Freshwater through the adoption of Te Mana o te Wai as the water management framework," he adds.

Professor Rich McDowell sampling water quality. *(Photo: Dairy Farmer)*

Submissions on the consultation close on 17 October. To read more on the proposals and make a submission visit www.mfe.govt.nz

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A global perspective on the future of water for food

In late April over 450 people from across the world convened in Nebraska to attend the 2019 Water for Food Global Conference.

Dr Mark Rosegrant delivered a public lecture as part of the conference looking at the future of water management worldwide to provide a sustainable secure food supply.

Dr Rosegrant is a research fellow emeritus at the International Food Policy Research Institute. He is the author or editor of over 100 refereed papers in agricultural economics, water resources, and food policy analysis and has won numerous awards.

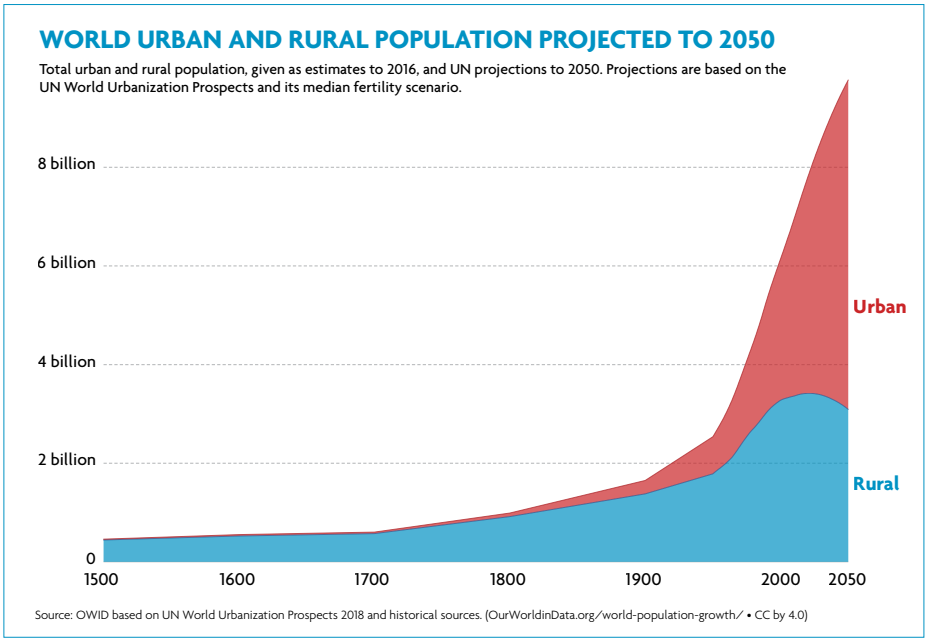
In the lecture, Dr Rosegrant highlighted that water security influences agricultural development and food security through multiple pathways:

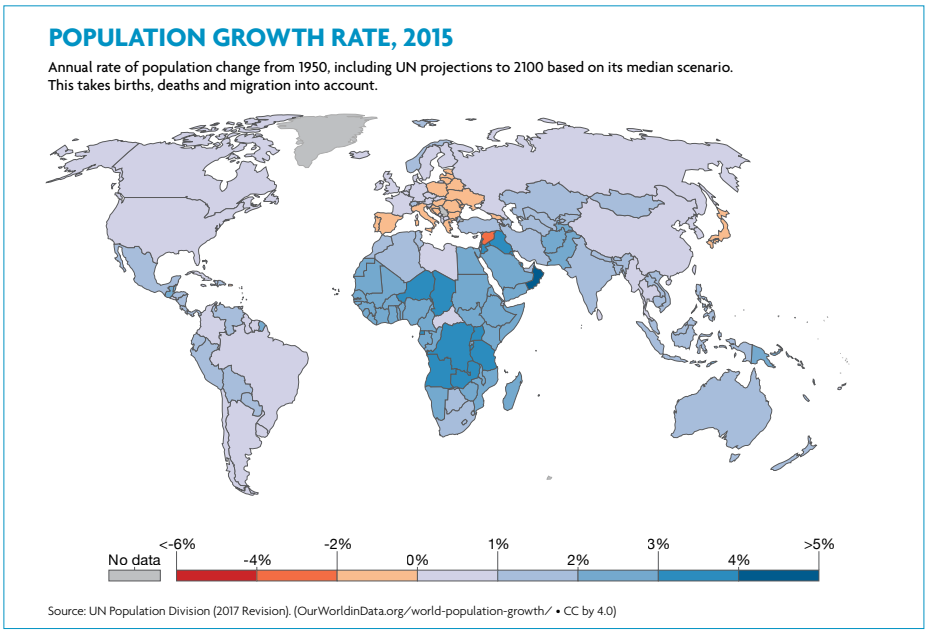
- it increases food production and farm income
- it reduces the risk of weather adversely affecting food production and farm incomes
- it enables higher food production and can reduce food prices for consumers
- it increases agricultural diversification and a more diverse diet
- it can enable improvements in the proximity and cleanliness of water sources which can create labour savings particularly for women, as well as health gains.

While hunger and undernourishment had declined worldwide since 2000, in the past few years this trend has reversed and undernourishment has worsened. In Asia the population is better nourished, while in Africa undernourishment has remained static or increased. Alongside this the number of overweight children has also grown.

Since 2010 there has been a change in where the world's population is living, with the number of people living in urban areas now exceeding those living in the countryside. For the next 30 years population growth will occur in urban centres while the world's rural population will decline slightly.

Much of the world's population growth will occur in Africa over this century. 2.5 billion more people are expected to be in Africa, with Asia the next fastest growing region with 430 million more people. In Europe the population is forecast to actually decline by 63 million.





As developing nation's incomes rise the demand for more expensive sources of protein like poultry, dairy and meat has been rising faster than for cheaper staple foods like grains. Cereal and grain demand is expected to rise by 37 percent by 2050 and demand for meat to rise by 66 percent in the same timeframe.

THE IMPACT OF WATER STRESS ON AGRICULTURE

"Water stress is increasing wordwide," Dr Rosegrant says.

"Currently about 36 percent of the world's population is in regions that are characterised as water-stressed. Almost 40 percent of grain production and 22 percent of GDP occurs in these regions. But if you take those numbers out to 2050 about half of the world's population and grain production will be in water-stressed areas and close to half of global GDP will be in these areas as well. Water stress is going to cause more and more problems in the future."

90 percent of the development of new irrigated land is expected to occur in developing countries and in many cases this will further stress water resources.

"Many of the best sites for irrigation have been used up, and many of the new sites are extremely expensive," said Dr Rosegrant.

New Zealand is one of the few areas not considered to be water-stressed. Other areas which are not considered to be water-stressed include much of South America and Central Africa, Canada, and most of Russia.

FUTURE WATER CHALLENGES

Future challenges for water policy at a global level will include:

- increasing costs to develop and deliver water – as more accessible water resources have already been developed
- resolving the wasteful use of already developed supplies encouraged by subsidies and distorted incentives
- the depletion of groundwater, water pollution and declining water quality
- climate change, extreme weather and increased variability in rain and river flows
- providing safe drinking water to the billions of people still without this
- overcoming barriers to financing irrigation and water development projects. These include financial risks and uncertainty about the impacts of climate change and a number of other issues.

STRATEGIES TO ADDRESS WATER SCARCITY AND FOOD SECURITY

Dr Rosegrant outlined a number of recommendations to address water scarcity and provide food security.

Countries should establish strong, well-defined water and land rights. And they should look at using water allocation models which cap water availability and provide farmers with an equitable share of the available water allocation each year and also create incentives for efficient water use.

New irrigation and other technology should be adopted, for example through using sensory tools or developing better tracking tools throughout the life of a product to help reduce food wastage.

Governments should eliminate generalised subsidies and instead invest in agricultural and water research and development, income support for small farmers where needed and only provide subsidies to achieve specific water management goals. They should also improve water governance arrangements and improve the capacity of those making decisions as well as tools for water planning and monitoring.

Increased investment in irrigation ($8-12 billion US per year) would be needed to support a growing population worldwide, with considerably more investment also needed in drinking water and sanitation infrastructure.

Dr Rosegrant saw limited potential to expand non-traditional sources of food and water – for example through recycling water from 'cleaned' wastewater and using this for urban irrigation and for the increased use of desalination where it is cost effective.

"We're in a period now where, not just in the US and but in other areas, higher trade barriers are being erected and that's going to cause significant problems for food security in the future," said Dr Rosegrant.

"We really need to support open trading regimes that will share climate risk and promote the effective use of virtual water – the water embedded in food. This is going to be increasingly important as climate change increases the reliance of many developing countries on food imports."

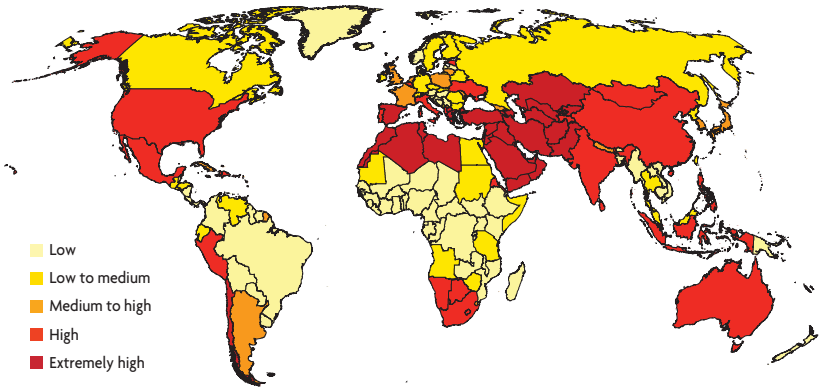
Dr Rosegrant says that projections show that parts of Africa and South Asia will require more imported food as demand will outstrip production growth in these areas.

"It's also going to be important to address

Dr Mark Rosegrant. *(Photo: www.flickr.com/photos/zimmcomm)*

WATER STRESS BY COUNTRY: 2040

Note: Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.



Source: World Resources institute (ow.ly/RiWop).

the short-term food shortages. We see more and more weather-induced production shocks globally. If trade is not there then those shocks are going to be transmitted directly to reduced consumption by the poor and harm to nutrition and health."

Schools and food retailers should aim to promote balanced diets for health and sustainability and consider food items which required less water to produce. However, people in developing countries will still need to have high quality protein sources like beef as part of their diet.

Investing in new irrigation development is a priority, particularly in Africa where much of the world's population growth will occur. Developing large scale irrigation projects has been challenging in Africa – due to the high cost, difficult terrain and lack of complementary rural infrastructure like rail, roads, and markets. Small-scale irrigation has more potential as it can be developed more quickly at a lower cost, and it can be more flexible for diverse farming systems and changing hydrology.

Growing tomatoes in Angola. Africa's growing population means more food production and irrigation development is needed in the region.

Whatever policies are developed to guide water management need to be region-specific and tailored to local conditions such as levels of development, relative water scarcity, the degree of water competition and climatic conditions. Dr Rosegrant says finding the right solutions are difficult and this takes time, political commitment and money.

Watch the lecture: you can view Dr Rosegrant's full lecture on www.YouTube.com, search for 'Heuermann Lecture Managing Water.'

New dam and pond regulations could impose additional costs on irrigators

In July and August, the Ministry of Business, Innovation, and Employment (MBIE) consulted on proposed new requirements for owners of dams or storage ponds.

IrrigationNZ has met with officials to discuss the proposal and gather more information about how they could work, and we have also been talking with irrigation schemes, farmers, and grower representatives. We are concerned that the proposed regulations cover small ponds and dams that virtually never present a practical risk of flooding events and could impose significant costs on the owners of dams and storage ponds.

The proposed regulations would apply to dams or ponds which are less than four metres high and hold 30,000 cubic metres or more, or are above four metres and hold 20,000 cubic metres or more.

This would result in a very large number farm storage ponds, effluent ponds, and irrigation races being captured by the legislation, even if they are on-plains where any spill would quickly become shallow water.

For owners of dams that meet the above criteria, the minimum they would need to do would be commission a recognised engineer to undertake a Potential Impact Assessment on the dam or pond. This is estimated to cost around $5,000.

If the engineer considered the impact assessment of a dam/pond failure was medium or high then an expensive dam safety assurance programme and annual audit would be required.

The proposed assessment criteria for dams are a concern because they could result in a bias toward higher potential impact classifications than are practically justified. Even for quite modest sized ponds, the costs of preparing a dam safety assurance programme could range from $6,000 to $30,000 with an annual audit cost of around $5,000.

We know from our member schemes and individual irrigators that many irrigators will be affected by the proposals, and farmers who have effluent ponds or flood capture dams could also be caught by the new regulations.

For example, on the MHV Water scheme, 144 storage ponds would be classified as a "large" dam under the new regulations.

IrrigationNZ's concerns about the proposed regulations have been covered in media stories by RadioNZ, The Country, Canterbury Farming and Southern Rural Life.

INZ'S SUBMISSION

IrrigationNZ said in our submission that the proposed regulations do not adequately consider and provide for the wide range of water infrastructure storage facilities captured by the framework, and in particular smaller, on-plains water storage ponds and irrigation races. IrrigationNZ has offered to gather more information on dams to better inform MBIE. There is no complete list of how many dams and ponds would be affected by the new regulations.

We submitted that two categories of dams should be included in the regulations – referable and classifiable dams. These categories were used in previous government consultation on dam regulations but the referable category was later dropped. Referable dams were previously classified as smaller dams with less compliance requirements – including that they do not require a dam safety assurance programme.

We would like to see dams which are under four metres and hold less than 100,000 cubic metres being treated as referable dams which are not subject to the potential impact of failure classification (PIC) process.

Many storage facilities are on-plains ponds and a significant amount of their water is stored below ground and doesn't pose a risk of escaping, even if the facility were to be damaged. IrrigationNZ submitted that the regulations on what is a large dam should only consider the volume of water that is held back by any embankment and not include water that is below ground level.

IrrigationNZ has significant reservations about the same assessment methodology developed to assess the potential impact of failure classification of large dams being applied to small dams, without considering that if a smaller dam or pond fails there is substantially less risk to people, property and the environment associated with this.

Our submission also highlighted that there are particular problems associated with applying the new regulations to canals which need to be worked through and a more appropriate framework developed to apply specifically to races and canals.

We are concerned that the timeframe proposed for dam owners to commission Recognised Engineers to undertake a potential impact assessment of failure on dams is too short, given that there are a limited number of experienced dam engineers that qualify as Recognised Engineers. IrrigationNZ submitted that a longer timeframe be adopted for assessments to be completed of between one and three years from when regulations take effect. Larger capacity dams should also be required to have assessments completed earlier than small dams.

Submissions on the new regulations closed in August. IrrigationNZ has requested the opportunity to speak to MBIE about our submission.

Can irrigators help control the cost of electricity?

A research project is underway in the Ashburton district to involve irrigators in work to try and reduce electricity costs for the district.

Ashburton has a different power user profile to most regions. Irrigation is widely used in the district and this means that EA Networks – the local power distribution company – experiences a peak in power demand in the height of summer, while most other regions have a winter power demand peak.

Nationally, Transpower – the organisation which owns and operates the National Grid – passes the cost of operating the network on to electricity distribution companies who then pass it on to consumers. A large portion of the cost passed on to consumers is based on power usage during peak demand periods (measured in thirty-minute intervals).

In Ashburton, demand for power for irrigation is highly seasonal depending on weather conditions. This charge is recovered from power users through a network charge on a retail power account.

In a wet summer where there is less need for irrigation, the peak usage periods tend to be in winter and the district could be required to pay a few million to Transpower in network charges. In contrast, when summers are dry and there is a lot of irrigation needed, the peaks occur in summer and the costs to the district can be above ten million dollars.

So, in 2018, the Ashburton district paid around $4 million to Transpower, while in 2019 it is paying $14.5 million. The huge variation in costs is a problem for both irrigators and for other power users in the district who all face large increases in electricity costs in some years to recover these costs.

This variability means that an irrigator operating in the district can face network charges from about $13,000 (per 100kW) one year to over $25,000 in a dry year. Electricity costs based on actual power are charged in addition to the network charge.

Dr Val Snow of AgResearch is leading a joint project with EA Networks which aims to look at ways irrigators can continue to operate, while reducing the potential for high Transpower charges to be incurred.

"The project will enable EA Networks to engage with customers to find solutions that work for them. Creating new products can only be done by understanding customer impacts and designing around those. Ideally through the work we can find a solution that works for irrigators by providing useable options that reduce the impact and cost of peak demand. If we can change the demand profile of our district it can limit or defer the need for costly new investment," says Jeremy Adamson, EA Networks Commercial Manager.

Part of the project involves analysing data EA Networks holds to identify when peak demand occurs. These data, along with information gathered from farmer workshops, is also being assessed to consider how much ability farmers have to change the timing of when they irrigate to avoid using power during peak demand periods in summer.

Dr Snow says that the existing data show that the highest demand on the network as a whole is typically between 8am and 8pm – and particularly between noon and 6pm – while irrigation power usage varied during the day and peaked from mid-afternoon to the early hours of the morning. More work is being carried out as part of the project to better forecast the times when demand for power is highest.

"Currently from our analysis of power usage data it looks like many farmers do have some flexibility to avoid irrigating for a couple of hours per day in high demand periods – for example by extending their irrigation which usually runs late at night to run on into the early morning hours rather than irrigating in the afternoons," she says.

This analysis will look at information like historical and forecast rainfall, temperature and factors which affect both irrigation demand and domestic and industrial power use.

"We have also been talking to farmers in workshops about what factors limit their ability to stop irrigating – for example whether they can easily turn off their irrigation system through automation, whether they can afford not to irrigate or if they have consent requirements which limit their ability to change their irrigation schedule," she says.

EA Networks trialled an opt in text message system for irrigators last summer where irrigators were notified when peak demand times were forecast so that they could voluntarily reduce demand.

Dr Snow says that the initial aim of the

project is carry out more analysis to better predict when a summer peak demand period will occur. From this a more sophisticated system can be designed where irrigators can voluntarily opt in to being notified of when they should reduce their power usage.

EA Networks says that the focus group workshops that are part of the research are designed to help irrigators identify solutions to reduce peak demand times and see if those ideas are workable.

Those options could include incentives or reduced power pricing to encourage farmers to change the timing of their irrigation, or other options.

If the district manages to avoid incurring any charges from Transpower by reducing peak demand periods, irrigators would also benefit by saving up to $12,000 per year in network charges related to peak demand.

The longer-term aim of the project is to determine if technology could be used to avoid incurring peak summer demand periods in the district.

One option being considered for this is to use a form of ripple control.

Ripple control is already commonly used by electricity distributers to automatically switch off hot water cylinders for up to four hours when peak demand is being experienced.

Dr Snow says that the project will look at the issues around using a form of ripple control technology and applying it to irrigators, as well as other options.

However, she says that there are a lot of complexities around using the technology on irrigators as not all systems will be able to be switched off remotely. The effects on irrigators and their farming systems will need to be considered and worked through so as to avoid the new technology being disruptive for farmers.

Ashburton often has summer electricity use peaks which increase network charges for power consumers.

Unlocking the secrets of growing great blackcurrants in South Canterbury

A combination of sunshine, an ideal climate and careful water use has created the perfect growing conditions for producing New Zealand's best-known blackcurrant delicacies.

In October, Barker's will celebrate its fiftieth birthday. The company is proud to continue a long tradition of using high quality locally grown ingredients to make products that taste like home.

"Barker's stands for great food, made with genuine care for people, communities and the environment," says Nicky Donkers, Barker's Corporate Commercial Director.

"We believe, in an ideal world, everyone would have the time and space to grow their own fruit and vegetables and make their own food from scratch. But we recognise for many this is not achievable so it's our duty to deliver a best-in-class range of healthy, trusted, convenient foods which are as close as possible to home-made, so Kiwis don't need to compromise on health or taste," says Nicky.

Barker's was started by Anthony Barker, who in 1969 began picking the wild elderberries on his farm to create traditional country wines. Gooseberry, strawberry, blackcurrant, apricot and raspberry wines, aperitifs and liqueurs followed. In 1981 the family created their first non-alcoholic drink – Barker's Blackcurrant.

Since that time Barker's product range has expanded as the company continued to grow. In 2015, the company sold part of the business to family-owned French company Andros, with Michael Barker and two senior managers retaining a shareholding in the business.

Barker's now has around 200 different products which are sold through supermarkets and distributors in New Zealand and Australia. More than 10,000 tonnes of products are processed annually by Barker's in Geraldine.

MANAGING A DIVERSE RANGE OF CROPS ON FARM

Hamish McFarlane is one of Barker's key blackcurrant suppliers in Mid and South Canterbury. Hamish is carrying on a family tradition, as his father started supplying fruit to Barker's in 1981.

About 100 hectares of his 550-hectare farm is planted in blackcurrants. He also grows potatoes, carrots, raspberries, cereals, grass and vegetable seeds, forage crops, plus cattle and sheep.

Hamish McFarlane. *(Photo: Rural News)*

Hamish says the climate in South Canterbury is ideal for growing blackcurrants. Scientists are continuing their research to understand why New Zealand grown blackcurrants contain some of the highest levels of anthocyanins (a group of antioxidants – the purple/red pigments) in the world. The specific climate they are grown in may be part of the secret as plants produce anthocyanins as a protective mechanism against environmental stressors, such as ultraviolet light, cold temperatures, and drought.

Anthocyanins have numerous health benefits. Studies have found that consuming anthocyanin-rich foods can help with asthma, eye health, recovery and performance, and can help protect people from heart disease. They are a natural functional powerhouse.

Hamish says part of the reason he likes growing blackcurrants is because of their low environmental footprint, and low fertiliser needs.

Blackcurrants are planted in winter from cuttings. They produce their first crop two and half years later and can keep producing for up to 15 years.

The farm is currently growing six main blackcurrant varieties and these all have slightly different flavours and harvesting dates. This allows the harvest to be spread across six weeks during January and February.

On the farm they use dripline, pivot, and gun irrigation to provide water to their blackcurrants and other crops.

With the farm producing such a wide variety of food – from fruit and vegetables to cereals, grass and vegetable seeds, forage crops, and grazing cattle and sheep – is it easy to manage all the different activities on the farm?

"Every crop has its own challenges," Hamish says. "They have different timings, nutritional needs, diseases and risks. While having a wide range of crops adds some challenges it does help spread our income and growing risks around."

IRRIGATION AND ENVIRONMENTAL MANAGEMENT

Hamish uses a combination of neutron probes, real time telemetric probes and in the field observation like digging to monitor soil conditions and decide when to irrigate.

He says that his team tries to take account of the weather forecast, crop rotations and the stage the crop or pasture is at to decide when and how to irrigate. Alongside this he looks at what production they need from the paddock at that time of year.

When making irrigation decisions, Hamish says that often it is a case of making the right economic call for the crop.

All of the actions on the farm are carried

out with a view to minimise or avoid detrimental environmental effects. This includes managing effects that are not included in their farm environment plan.

"Generally farming businesses rely on achieving the highest output for the lowest input to make a profit, so we try to minimise diesel, time, water, fertiliser and packaging on an ongoing basis," says Hamish.

"All fertiliser is applied via GPS control which has resulted in a significant saving in the amount we apply each year."

Where possible, Hamish tries to incorporate crop residue back into the soil and still runs a mixed livestock system which works well on their soils.

He is also progressing planting plans to improve biodiversity and provide shelter.

"We have found that generally, if we have an adverse environmental effect, we also have a poor performance result," Hamish adds.

COMMUNITY AND ENVIRONMENT GUIDE BARKER'S BUSINESS PHILOSOPHY

Responsible environmental management is also important to Barker's approach to business.

"Most farmers are doing an amazing job caring for the land, wanting to leave it in great shape for the next generation. We want to make sure we're working with responsible partners when it comes to growing fruit because our brand is at stake as well," says Nicky Donkers.

Barker's is part of the Waihi and Te Moana catchment group which brings together landowners, farmers and Environment Canterbury to improve water quality and biodiversity and support the implementation of good management practices.

They have also joined the Sustainable Business Network and are part of a group of South Canterbury manufacturers who are collaborating with researchers from the University of Canterbury to find solutions for sustainable waste and by-product management. Barker's introduced new pallet wrapping equipment last year at their Winchester warehouse which has reduced the amount of plastic wrap used by over 50 percent.

Recently Barker's partnered with IrrigationNZ and Heartland Chips, to put on an interactive display that went to the Ashburton A&P Show (where it won an award for the best small trade site), the New Zealand Agricultural Show in Christchurch and the Wanaka Show.

The display illustrated how New Zealand was water rich and how water underpins a wide range of food production.

"People may not realise that water is an important contributor to growing great food. It's one component, along with location, great natural light and sunshine, and general care. People see our products on the shelf or consume them in a cafe but may not be aware of where some of them originated so let's trace it back to where it all begins," Nicky says.

Careful water management is very much part of Hamish's role not only in his day to day responsibilities on farm but also in his role as the Chair of the Orari Temuka Opihi Pareora Zone Committee, where the committee is required to take a long-term view to protect water resources for future generations.

Looking to the future Barker's wants to stay based in Geraldine and focus on providing customers with great tasting products they can trust, while continuing to innovate and grow.

Barker's were part of IrrigationNZ displays at recent agricultural shows.

Barker's has many long-serving employees on their staff, with over 28 staff on their team who have worked there for over 15 years.

"We have developed a good reputation as a good place to work. We have always fostered a family culture and a culture of mutual respect, but we still have more to do," says Nicky.

As part of a new corporate communications role that has been established Barker's have developed a charitable fund to help support local not-for-profit groups, further strengthening their relationship with their local community.

While preparing for its fiftieth celebration, Barker's also celebrated receiving gold and silver awards at the 2019 Outstanding NZ Food Producer Awards and this month is opening a new foodstore and eatery in Geraldine. The new complex is located across the road from its current retail store.

Barker's relationship with the French company Andros will form an important part of their business plan going forward, as they expand into more international markets.

To find out more about Barker's, their new Geraldine eatery and foodstore, and their products visit www.barkersfoodstore.nz and www.barkers.co.nz

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8/19

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New electric trout barrier installed to protect mudfish

A new solar-powered electric trout barrier, designed to protect mudfish, is the first of its kind to be installed in the Southern hemisphere.

The Canterbury Mudfish is the most threatened of all New Zealand's mudfish species, with a 'Nationally Critical' conservation status.

The electromagnetic fish barrier technology was designed by US company Smith-Root.

The new barrier will allow the mudfish to expand into the lower reaches of the site and stop predation by trout – increasing spring-fed stream habitat for the mudfish from 880m^2 to 8,000m^2 in the Selwyn Waihora catchment. This technology could revolutionise native fish conservation at sites threatened by trout across the region.

The trial is taking place at Haldon Pasture Springs, located between the Waikirikiri/Selwyn River and the Hororata River.

Environment Canterbury is operating the Haldon Pastures barrier as an experimental pilot development to study and research predator exclusion, population monitoring, and to experiment with innovative technologies to protect mudfish.

"This particular mudfish population has been able to get through the last three years of drought and it bounced back in the past year, which was much wetter," says Selwyn Waihora Zone Delivery Lead Johannes Welsch.

Johannes says that Haldon Pasture Springs is one of the best habitats, and spring/stream systems, we have left in Selwyn, with almost no impact or modification by agriculture. It is also mostly willow and weed free.

The innovative pilot project has involved a wide range of organisations and has received funding from Fonterra's sustainable catchments programme.

"This idea has been germinating for over five years, so it is fantastic to see it progress due to the committed landowners and the support of many organisations," says Department of Conservation Senior Ranger Anita Spencer. "If successful, it will lead to a much larger secure area for mudfish and be a significant milestone in mudfish conservation."

Mudfish are known to bury themselves into the ground when streams and springs dry up and can hide deep in the mud, surviving for up to three months. They are typically found in still or very slow-flowing, meandering streams with deep pools and associated wetlands or spring-fed streams. The mudfish population is affected by predation from introduced exotic trout that eat mudfish in areas where they both live. Common barrier solutions to keep trout out of a stream system require a significant slope degree (not evident at this site).

The barrier is 100 percent powered by solar electricity. A solar panel array, designed and installed by Frizzell Agricultural Electronics, charges a battery bank that provides power to the electrical barrier.

The opening of the new solar powered electric trout barrier.
(Photos: Environment Canterbury)

IRRIGATION NZ
CONFERENCE AND EXPO

WATER FOR LIFE
7–9 April 2020, Christchurch

Water is essential to people, communities, ecosystems & our cultural wellbeing.

IrrigationNZ is using its biennial conference to lead the conversation on the future of water for Aotearoa.

We understand how important reliable water is for a strong economy and strong rural communities. How we will all manage and steward this precious community resource in the future – with all the uncertainties that we are now experiencing – will be critical to ensuring New Zealand maintains its place on the world stage as farming innovators and leaders.

The Water for Life conference will be held in Christchurch from the 7-9 April 2020 and will bring together thought leaders and decision-makers from across the irrigation and the wider water sector. Themes will include the importance of multi-benefit water infrastructure, the use of technology for enhanced decision-making, the future of farming, and water policy developments.

We will have a thought-provoking range of speakers, as well as a panel discussion, break-out sessions, a trade exhibition, pre-conference tours, gala awards dinner, networking breakfast, and a welcome drinks function.

IrrigationNZ's conference always attracts a wide range of people with an interest in water management and this year will be no different. We encourage attendance from farmers, the irrigation service sector, those with an interest in water and the environment, regional and district council staff, government representatives, and water management professionals.

Elizabeth Soal, CEO IrrigationNZ

YOU SHOULD ATTEND IF YOU:

- Want to be a part of the conversation around the future of water in Aotearoa New Zealand
- Care about how our water resources are managed and governed
- Want to know more about how water will help New Zealand lead sustainable and innovative farming practices
- Are excited about how technology can help us use water more effectively and productively

Registrations open in October, so mark it in your diary now.
We look forward to seeing you there!

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WATER FOR LIFE
CONFERENCE
AND EXPO

Conference Sponsorship

We still have sponsorship opportunities available for organisations wishing to maximise their involvement with the conference and elevate their profile in the irrigation sector.

Depending on your company goals and budget, we have a range of sponsorship packages available for you to choose from. You can find more details on these packages and the benefits associated with the varying levels of sponsorship here: **www.waterforlife.kiwi**

We are open to further discussions on how we can best adapt these packages to more closely align with your marketing objectives. Please do get in touch with Jules to explore potential partnerships moving forward.

Contact
Email: jules@beckandcaul.co.nz
Number: 027 739 1832

Conference Exhibition

Alongside the packed Conference programme, we will also welcome back our fantastic Conference Expo. A must visit area for delegates, and a draw card to many locals who can't make the whole Conference, the Expo spots always sell out quickly.

Offering a high traffic area, delegates will continually visit the area throughout the day for refreshments. Attendance will be promoted to a wider audience in the area, beyond conference delegates, with an interest in relevant industries and products. The Expo offers you the chance to showcase your wares amongst an interested and diverse audience, communicating directly with them and building valuable relationships. To avoid disappointment, book your site now by contacting **jules@beckandcaul.co.nz.**

Conference Registration

Registration for the 2020 Conference & Expo will open in October. Whether you are a farmer in the irrigation service sector, have an interest in water and the environment, a member of regional and district council staff, a government representative, or water management professional, attendance is essential if you want to be a part of the conversation on the future of water.

Two days of stimulating conference sessions will allow for the dissemination of information from leading national and international speakers and open the floor for debate. The Conference will be supported by a pre-conference tour, welcome function, delegate breakfast, conference dinner and the Conference Expo.

Make sure you register early for early bird rates and to lock in your position to join the conversation.

Conference Accommodation

As the South Island's largest city, known as the 'garden city', Christchurch offers a picturesque hub bustling with innovative businesses and forward thinkers. After hardship in recent years, Christchurch now offers a place of transformation – change and innovation have been embraced, a strong economy prospers, and the future is bright for all those who call Christchurch home.

Christchurch's history is rooted in a significant cultural relevance to Ngāi Tahu. Ancestors treasured the area for its abundance of natural resources and began to call the area home. In recent years, after works to repair the city after damage from the earthquakes, Ngāi Tahu have woven Māori heritage back through the city's architectural landscape – with the shared history of Christchurch clear to see. The Conference has secured block bookings in many hotels in Christchurch for the duration of the Conference. We will provide a list of partner hotels and discount codes nearer the time. If you have any queries regarding this, please email jane@beckandcaul.co.nz.

WATER FOR LIFE
CONFERENCE AND EXPO

Innovation Awards

ENTRIES OPEN

One of the highlights of the Conference is our prestigious Innovation Awards, an accolade awarded to 'the best innovation, discovery, or achievement that makes a positive contribution, impact, or benefit to irrigation in New Zealand.' Celebrated at the Conference dinner, with a $2,500 prize, this award celebrates, encourages, and promotes the positive things irrigation brings to our communities. Our sector does extraordinary things on farms, in schemes, in business, and in the service sector. To ensure you don't miss out on the opportunity for your achievements to be recognised by your peers, take a look at our key dates below:

- **1 September - Entries & Nominations Open**
- **11 October - Nominations Close**
- **1 November - Entries Close**
- **7 November - Judging Commences**
- **8 April - Announcement of Winner & Presentation of Award at INZ Conference Dinner**

WONDERING WHETHER YOU SHOULD ENTER?

Take a look at previous winners and finalists on www.irrigationnz.co.nz and review our eligibility criteria below:

- The prize can be awarded to an individual or team. Only one entry is permitted per person / team
- We encourage entries and nominations from irrigators, schemes, user groups, environmental groups, industry, and university students
- The innovation may be new or a reinvention or reapplication of an old technology
- The innovation must demonstrate a clear, recent (last 5 years) or potential impact to irrigation in New Zealand
- The individual or nominated team representative must be either a New Zealand citizen or a permanent resident
- For team entries, one person must be nominated as the team representative. This person will be the public face for the innovation
- The winning entrant will be expected to attend the Conference Dinner, receive the award at the INZ Conference Dinner and speak with media
- The innovation must meet current ethical practice and have been carried out largely in New Zealand

SELECTION CRITERIA

The merit of each entry will be assessed by a judging panel and will be based on 'Innovation in Irrigation'. This is the potential for the new knowledge to have a positive impact on irrigation through technology development or in a manner that will enhance the economic, social, cultural or environmental aspects of irrigation.

Further information can be found at the below link, or by contacting **Eleonore Dumaine** at **edumaine@irrigationnz.co.nz.**

www.irrigationnz.co.nz/EventsAndTraining

For more information about sponsorship opportunities please contact:
Julie Lee, Conference Manager, Irrigation New Zealand
m. 027 739 1832 e. jules@beckandcaul.co.nz

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A Marlborough vineyard in the autumn of 2018. The following season was a more challenging one for winegrowers.

Dam – not enough water

By Tessa Nicholson.

The summer of 2019 is not the first time Marlborough has suffered from a big dry. There have been many others, but this year, the effect of no rain for weeks on end was perhaps more strongly felt among grape growers in the region.

When talking to winemakers and viti-culturists, it became apparent that Sauvignon Blanc fruit from areas that were hardest hit by a lack of water supply, suffered. Yields were lower than in previous years, thiols were below averages expected and acidity levels were also lower.

From late December until the end of February, rainfall was a mere 12.8mm. January's rainfall of 3.8mm was only eight percent of the long-term-average (LTA). February's of eight mms was 16 percent of the LTA. Add to that the high temperatures and the evapotranspiration, and shallow soil moisture was under pressure. In February alone, soil moisture in the 5-35cm depth at Grovetown Park was 13.9 percent, the lowest recorded for February in 17 years.

The impact of the hot summer saw river levels fall below the 8m^3/s cutoff level for irrigation supply – on February 1. This is not unusual in Marlborough – there are a number of years in recent history that the consents are shut off in the month of February. However, it was the length of the shut off that was of concern to many growers.

Val Wadsworth, Marlborough District Council Environmental Scientist – Hydrology, said the shutoff continued through until 8 March, with a one day respite on 26 February. Five weeks in total. The river was again shut-off for another four days in March.

There are close to 135 consents to take water from the Wairau River – the largest being the Southern Valleys Irrigation Scheme (SVIS). This scheme, commissioned in 2004, provides water to horticultural, farming and rural residential properties over an area of approximately 4,500 hectares. It's fair to say the majority of the 400 landowners who are members of the SVIS are using the water for grapes.

> "We cannot survive without irrigation and we need to invest in identifying and building a regional solution to securing, fit for purpose, sustainable water resources for Marlborough vineyards."

Some irrigators have groundwater consents which they were able to fall back on, when the river fell below 8m^3/s. But for many others, having no irrigation for five weeks meant they had to truck water in to keep the vines alive. At around $13 for every cubic metre, that is a costly exercise. But it is only a drop in the ocean compared to losing part or all of a crop that could be worth anywhere between $20,000 and $25,000 a hectare.

Back when the SVIS was first mooted there were discussions about building a large dam to supply members, during periods of no rain. The cost at the time was seen as prohibitive, and the idea was dropped. While some growers built their own small dams or storage ponds, there are thought to only be around 20 among SVIS members.

The Marlborough District Council (MDC) says there are currently 124 water storage facilities spread across the region. While 124 may sound like a lot, compare that figure with the 1060 individual vineyards in the region. It leaves a lot of vineyard blocks at the mercy of the river levels and mother nature supplying water when it is needed.

Glyn Walters, communications manager for the MDC says as far as they know, all 124 have been built for vineyard supply.

They range in size from 10,000 cubic metres to 1 million, with the average dam being between 20,000 and 70,000 cubic metres. Walters says they are spread throughout the region, in all the main grape growing areas, from the Wairau Valley, through to the Awatere and Blind River.

It was mentioned by Steve Smith MW at the recent Sauvignon Blanc Celebration, that water was likely to become a major issue for the Marlborough region.

"We cannot survive without irrigation and we need to invest in identifying and building a regional solution to securing, fit for purpose, sustainable water resources for Marlborough vineyards." His comment was timely, given it was made on day one of the SVIS being switched off. Smith couldn't have known that the shut off would last for five weeks, or that the impact would be so greatly felt through-out the region's vineyards. But securing a secure water source for the future makes financial sense.

"This may seem like an overly ambitious and expensive project, but when you have more than five billion dollars invested in the vineyards of Marlborough, it proves prudent and necessary."

I doubt there is a grower in the Wairau and Waihopai Valleys who wouldn't agree.

Republished with permission from NZ Winegrower, Issue 116.

Synchronising food production can have disastrous effects

By Zia Mehrabi, Research Associate, University of British Columbia and Navin Ramankutty, Professor, University of British Columbia.

Crop failures are an important cause of food price spikes, conflict and food insecurity. The likelihood of local crop failures being catastrophic at the global level is exacerbated when they happen at the same time — that is, when our agricultural systems become more synchronised.

In a paper in *Nature Ecology and Evolution*, we show that while some crops such as maize and soybean have become less synchronised in recent decades (a seemingly good news story), the synchronisation of production between crops increased overall. This has, in turn, destabilised our total global calorie supply.

Our analysis calls for governments to think about ways agricultural policies on trade, land reform, farm distributions, and cropping choice, may affect the stability of the food system as a whole, beyond locally focused efforts to increase resilience in production.

SYNCHRONY IS BAD NEWS

Sometimes it's amazing to watch things move in synchrony. Like in synchronised swimming, or in a dance routine, or when an orchestra plays in concert. In nature, synchrony can be incredible to watch, like when starlings move together in a murmuration, or when large numbers of fish school. While most of the time synchrony can be an awesome spectacle, when it comes to agriculture it is bad news.

In our analysis, we found that many of the largest global crop failures on record were marked by increases in synchrony. Examples include: when maize production dipped by 20 percent in 1983, soybean production dipped by 14 percent in 1976 and rice production dipped by eight percent in 2002.

While these relationships may seem intuitive, our research quantified the degree to which things became synchronised under the historical record. Moreover, we also found that when production became more unstable globally, it didn't necessarily arise from agricultural systems becoming more unstable locally. That is, local production sometimes became more stable, but global instability continued to rise (notably for soybean between 1961–68, and rice between 1969–76) — because synchrony increased.

POSSIBLE SOLUTIONS

There are essentially two ways we might mitigate the losses brought by synchronous failure of crop production: either raise average production of crops or reduce the volatility in crop production locally. Raising average production can be done, for example, through yield gap closure, or yield ceiling raising. Reducing the volatility in local crop production can be done, for example, through implementing climate smart cropping systems or developing technological infrastructures such as irrigation to resist environmental stressors.

We explored the extent to which these mitigation strategies might help offset the risk of a complete synchronised failure event. Remarkably, we found that we'd need to raise average production of breadbaskets by three to five times to counter the losses, and that closing yield gaps in places with low production was unlikely to work at all within any sensible ranges.

Moreover, we found that even if we reduced the variation in production locally everywhere on the planet, we'd need to do it by a factor of 10. That's a lot to ask from better irrigation and climate smart crops. In other words, while different mitigation strategies worked in different ways, the options for solving synchronised failure events seem quite limited.

OUTLOOK

The obvious thing to prevent major global crop failures would be to ensure different growing areas do not synchronise their production in the first place. But our current handle on the role of markets, climate and how much leverage humanity has on synchrony in food production is currently still very poor. Can we better design our food systems to be less synchronous? And what role do climate, market distortions, free flow of information on prices, trade, land reform, and changes in farm sizes, distributions, numbers, cropping choices, and crop diversity play?

Many of these are open and unanswered questions that our study was unable to answer. But there is one thing we can say: synchrony matters. Our study shows that if we care about stabilising the supply of food globally, then we need to start thinking about food systems as a whole, rather than in isolated parts.

Rice paddy, Kamo-shi, Niigata Prefecture, Japan. *(Photo: Yamakidoms, CC BY-SA 2.0)*

Is water trading an option for New Zealand?

The New Zealand Initiative recently released a report recommending New Zealand adopt the use of a cap and trade water management system which it sees as the best way to achieve the goals set out in the government's Essential Freshwater programme.

"New Zealand deserves far better freshwater management," says report author Dr Eric Crampton, Chief Economist with the Initiative.

"Aquifers need to be maintained, and rivers need to flow. Several reports on freshwater management have pointed to cap-and-trade regimes – versions of the Emissions Trading Scheme for river basins that are under pressure – as a promising way forward. But fear of sparking Treaty claims has blocked those solutions."

The report called *Refreshing Water: Valuing the Priceless* aims to recognise the interests of iwi and existing consent-holders and share the burden of achieving sustainability.

The report recommends that current consent-holders, including farms, industries, commercial users and councils, should have their existing consents converted into tradeable water permits. Crown negotiation with iwi would provide a tradeable water allocation and confirm kaitiakitanga (guardianship) over rivers.

Reductions in water use in overallocated places would come through a combination of time-limited rights and Crown buy-back of water rights through the trading system.

The report offers an alternative approach to the current system of allocating water rights which some describe as a first come, first served system.

REPORT RECOMMENDATIONS

1. Central government should take on the initial set-up costs for developing and implementing a tradeable water management system.
2. Initial catchment-level caps should not be lower than current use, and should incorporate room for allocation to iwi. The report suggests an initial trial in Canterbury.
3. Initial allocations to current consent-holders, whether agricultural, commercial, industrial or urban, can provide permanent tradeable rights, longer-term but non-renewable rights, or a bundle of non-renewable annual rights extending over the same period.
4. The burden of reductions from those initial caps to sustainable limits should be shared between water users and the broader community through a combination of Crown purchases and retirement of allocations, and by a structure of initial allocations that reduce the rights held by current users over time.
5. Sustainable catchment-level caps should be determined by the local community, iwi and hapū. They should be informed by strong environmental science, and by information revealed over time by the trading system.
6. Crown-iwi negotiations could define the minimum river flows consistent with Te Mana o te Wai as being the self-owning river, as in Whanganui, with similar trusteeship rights. The trading system would protect those minimum river flows. Additional water rights awarded to local iwi and hapū above that minimum flow could be left with the river, or traded.
7. Effective cap-and-trade systems require binding and environmentally meaningful caps. Those require effective monitoring and enforcement activity. Appropriate structure of the initial property rights can reduce enforcement costs.

We spoke with report author Dr Eric Crampton about his ideas on how water trading could work in New Zealand.

What are the benefits and disadvantages of water trading?

Trading helps make sure that water goes to the places where it is most valuable. So potential users locked-out by current first-in allocations in places with binding extraction limits could buy water rights without having to purchase consented land. This could facilitate beneficial land use changes. And it also would ensure that any reductions in total use in order to achieve environmental objectives could come at the lowest possible cost because water users who get the least value from the water they are using will be the first ones to sell water back into the system.

Many areas already have set extraction limits for rivers or groundwater. How would a cap and trade regime affect those limits?

Extraction limits help to define the caps in any cap-and-trade system. In places where water is so plentiful that nobody would ever consider extraction limits, there is little point in running a cap-and-trade system. It's in conditions where water is scarce that cap-and-trade really can help.

The Taylor River in Marlborough.

Dr Eric Crampton is the author of a new report recommending a water trading regime for New Zealand.

Your report mentioned trading operating at a catchment level. How would the catchment be defined and how would the trading system work where there are groundwater and surface water interactions? How does trading protect river flows?

One way of thinking about catchments is that they are places where there are flow-on effects of water use. If I draw water from my bore, it will affect everyone on the same aquifer, and may affect adjacent rivers. That area will be the catchment. The smart-market system developed by John Raffensperger and Mark Milke incorporates these effects very nicely. It sets a constraint on the system so that outflows from the aquifer cannot exceed inflows over the medium term – the aquifer has to be maintained at an appropriate level. It puts a constraint on minimum river flows, so that the combination of draws from adjacent aquifers and from the river itself do not pull river flows below those levels. And it sets a constraint requiring that aquifer pressure at sea level is sufficient to prevent salt-water incursion. The back-end hydrological modelling is built into the trading system.

Where water is over allocated what is the process to get allocations back to a sustainable level?

That's inherently a political question. I think the burden of reducing use to sustainable levels should be shared between current water users and the Crown. What each side's share should be – that's more contentious. But any system that would put all of that burden only onto existing users will have a much harder time encouraging participants to buy into the system in the first place.

How would water trading affect irrigation schemes who hold water consents?

Ideally, current consent holders would be provided tradeable rights in the trading scheme based on their historic water takes – using, say, a 2018 baseline to prevent people from just increasing use today in anticipation of a rights-allocation to come. Irrigation schemes with consents to draw water should receive tradeable rights in the cap-and-trade system.

In a well-functioning market, irrigation schemes with substantial storage capacity should be able to buy water through the system when it is cheap, and hold it to sell back into the system when water is scarce.

You suggest that a royalty payment would be associated with a water right. Would the royalty consent that holders pay just cover the cost of administering the system or would it cover the cost of buying back water rights in over allocated areas?

Again, that's inherently a political question. I think there is a good case for setting a fee on holding water permits to help fund the trading scheme. If you fund the trading scheme through fees on trading, you will distort the market and prevent some potentially valuable trades from taking place.

Going beyond that, you start getting into more complex dynamics. I'd suggested at the outset that any burden of getting to sustainable limits should be shared between Crown and water users in overallocated catchments. Imagine, for sake of argument, a catchment that was 25 percent overallocated. Cutting everyone's use by 20 percent would get you down to the cap. Suppose that you decided to share the burden equally between the Crown and current users. You could do that by giving current users rights equivalent to 90 percent of their current use, and having the Crown buy-back rights within the system equal to 10 percent of the initial overallocation.

I do not know whether an equal burden-sharing is the right answer, but take it as argument. You could get the same result, in terms of equity, by giving current users rights equivalent to 95 percent of their current use but encumbered with a royalty charge sufficient to fund the buy-back of 5 percent of the initial cap, and the Crown buying back the remaining amount. The burden is the same – it just has current owners taking a smaller lump on the initial allocation but a bigger lump on a royalty charge. You can build those to amount to the same thing. So the better question then would be what is the equitable overall distribution of the burden between the Crown and existing users, and how best can rights be structured to get there.

Where iwi settlements are in progress Māori landowners also want the ability to use water. How does this system take this into account?

Even absent iwi settlement, a cap-and-trade system would be highly beneficial for Māori landowners currently locked out of land conversion, whether to dairy or to horticulture or otherwise, by first-in allocations in catchments that are restricted. I would expect that, in some catchments, Crown negotiations with iwi may find iwi rights that had not been ceded by contract, Treaty or sale. In those cases, there would have to be an additional allocation to iwi at the outset.

Do you think developing a tradeable system would encourage certain types of land use or water use?

I expect that, in overallocated catchments, intensive use of sensitive land would be discouraged if there were a price on water. The places that take the most water to generate a return when water isn't directly priced would be the first places to sell water back into the system. Those will often be the places that are also most environmentally sensitive. So some dairying on marginal lands would convert back to less intensive pastoral uses – and the farmers there would profit by selling their water rights back into the system. But other places that have been stymied in converting to things like kiwifruit orchards or vineyards will be able to draw a lot more value out of every litre of water, and will be able to acquire those rights easily within the trading scheme.

Does water trading encourage or reward water storage in any way?

Of course! Filling reservoirs when water is cheap and selling water from storage when water is dear both alleviates water shortages and provides profit to those who invest in storage. If catchment-level price differences are high, it may be profitable to build water transport options across catchments. And futures prices of water along with price fluctuations for water can help to signal which investments will pan out.

The full *Refreshing Water: Valuing the Priceless* report and a summary can be read online at www.nzinitiative.org.nz

Waitangi Tribunal Report recommends overhaul of water management regime

A recent report by the Waitangi Tribunal has put forward some significant proposals for reforming freshwater management in New Zealand. The 588-page report on fresh water and geothermal management was issued in late August.

One of the key recommendations by the Tribunal is that Māori and the Crown should jointly manage water.

The report recommends that a national co-governance body should be established with 50/50 Crown-Māori representation. The body would be responsible for water policy, including water quality standards and national bottom lines. It would also consider if a separate Water Act is needed. The co-governance body should design and oversee a programme for restoration of freshwater bodies. It should also monitor the performance of local authorities in protecting freshwater and meeting their obligations.

The Tribunal supports joint management agreements for water bodies applying to the whole catchment of a water body, and including a leading role for iwi and hapū in developing, monitoring and enforcing water quality requirements.

The report also recommends that iwi and hapū must be directly involved in freshwater decision-making, and that Māori values, rights, and interests must be recognised and provided for in decisions.

The Tribunal recommended that the Resource Management Act be amended to include Te Mana o te Wai as a matter of national importance that must be recognised and provided for by Resource Management Act decision makers.

WATER QUALITY

The Tribunal recommends that the overall aim of the National Policy Statement (NPS) on Freshwater Management should be to improve water quality where it has been degraded in order to restore or protect the health of those water bodies.

The NPS should seek to strengthen protection of wetlands, aquifers, and estuaries, and include more effective controls for nutrients. More stringent rules should be developed to recognise and provide for Māori values (including Te Mana o te Wai).

The report also recommend that:

- National stock exclusion regulations should be developed urgently
- Fish habitat should be protected and restored to save threatened species
- Mahinga Kai values should be included in national freshwater objectives.

The Tribunal also recommend that the Crown provide funding and that, where possible, impose levies on commercial water users to fund the restoration of waterways.

WATER ALLOCATION

The report recommends that New Zealand's water allocation regime should be urgently reformed to recognise and provide for Te Mana o te Wai.

The first-in, first-served system of water allocation should be replaced, and over-allocation phased out.

The Tribunal wants to see the Māori-Crown co-governance body develop a new water allocation regime.

It also recommended that the Crown should arrange for an allocation of water on a percentage basis to iwi and hapū, according to a regional, catchment-based scheme to be devised by the national co-governance body in consultation with iwi and hapū. If catchment circumstances do not allow for an allocation to be made, the co-management body should hold an inquiry and look at possibilities to provide an allocation or develop other alternatives, including compensation.

The Crown should also arrange for an allocation of water for the development of Māori land.

The Tribunal also supported the idea of a test case being brought before the courts to decide whether native title in fresh water still exists.

Get ready for the irrigation season

September is the right time to check your equipment and irrigation schedules are up to scratch for the coming irrigation season.

Poorly operating irrigation systems cost time and water efficiency, not to mention the additional cost to production. Here are some simple actions you can take to ensure your irrigation season goes as smoothly as possible.

1. CHECK FOR LEAKS

Water not irrigating the right place is water wasted. This also applies to end gun settings and broken sprinklers.

2. GET YOUR CHECKLIST OUT

IrrigationNZ has a complete pre-season checklist for different irrigation systems you can use to check your systems are working correctly.

Checking pressure and flow is one part of the list which can be overlooked. This is generally affected by the wearing of pump impellers over time. Checking that your flow and pressures are within 10% of operating design is critical to application efficiency. The checklist covers a range of other points. You can print the checklist out, sign and date it and keep it as evidence for your Farm Environment Plan or farm records.

You can download a checklist online at www.irrigationnz.co.nz under 'Practical Resources' then 'Risk Advice/Start Up.'

3. DO A BUCKET TEST

This lets you know how much water you are applying and how even your application is. Knowing how much water you are applying is critical for irrigation scheduling. Improving the uniformity of application will result in more of your irrigation being used.

You can download a free 'Check-It Bucket Test' app from Google Play or the App Store.

4. CHECK THE TRACK

Take the time to walk the irrigator track to check its clear of any potential hazards or obstructions like trees or fences. This could save you money and avoid your irrigator being out of action.

5. INVEST IN SOIL MOISTURE MONITORING & WEATHER FORECASTS

An efficient irrigation system is only as good as the scheduling of the irrigation. Knowing when to irrigate and how much to apply will save both time (irrigation days throughout the season) and money (pumping costs per day). Linking soil moisture monitoring with weather forecasts will allow any rainfall during the irrigation season to be taken advantage of.

6. MAKE A PLAN

Now is the time to look at your seasonal plan. How will you cope if you get a dry season? Does you consent have adaptive management conditions? How would this affect your irrigation scheduling? Identify your higher production areas and your lower productions areas. Does your system have the capability to isolate areas of lower performance if the season gets tight and focus on irrigating your more productive areas?

7. UPSKILL YOUR STAFF

If you have any new staff on board you need to provide training so they understand how to correctly schedule and operate irrigation equipment to ensure you optimise water use, avoid damage to expensive equipment and meet your health and safety requirements. For details of training events IrrigationNZ is running this spring, see www.irrigationnz.co.nz/events

Building our understanding of rural resilience

A new book which draws together a decade of research from a team of academics and the views of rural New Zealanders provides new insights on rural resilience and the state of rural communities today.

Heartland Strong is the work of seventeen authors. The researchers are predominantly from AgResearch, with specialists from PwC, iwi leaders and international academics also contributing to the book.

The book summarises research from two programmes which have been running since 2007 called Rural Futures and Resilient Rural Communities (now part of the Our Land and Water Challenge).

Dr Robyn Dynes of AgResearch was one of the academics who had an oversight role in the Resilient Rural Communities programme.

"The aim of the project was to better understand what makes communities resilient," she explains.

The research was timely as the past 20 years have seen some rapid and significant changes affect New Zealand's regions.

Dairy farming has expanded, the amount of irrigated land has grown and more intensive farming models have created more demand for labour. As well as creating jobs for New Zealanders, this has also created more demand for immigrants to fill positions.

The number of organic farms has grown, new farming models and niche products have developed and many farms are now carrying out supplementary activities like tourism.

There has also been a trend for services to consolidate in larger centres while smaller centres have often seen government services, schools and businesses shut down. A number of larger towns – for example Ashburton and Timaru – have flourished by offering more services and have benefitted from the intensification of farming in the surrounding areas.

Meanwhile more regulation of farming has occurred – including health and safety requirements and environmental regulations.

New ownership models are also increasingly common – like corporate or syndicate models – as the rising price of land has made it more difficult for younger people to purchase farms without assistance.

The average age of farmers today is 58 years old and farm succession is now a major challenge for farming families.

As part of the Resilient Rural Communities project interviews were undertaken with rural communities in the North Island to understand how people living in those areas understood resilience and how resilient they considered their communities to be.

Communities were able to point to factors that made them resilient – such as good schools, close relationships, natural resources and Māori culture. They also identified different issues in their communities that made them less resilient – like businesses and government closing their offices, environmental issues and schools or clubs which were struggling to survive.

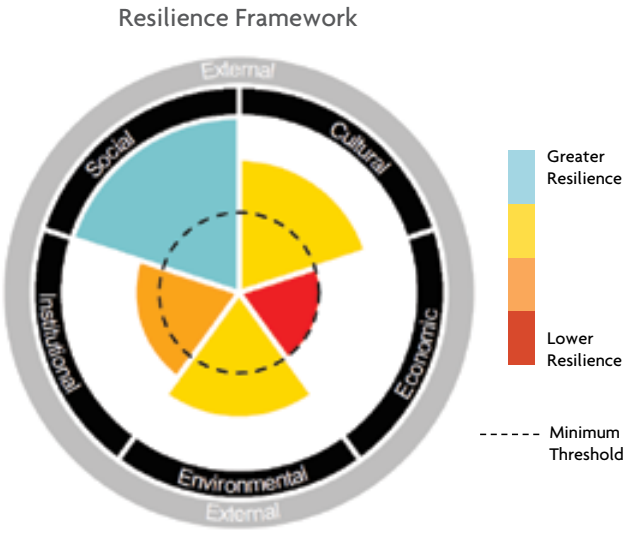
"That research found that communities viewed resilience as having different meanings and identified different factors contributed to resilience," says Dr Dynes.

From their research, the Resilient Rural Communities programme developed a model of resilience which identified the factors which can contribute to, or reduce, resilience (see table).

In order for a community to be resilient a minimum threshold must be met for each resilience dimension, however communities will naturally have some dimensions which perform better than others.

RESILIENCE DIMENSION	ELEMENTS OF RESILIENCE
Social	Social inclusion, networks, organisations, health, housing, leisure, education, families, skill base
Cultural	Records of cultural knowledge from history, maintenance of cultural identity, intergenerational practices, cultural manifestations, inclusion in other dimensions of resilience, arts and crafts, tikanga
Economic	Productivity, profitability, employment, infrastructure, debt and equity, industry groups, technology, innovation, value chains
Institutional	Social norms, social licence, regulation, infrastructure, services, social inclusion, local government, Māori institutions, identity
Environmental	Land resources, water, landscape, biodiversity, biosecurity, climate change
External	Natural resource base, national government, international markets, wider society

The elements included under each dimension of resilience in the Resilient Rural Communities programme's resilience framework.



DEVELOPING A MODEL FOR DECISION MAKING IN RURAL COMMUNITIES

The Resilient Rural Communities research programme developed a multi-agent simulation model to test some scenarios on how the rural sector might respond to different changes.

The first region where this model was developed was in Southland. One of the scenarios it looked at was the effects of adopting different strategies to reduce nitrogen leaching in Southland. A business-as-usual scenario was one option, with another option looking at diversifying land use, and lastly introducing different nitrogen (N.) loss limits and methodologies.

The model used farmer interviews to identify how they would respond to regional rules introducing different N. losses limits and

Having irrigation available in the Hawke's Bay provides farmers with land use options.

different approaches such as grandparenting based rules or applying the same limits to all farming systems.

The effects considered looked at farm profitability, land use changes (for example conversion from or to dairy), and N. losses. The cost per kilogram of N. leaching saved was used as one comparison to evaluate options.

The interviews with farmers revealed that they didn't make decisions solely based on economic rationalism – as in some cases that would have made selling the farm a better personal economic decision – but based on a range of values.

Farmers displayed a spectrum of comfort with risk-taking behaviour. Factors like the age of farmers, whether they had a farm succession plan and the decisions other farmers made in their network also influenced what choices people made.

Some of the options modelled cost as much as $440 per kilogram of N. saved, while other options actually saved money by encouraging farmers to become more efficient.

The most extreme options reduced N. loss by 45% region-wide but resulted in most dairy farmers exiting out of Southland and a cost of $2 billion lost in annual agricultural production.

Policies which allowed for variable N. loss rules and limits based on soil drainage properties of land were some of the best-performing options. One variable N. limit was modelled to achieve a 13 percent decrease in N. leaching across the region at a cost to agricultural production of $60 million.

Introducing grandparenting rules requiring dairy farms to reduce their N. losses by 25 percent was effective in achieving environmental improvements but was comparatively expensive and reduced agricultural production by $1.5 billion. A less expensive and more effective option modelled was to require all farms (including sheep and beef farms) to use best practice mitigation techniques. This was estimated to cost $190 million in lost agricultural production and reduce N. leaching by 33 percent.

Bill Kaye-Blake, the Chief Economist at PwC, was involved in organising a series of community workshops in Hawke's Bay as part of the project.

The workshops aimed to consider options for future development in rural areas, better understand values and the decision-making of farmers and growers and what needed to be done to progress these options.

The options being considered included implementing the Tukituki Catchment Plan – which imposed higher minimum flows for the Tukituki River and significantly restricted irrigation – a business as usual scenario and an option to integrate stock management over hill country and flat land. That option involved stock being moved from a hill country farm to a lowland property to improve productivity and achieve better environmental outcomes but would have required collaboration between different farms to achieve.

The decision-making model used the same framework as in Southland and considered what the impacts of different options would be on farm productivity, employment and the environment.

Bill says that in the case of Hawke's Bay irrigation contributes to resilience as it opens up options for farmers. Those options are both within a farming system – for example for lamb finishing within a sheep farming system – and to combine or change land use – for example to enable a shift to horticultural production.

"Having options is really important. It enables people to do more with their land and to have more flexibility to adapt their practices," he says.

The research team say the decision-making model can be used to evaluate other scenarios affecting farmers – for example whether farmers will sign up for a new irrigation scheme.

Dr Dynes says one area the research team would like to see it applied to is to model how to improve the uptake of new technologies by drawing on an understanding of human decision-making factors.

With a growing understanding of the complexities which influence farmer decision-making, Dr Dynes says that more research on the effects of new policies is needed before they are introduced.

"We found that often there are a lot of unintended consequences of policies which may not always have desirable outcomes," she says.

The research team supports the concept of 'rural proofing' policies before they are introduced. They highlight that this is particularly important in the environmental space, as rural land occupies much of our landscape, leading to a temptation to prioritise national environmental goals ahead of the other needs of rural communities.

They also emphasise that rural communities do have many options available to them, and new technology as well as the opportunities to diversify farming models and innovate are adding to these options.

Government taking action on agricultural emissions

By David Goodman and Josh Williams, Anderson Lloyd.

The Government recently released details of its proposals for lowering agricultural emissions.

Reducing agricultural emissions is a key part of the Government's plans to transition to a low-emission economy and achieve its 2050 targets in the Zero Carbon Bill.

The Government's consultation document is informed by the Interim Climate Change Commission's (ICCC's) recommendations for reducing agricultural emissions, as well as engagement with the agricultural sector. The ICCC ultimately concluded that the best way to motivate farmers to reduce emissions is to put a price on them.

When it released its consultation document, the Government announced that it has reached a consensus with farming leaders to price emissions from livestock at the farm level from 2025. Pricing emissions at the farm level (rather than the processor level) will give farmers greater control over how they manage emissions on their property, but results in a much more complex scheme, and it will take time and collaboration to develop the tools and systems required to implement it (which is reason for the 2025 start date).

In the meantime, the Government is looking to introduce an interim measure to incentivise farmers to reduce emissions now, and will provide farmers with a 95% free allocation on their emissions to help them transition. The ICCC recommended including agricultural emissions in the ETS now, as it would not only send a clear signal to factor in an emissions price into investment decisions, but it would also generate funds that could be used to support farmers as they transition. At the current price of around $25 per tonne, and with a 95% free allocation of units, the Government expects that this will cost farmers on average $0.01 per kg of milk solids, $0.01 cent per kg of beef, $0.04 per kg of venison and $0.03 per kg of sheep meat.

The Government recently sought public feedback on its proposals, including:

From 2025: Farmers pay for their livestock emissions

- Farmers report and pay for their livestock emissions, while credits may be earned if emissions were negative.
- This is intended to incentivise reductions to on-farm emissions and to recognise a wide range of mitigation practices that farmers could use.
- The ICCC recommended a levy/rebate scheme, as it would avoid the need for farmers to trade units and is therefore simpler and less costly. This is not discussed in the consultation document, which suggests that the Government is still considering this proposal.
- The level of free allocation that would apply from 2025 is not clear. The ICCC calls this out as one aspect of the policy design work that needs to happen between now and 2025. The commitment to provide a 95% free allocation is only talked about for Option 1 between now and 2025, so it remains to be seen whether this will continue to apply from 2025[1].

From 2025: Processors pay for fertiliser emissions

- Manufacturers and importers of fertiliser report and pay for fertiliser emissions.
- Because the only way (currently) to reduce fertiliser emissions is to use less of it, the incentive to use less is the same regardless of whether emissions are priced at the farm level or at the manufacturer/ importer level (with costs passed on to farmers).

From now until 2025 (Option 1):
Processors pay for both livestock and fertiliser emissions via the ETS

- Dairy and meat processors, and manufacturers/importers of fertiliser, report and pay for emissions from 2021 (with livestock emissions moving to farmers from 2025).
- Government to provide a 95% free allocation of emissions units (based on a combination of farm output and inherent land productivity).
- The ICCC estimated that, with a 95% free allocation, at least $47 million would be raised each year from emissions pricing, which would be used to support farmers with the transition[1].
- This option treats all farmers who supply processors the same, and does not recognise each farmer's individual emissions footprint.

From now until 2025 (Option 2):
A formal sector-government agreement

- An alternative to Option 1 put forward by the agricultural sector.
- A programme of action to support emissions reductions (including a roll out of Farm Environment Plans that address emissions reductions), funded through existing government funding, farmer levies and commercial funding.
- A commitment to work with the Government to design a pricing mechanism by 2025, which is part of a broader framework that supports farmers to make practical changes on the ground and contributes to lower global emissions.

Farmers should expect costs associated with paying for their emissions, implementing mitigation practices to reduce their emissions, and calculating and reporting their emissions. Processors are also expected to pass on most of their costs to farmers, but may struggle to do so in offshore markets that don't price agricultural emissions given the competitive nature of those markets.

The consultation recognises that there may be other opportunities to support on-farm emissions reductions or carbon sequestration (beyond on-farm forestry). It also recognises that there are further decisions that need to be made.

You can go to the Ministry for the Environment's website for a copy of the consultation document.

This article was written by David Goodman and Josh Williams at Anderson Lloyd. If you would like to discuss the Government's proposals for agricultural emissions, please contact them directly. For contact details, please visit https://al.nz.

1. If a 95% free allocation raises $47m, then a 0% free allocation (i.e. farmers pay 100% of the price of their emissions) would raise $940m.

An aerial view of Burgess's Stream where riparian planting and wetland restoration is planned. *(Photo Gina McKenzie)*

Biodiversity boost proposed for Burgess's Stream

Burgess's Stream, near Eyreton, has been identified as a focus area for the first stage of Waimakariri Irrigation Limited's (WIL) biodiversity project which is designed to restore and enhance local waterways.

The project focuses on 1,600 hectares of shareholder land in the Burgess Stream and Old Eyre River catchment. Within that area, 6.3 hectares have been selected by the irrigation company as potential sites for riparian planting and wetland restoration.

Burgess's Stream contains a cluster of springheads, along with pockets of native species which makes it an ideal site for restoration.

WIL CEO Brent Walton says homing in on areas which have the greatest potential for restoration is vital for the success of the project.

"We want to achieve real improvements for Waimakariri's biodiversity values with this project which is why we've identified Burgess's Stream as our first restoration site.

"The four shareholders whose farms intersect the stream are committed to being involved in on-the-ground improvements."

Landscape architect Dan Cameron and ecologist Dr Judith Roper-Lindsay, who created a feasibility report for the project, have been encouraged by strong landowner support for the project.

"We've held a series of farm meetings to connect with WIL shareholders whose farms border the stream and they are all keen to be involved in the project.

"It's really heartening to see that some of them have already carried out native planting and getting everyone working together will take it to the next level."

Judith, who is also a member of the Waimakariri Zone Committee, describes the stream as having the potential to support additional native species.

"We saw invertebrates, birds and remnants of native vegetation, including native broom, and this combined with the deep, fast flowing water makes it an ideal site for riparian planting and possibly a wetland.

"It also ties in well with what the Zone Committee is trying to achieve in terms of working collaboratively with communities to prioritise on the ground actions which have a positive impact on local waterways."

Dan says the next phase of the project will focus on working with landowners to select and design the planting site and getting the right mix of native species for the soil conditions.

"It's essential to consider what plant and animal communities would have been there in the past, while considering modifications to the land such as pivots, tracks and gates. We'll be looking at more riparian planting and setbacks from the stream."

Having the support of shareholders is vital to ensure ongoing improvements throughout the project and Brent says everyone involved with WIL realises they have an important part to play in improving Waimakariri's waterways.

"We're serious about making a difference and want to work together with organisations and local government to make a real improvement to our local streams and rivers for future generations to enjoy."

Landscape architect Dan Cameron and ecologist Dr Judith Roper-Lindsay review the Burgess's Stream site selected for the first stage of Waimakariri Irrigation Limited's (WIL) biodiversity project. *(Photo Gina McKenzie)*

How centre-pivot irrigation brought the dust bowl back to life

Crop circles saved the Great Plains when farmer Frank Zybach invented a new sprinkler system in the 1940s. By Joe Anderson, Zócalo Public Square, smithsonian.com.

If you live in the Great Plains, sooner or later you'll get a question about those "crop circles" that can be observed from airplane windows during flights over the region. The answer is contained in the question: Put simply, they are circles of cropland.

The circular pattern, however, is different from the regular patchwork many people imagine traditional farm fields to be. The shape is the result of the centre-pivot irrigation, a development of the post-World War II era that profoundly changed the course of American food production. In fact, the rise of centre-pivot irrigation turned the Plains – an area that had been dry land for more than 100 years – into a place that could sustain crops such as corn, creating an agricultural and economic powerhouse that carries the seeds of its own destruction.

In the early 19th century, the first Euro-American explorers labelled the region between the Rocky Mountains and the 100th meridian as the Great American Desert, a depiction that had remarkable staying power. For many years, American political leaders and other observers decried the prairies as waste, unable to support civilization, even though Native Americans had made homes there for thousands of years. The geological record tells us that many of those explorers who saw a desert arrived in drought years. Those who arrived in wetter years saw the region in greener hues, presuming that the land was a potential garden simply waiting for a gardener.

This promise of a garden-in-waiting was partially true. Very quickly, settlers and boosters discussed lending nature a hand through irrigation projects. Diverting water from rivers through canals provided water for thirsty crops such as alfalfa and corn. Such surface irrigation had limits, though. Users needed to be close to rivers and were dependent upon the variable, seasonal flow of those waters.

By the late 19th century, farmers had started pumping groundwater from wells, first using power from windmills—which became ubiquitous—and later from gasoline engines. But these techniques were expensive, far beyond the reach of most settlers. Even for those who could afford them, it was almost impossible to pump enough water to make a difference on a large scale. The groundwater was deep, sequestered between and among rock, gravel, and clay in a vast underground reservoir now known as the Ogallala Aquifer.

Groundwater irrigation from the aquifer received a boost in the 1930s and 1940s, when pumps powered by automobile engines accessed water from greater depths. Before long, government investment in rural electrification helped farmers power a growing share of the irrigation pumps with electricity; later, low-cost natural gas became the fuel of choice. Irrigators laid pipes across fields of crops, with sprinklers spaced at intervals. The practice was labour-intensive, requiring a lot of workers to move the pipes for seedbed preparation, for cultivation of row crops, and for harvest.

The 1930s also witnessed a protracted drought across much of the country, which brought into question the suitability of the region for agriculture. It was during the "Dirty Thirties" that a portion of the region in Colorado, Kansas, Texas, and the Oklahoma panhandle, suffering from extreme conditions, became known as the "Dust Bowl." Government soil experts asserted that the solution was a retreat from agriculture across much of the country. They proposed classifying each acre according to its productive capacity and buying out land deemed as "submarginal." The end of the drought and the onset of World War II, however, allowed the resumption of maximum production and scrapped the dreams of land use planners.

In 1948, an innovative Nebraska farmer named Frank Zybach developed a new type of sprinkler system, the centre-pivot which he patented in 1952. Placing the pump at the centre of the field next to a well, irrigation pipes supported by trusses were mounted on wheeled towers that could make a circuit of the field under their own power, leaving that distinctive circle pattern. Gun-style sprinklers sprayed water out from the pipes at set intervals, with smaller nozzles closest to the pivot and the largest nozzles at the end of the line. The system could cover 133 acres of a 160-acre field, and didn't have to be disassembled by workers when it was time to plant, till, or harvest.

A centre pivot irrigation system watering a potato field in the Mid-West.

An aerial view of farmland in the Mid-West of America.

Ever more powerful motors allowed irrigators to increase the systems' scale, with the largest set-ups covering all but the corners of a 640-acre section of land. Over time, farmers positioned sprinkler nozzles closer to the ground, resulting in less evaporation. During the return of drought conditions in the 1950s, those who had chosen to irrigate had an advantage over those who did not, which convinced many latecomers to get on board. In 1993, historian John Opie observed that industrial irrigation that emerged in the Great Plains was a three-legged stool supported by fertile land, plentiful and low-cost groundwater, and inexpensive fuel.

Centre-pivot irrigation was a technological triumph—and it also transformed the agricultural geography of the country. With feed crops becoming available in the Great Plains and easily portable via the new interstate highway system, feedlots and meatpacking plants moved to the region. An abundance of low cost labour and low-cost water for raising livestock and processing meat led the area, where 160 acres of land could previously support just one steer, to become a centre for some of the world's largest high-density livestock feedlots with hundreds of animals per acre. Large-scale pig production facilities have thousands of animals under one roof. Any one of these farms requires more water for drinking and waste removal than a typical city: a farm of 20,000 pigs uses far more water than a community of 20,000 people.

Water for irrigation and large-scale animal feeding didn't only grow crops and livestock, it gave life to the Great Plains communities that depended on agriculture. Families and labourers shopped at local retailers and deposited wages in local banks, keeping small towns alive, and irrigators paid the property taxes that sustained local governments. Centre-pivot irrigation supported local high schools, clubs, churches, and a whole way of life that would have literally dried up if the fields were less productive.

The drought of the "Dirty Thirties" had exposed the limits of the Great Plains, raising the question of whether large parts of the region were suitable for agriculture, but the adoption of centre-pivot technology changed everything. For irrigators and their allies, the development of the centre-pivot "crop circle" was entirely beneficent. History, they could claim, was on their side. By the 1980s, irrigators from Texas to Nebraska sunk tens of thousands of wells, drawing on the massive Ogallala Aquifer. Irrigation, combined with new hybrid seeds, fertiliser, and pesticides continued to bring high productivity to an arid region.

It is little wonder, then, that for many people on the Great Plains, water regulation is a dirty word. Attempts to manage groundwater through local authorities during the 1970s relied on voluntary compliance—and there was so much money to be made with cheap water that regulation, many irrigators reasoned, constituted a violation of the natural order of the Great Plains and wasn't worth the effort. It is easy to see why: the centre-pivot irrigation regime had come to seem inevitable, like a phenomenon of nature. When I was young, growing up in the area, I thought it was as natural as the seasonal migration of geese, ducks, and Sandhill cranes, and as inevitable as tornado season.

Centre-pivot technology epitomises much of what it is to be an American. It was a technological triumph that enabled a production revolution. The people who built it took pride in their achievement: they were American inventors who created something out of almost nothing. But the system also drew on less-productive American impulses—not just ingenuity and drive, but also unchecked resource use and ever-increasing scale.

In recent years, it has become apparent just how finite the Ogallala Aquifer is. While water levels have increased in some areas, in most parts of the aquifer they have declined at a rate faster than natural recharge—sometimes by a foot per year—because of production

agriculture. As of a decade ago, geologists estimated that there were less than 100 feet of saturated thickness remaining, with a minimum of 30 feet of thickness needed for successful irrigation.

By the time irrigators sensed the limits of groundwater irrigation, the region was stuck in what historians call an infrastructure trap: the success of centre-pivot irrigation has thwarted alternative visions for developing these dry areas. Capital investment in wells, pumps, centre-pivots, other equipment, and buildings have made it difficult to transition to less water-intensive farming practices. Consequently, change has been modest.

Twenty-five years ago John Opie noted that some irrigators adopted water-saving technology, but those measures did little to slow the overall draw on the aquifer and did not involve rethinking irrigation. Opie reported that some irrigators even admitted that when the aquifer is gone, the region's economic lifeblood will be gone, but continued to irrigate anyway.

In 2013, a group of farmers in Kansas created a 99-square mile conservation zone in which all participants reduced their water use. As one farmer stated, "We had to change the culture. We took water for granted." As of 2018, many of those who reduced their water use claimed that agriculture can be profitable even with reduced pumping. But efforts like these are the exception to the rule. The unwillingness to compromise short-term gain for long-term sustainability, of course, is just as American as the ingenuity that created center-pivot irrigation the first place. What a strange bind that for residents of the Great Plains, unchecked depletion of a major groundwater source has foreclosed options for future growth in the region.

The Lake Maloney Dam in Nebraska.

This essay is part of 'What It Means to Be American,' a project of the Smithsonian's National Museum of American History and Arizona State University, produced by Zócalo Public Square.

Community day at BCI's Akarana Pond

Around 100 members of the public and shareholders attended a community open day in April at Barrhill Chertsey Irrigation's new storage pond.

Barrhill Chertsey Irrigation (BCI) was pleased with the turnout – especially given the day experienced cold and wet conditions. Shareholders, their farm staff and members of the public enjoyed the opportunity to share a coffee with the team and a catch up and the chance to learn how this important piece of infrastructure works with BCI's water delivery and long term strategy.

"With a strong focus on investing in high quality intergenerational infrastructure, building the 1.5 million cubic metre Akarana Storage Pond has enhanced the scheme's operational efficiency and reduced reliance on on-demand pumping," says John Wright, Managing Director of BCI.

"The pond will enable BCI to supply the peak seasonal demand for irrigation water without requiring additional pumping capacity at Trustpower's Highbank Pumping Station. Whereas traditionally irrigation ponds are designed to improve reliability of supply, this dam will store water for the periods of peak demand from BCI's shareholders, enabling BCI to better control the long-term costs of delivery of water. This in turn provides economic benefits to the local community."

Construction of the new storage pond began in February 2018 and it was commissioned in October 2018. Named after the farm where it is located, just outside Methven, the Akarana pond sits on 40 hectares and has a maximum depth of five metres. The pond was formed from gravel embankments and has an internal HDPE geomembrane liner on the sides and a loess/silt liner on the base of the pond.

The $11 million pond development project was fully funded by BCI and its bankers, and shareholders will service the ongoing cost of the infrastructure. BCI has around 200 farmer shareholders and irrigates around 20,000ha in Mid Canterbury. In 2017 shareholders of the scheme took full control of BCI's ownership by buying out their joint venture partners, EA Networks, who owned 50% of the scheme.

BCI has a consent to use water from the Rakaia River from multiple intake points. The largest intake point is owned and operated by Trustpower Limited and is positioned next to the Highbank Power Station near Methven. Water taken at this site passes through a fish screen before being pumped 104 metres to the Rangitata Diversion Race (RDR), a canal built in the 1930's and 1940's that crosses the district from the Rangitata River to the Rakaia River. From the RDR, water is transferred to various parts of the BCI pipe network. BCI has nine main distribution networks across Mid Canterbury and around 250 kilometres of buried pipeline.

As there are restrictions on when water can be taken from the Rakaia River due to environmental flow requirements, the scheme uses Lake Coleridge as its primary storage site. BCI has an agreement with Trustpower Limited (who manage Lake Coleridge) enabling surplus water from when the river has high flows to be stored in the lake and released when the river flows are below minimum levels.

BCI also operates a 530kW hydro electricity generator on part of its network near Barrhill. The energy produced is used in Ashburton district's power network and offsets some of the energy consumed by the scheme in delivering water.

The Akarana pond is filled by diesel-generator-powered transfer pumps from the RDR and connected to the existing, gravity-fed Methven pipeline. The scheme already has five storage ponds which buffer flows to its network, and adding the new pond will reduce the amount of pumping needed at Trustpower's Highbank Pumping Station which draws water from the Rakaia River.

For more information about BCI visit www.bciwater.co.nz

Our Land and Water takes on economic and environmental challenges

Our Land and Water is one of 11 National Science Challenges that are funding scientific research into issues of national importance. Our Land and Water is funding and coordinating research that tackles the biggest science-based issues and opportunities facing our country in the area of primary production, and the complex relationship it has with our precious land and water resources. Here, we continue looking at some of the projects funded by Our Land and Water.

Our Land and Water research suggests organic dairy farming systems may be more profitable than conventional systems. *(Photo: Alex Wallace Photography / Jersey Girl Organics)*

IS ORGANIC FARMING WORTH IT?

Organic, 100% pasture-fed and carbon-neutral are examples of 'credence attributes': a feature of a product that cannot be perceived, but may have environmental, animal welfare, social welfare or cultural benefits. Some consumers are willing to pay more for products with these additional qualities.

The Credence Attributes On-Farm research project, funded by Our Land and Water, has connected information about this potential price premium with the cost of the practical changes required to deliver these credence attributes on New Zealand farms, to estimate changes to farm profitability.

"We modelled three product attributes – pasture-fed, carbon-neutral and organic – to see what changes the average farm would need to make to produce these products, what the environmental impact would be, what it would cost, and what the price premium might be – and how much of that could be returned to the farmer," explains lead researcher Dr Gina Lucci, senior scientist at AgResearch.

Using data for 'average' DairyNZ system 3 farms in the Waikato and Southland, and for a Class 4 North Island sheep and beef farm, Credence Attributes On-Farm researchers modelled the farm system changes required to deliver pasture-fed, carbon-neutral and organic products. These models also enabled nitrogen and greenhouse gas reductions to be estimated.

Researchers also conducted a meta-analysis (combining the results of 94 other studies) to learn how much more consumers are willing to pay for attributes such as organic dairy (36 percent more, for this example).

Bringing all this data together allowed Credence Attributes researchers to estimate changes to profitability (economic farm surplus) for conventional farms that made systems changes to deliver pasture-fed, carbon-neutral and organic products. The costs of accreditation fees and offsetting for the carbon-neutral products were included, and the share of the consumer price premium returned to the farmer was estimated based on what was 'leftover' after other businesses along the value chain took their share.

Researchers were anticipating some increase in profitability, says Dr Lucci, but some results were very surprising – particularly the profitability of organic dairy products, which increased as much as 67 percent.

The estimated profitability increase for the farmer was greatest for organic (increase of 42 percent to 67 percent) and pasture-fed (increase of 36 percent to 4 percent) dairy products. Carbon-neutral products were also more profitable (increase of 11 percent to 25 percent).

There were also reductions in carbon footprint and nitrogen leaching, compared to the conventional base systems. Carbon-neutral dairy had the greatest potential to reduce nitrogen (N) leaching (a 41 percent N reduction) and carbon footprint (by 11 to 17 percent), due to imported maize being used for 30 percent of the feed. Configuring to organic dairy also reduced N leaching (by 17 to 24 percent) and carbon footprint (from 11 to 20 percent).

Lucci says the research shows that organic dairy has great potential to deliver both greater returns to the farmer and the greatest environmental benefits, while sounding a note of caution. "The modelling was done using Farmax and Overseer, which is a long-term average and doesn't take into account the kind of variations you'd get from year to year with droughts or too much rain. This is for an average year where everything goes right!"

"Organic farming is a high-risk, high-reward system that requires learning and experimentation, and it is not going to be the answer for everyone."

You can read more about this subject at www.ourlandandwater.nz/credence-attributes-synopsis

CLASSIFYING 'PHYSIOGRAPHIC ENVIRONMENTS'

Water quality varies widely between regions around New Zealand, even where there are similar land uses and pressures. This is because of the influence the natural landscape has on water quality – accounting for twice as much variability in water quality than land use alone.

Our Land and Water is gaining understanding of this influence through physiographic science, which works 'backwards', using water composition to trace the water's journey back through the landscape to understand how the landscape affects water quality.

Researchers in the Physiographic Environments of New Zealand (PENZ) project have developed a new methodology to integrate water quality data with existing map layers (such as soil, geology, and land cover) to

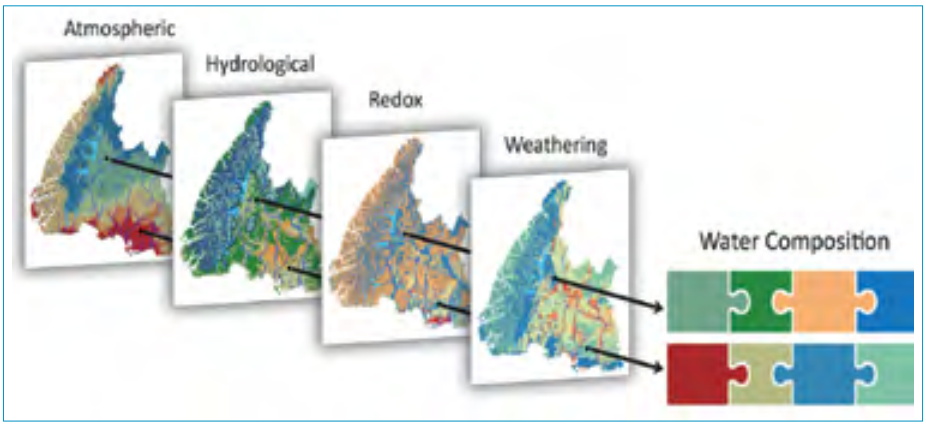
map and model the processes that control the variability of water quality. When combined with a map of land use intensity, they can be used to model water quality.

PENZ researchers then combined these maps to create a Physiographic Environment Classification, which groups areas that have similar landscape features. Areas classified as the same Physiographic Environment will respond to land use pressure in a similar and predictable manner.

The physiographic classification gives a high degree of confidence to water composition estimates and enables farm and catchment efforts to improve water quality to be matched to the landscape, with higher certainty regarding effectiveness.

Examples of 'on the ground' management practices that can be informed by physiographic science include land use management practices like the selection of stock wintering paddocks, and physical mitigation measures like riparian planting and peak runoff control). Farmers can also use this tool to help choose the best time to apply fertiliser.

Regional councils (Northland, Auckland, Waikato, Bay of Plenty, Horizons, Canterbury, Southland) are sharing data and collaborating to enable the physiographic approach to be applied to their regions.



A number of factors influence water composition. *(Image: Our Land and Water)*

"Most importantly, this information needs to be accessible to land users to make a difference," says PENZ researcher Dr Lisa Pearson of Land and Water Science. "To do this, we have an MPI Sustainable Farming Fund project that is developing an education portal that farmers will be able to use to see how and where contaminants like nitrogen leave their land, so that they can make well-informed land use decisions to reduce losses."

A steering group of six Southland farmers representing different enterprises are guiding the content and design of the website and interactive app, plus industry representatives are working with the farmers to help tailor the website for their specific farming activities. A prototype will be ready by the end of 2019, with a national roll-out in 2020.

"We want to empower land users to make more effective decisions in land management and mitigations," says Dr Pearson, "creating a future landscape and community that is more resilient, healthy and prosperous than it is today."

More online learning in development

More online learning modules for irrigators are being developed by IrrigationNZ currently.

The new online training will provide a series of short videos explaining and demonstrating how to do a bucket test on different types of irrigation systems.

The videos will explain the correct way to do bucket tests for each irrigation system. It will explain what doing the test involves and will cover the equipment you need to have with you before you head out to do the test. The video will also show you how to do the testing, including where to place buckets and how to time your testing and interpret your results.

Videos covering bucket testing for pivot, drip, linear, gun, travelling, K-Line and solid set irrigation systems will be available through the new module. Each video will be up to seven minutes long.

The new online options are about modernising the learning options IrrigationNZ offers and making it easy for irrigators and farm staff to upskill themselves without leaving the farm.

Steve Breneger and Bayley Pearce (WaterForce) shooting new videos for the e-learning platform. Bayley is carrying out testing while Steve is behind the cameras and operating the drone.

UPSKILL YOURSELF FOR FREE!

The first module of IrrigationNZ's new online learning system is available for INZ members to use for free. The system features animated videos explaining topics like soils, climate, plant water use, water budgets, soil moisture monitoring and scheduling.

The training can be completed in short modules and can be done whenever there is time available on the farm or after hours as part of staff professional training.

If you have new staff joining you the online training will help them get a better understanding of irrigation management and you can complement this training with some instruction on the farm. The training is also suitable for more experienced staff who already use irrigation, to help expand their knowledge.

Eleven short 10-20 minute lessons make up the first training module. Each module is followed by a quick online assessment. It takes around three to four hours to complete all of the modules and assessments.

To use the online system visit www.irrigation.co.nz and select the 'E Learning' option on the webpage.

Seasonal climate outlook September–November 2019

OUTLOOK SUMMARY

The central Pacific El Niño event that arrived in March 2019 has ended, giving way to ENSO neutral conditions, owing to cooling sea surface temperatures (SSTs) in the tropical Pacific and a neutral Southern Oscillation Index (SOI) during August.

SSTs in the central equatorial Pacific were 0.2°C above average and the SOI was -0.2 for the month of August, both within the neutral range. Oceanic ENSO neutral will most likely continue (60% chance) over the next three months.

An area of warmer than average seas in the west-central tropical Pacific is expected to occasionally influence New Zealand's weather patterns, contributing to sub-tropical low pressure systems that can bring heavy rainfall.

For September to November, air pressure is forecast to be lower than normal in, and particularly south of, the New Zealand region. This is forecast to bring more southwest quarter winds than normal for the season as a whole, although periodic easterly quarter winds are probable.

September and at least the start of October are forecast to be particularly unsettled, along with an elevated risk for sharp cold snaps. Those with interests in New Zealand's primary sectors (e.g. agriculture) should pay close attention to weather forecasts to assist with mitigating potential impacts.

Temperatures for the coming three month period are forecast to be near average for most of the country except the north and west of the South Island, where near average or below average temperatures are about equally likely.

Rainfall is forecast to near or above normal for most of New Zealand except for the west of the South Island where near normal rainfall is most likely.

September to November 2019 temperatures have about equal chances of being near average (45% chance) or below average (40% chance) for the north and west of the South Island. All other regions of New Zealand will most likely experience near average temperatures (50% chance). There is an elevated risk for sharp cold snaps, especially for the South Island, during the first half of the season.

September to November 2019 rainfall is about equally likely to be near normal (40–45% chance) or above normal (35–40% chance) for much of New Zealand except for the west of the South Island where near normal rainfall (45% chance) is most likely.

September to November 2019 soil moisture levels and river flows are most likely to be near normal (40–45% chance) for all regions of New Zealand.

PREDICTIONS FOR SEPTEMBER–NOVEMBER 2019

Northland, Auckland, Waikato, Bay of Plenty

- Temperatures are most likely to be near average (50% chance).
- Rainfall totals are about equally likely to be near normal (40% chance) or above normal (35% chance).
- Soil moisture levels and river flows are most likely to be near normal (40% chance).

Central North Island, Taranaki, Whanganui, Manawatu, Wellington

- Temperatures are most likely to be near average (50% chance).
- Rainfall totals are about equally likely to be near normal (45% chance) or above normal (40% chance).
- Soil moisture levels and river flows are most likely to be near normal (45% chance).

Gisborne, Hawke's Bay, Wairarapa

- Temperatures are most likely to be near average (50% chance).
- Rainfall totals are about equally likely to be near normal (40% chance) or above normal (35% chance).
- Soil moisture levels and river flows are most likely to be near normal (40% chance).

Lupin flowers in New Zealand's high country.

Tasman, Nelson, Marlborough, Buller

- Temperatures are about equally likely to be near average (45% chance) or below average (40% chance).
- Rainfall totals are about equally likely to be near normal (40% chance) or above normal (35% chance).
- Soil moisture levels and river flows are most likely to be near normal (40% chance).

West Coast, Alps and foothills, inland Otago, Southland

- Temperatures are about equally likely to be near average (45% chance) or below average (40% chance).
- Rainfall totals are most likely to be in the near normal range (45% chance).
- Soil moisture levels and river flows are most likely to be near normal (45% chance).

Coastal Canterbury, east Otago

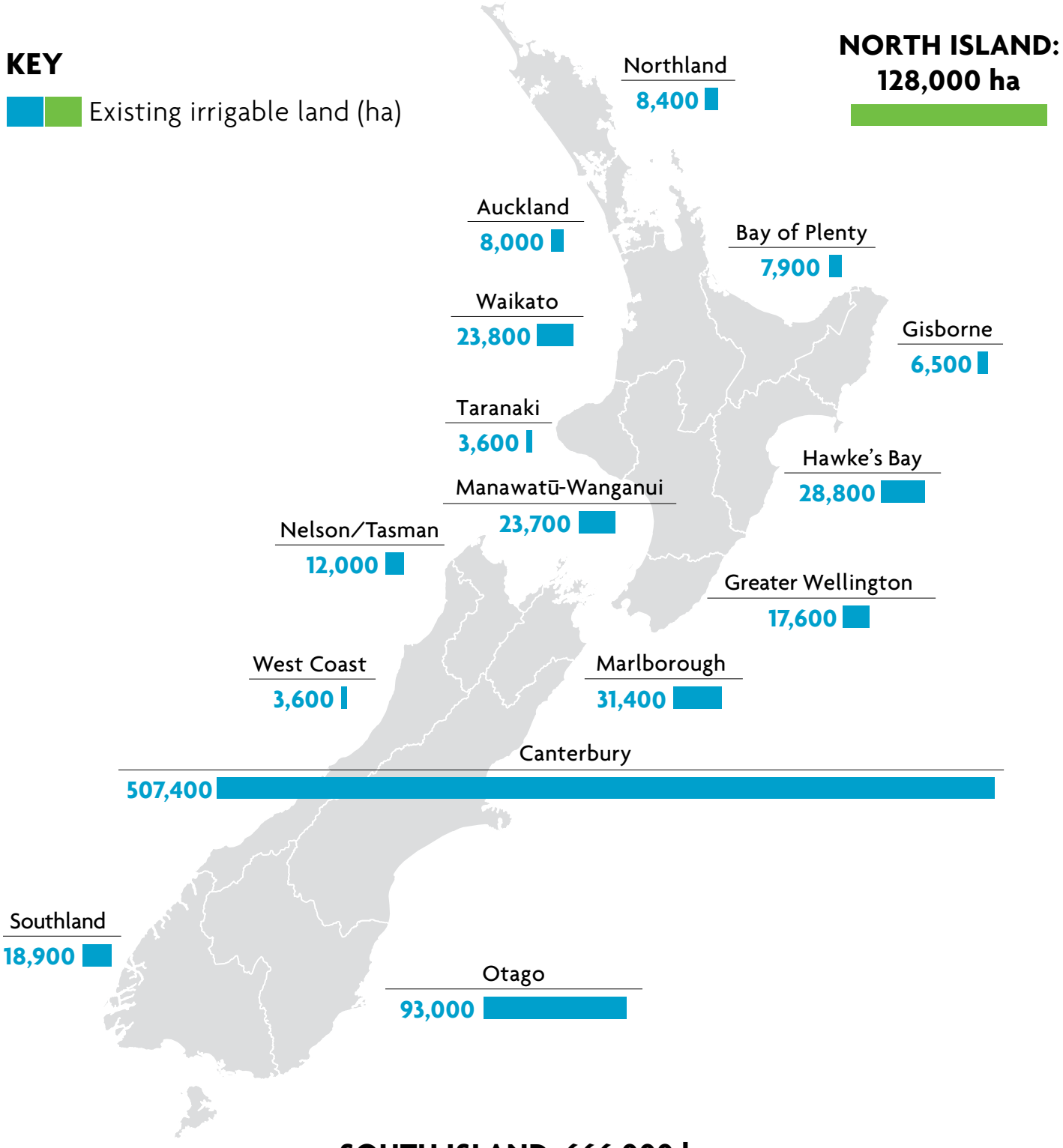
- Temperatures are most likely to be near average (50% chance).
- Rainfall totals are about equally likely to be near normal (40% chance) or above normal (35% chance).
- Soil moisture levels and river flows are most likely to be near normal (45% chance).

This is an extract of the Seasonal Climate Outlook published by NIWA.

Spring landscape near Tai Tapu, Canterbury.

PRODUCT & SERVICES DIRECTORY

TOTAL IRRIGATED LAND IN NEW ZEALAND = 794,000 HECTARES



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