

OUR LAND AND WATER

Toitū te Whenua, Toiora te Wai

Our Land and Water Annual Report Summary



July 2020 – June 2021

10 Things Our Land and Water Learned in 2020–2021

1

Our rivers would be in far worse condition today if farmers had not adopted better practices between 1995 and 2015.

4

Kaupapa Māori principles underpinning Māori food production can improve connected outcomes such as oranga (human wellbeing), tātai hononga (social capital), tiaki taiao (natural capital) and ōhanga (economic capital).

7

A suite of indicators for land management actions was identified that could be standardised and widely used to improve water quality.

2

If all known mitigation actions were fully adopted by all pastoral farmers by 2035 the potential load of nitrogen and phosphorus entering rivers could decrease one-third.

5

Nitrogen loads exceed current regulations in 9 of the 15 regions. At least 43% of agricultural land is in catchments under pressure from excess nitrogen.

8

By 2050 wine grapes are predicted to flower earlier and ripen 1–2 weeks earlier than currently, requiring different cultivars in more southerly regions.

10

Increasing the time cattle grazed a wet pasture from 1 to 2 days can significantly decrease soil macroporosity and hydraulic conductivity, and increase phosphorus losses.

3

Grazing winter forage crops can increase annual soil loss by up to 1200%, compared to pasture grazing.

6

A new lake classification system was developed, linking specific lake types to stressorresponse relationship shapes, to assist with managing lake eutrophication.

9

A national map of soil phosphorus showed areas of significant enrichment and risk to water quality, predicted to take 26–55 years to decline to environmentally acceptable levels.

- 1 https://doi.org/10.1080/00288233.2021.1876741
- 2 https://doi.org/10.1080/00288233.2020.1844763
- **3** https://doi.org/10.1016/j.jenvman.2021.112206
- 4 https://doi.org/10.20507/MAIJournal.2020.9.3.1
- 5 https://doi.org/10.1080/00288330.2020.1758168
- 6 https://doi.org/10.1080/20442041.2020.1765714
- 7 https://doi.org/10.1016/j.jenvman.2020.110475
- 8 https://doi.org/10.3389/fpls.2021.618039
- 9 https://doi.org/10.1016/j.geoderma.2020.114621
- **10** https://doi.org/10.1080/00288233.2021.1910319

Our objective is to maintain and improve our land and water quality for future generations, while enhancing the value of the primary sector to New Zealand.

The Our Land and Water objective holds te ao Māori (a Māori world view) at its heart as a central unifying concept, giving effect to a vision that recognises our fundamental connection to our land and water, to which we give and receive benefits in a reciprocal way. It embraces a concept of value creation from agriculture that is much broader than growth in production or productivity. Te ao Māori is now well embedded across the OLW research portfolio, with over 45% of current research being Māori-centric or kaupapa Māori research.

IMAGE CREDITS:

Cover: Alex McVinnie, Truestock / Tina Rodger, Truestock / Kathryn Taylor, Truestock Page 4: Nazar Ab, iStock / Arno Gasteiger / ParkerDeen, iStock / Rafael Ben-Ari, Adobe Stock / Tourism New Zealand Page 9: Rob Suisted Page 19: Natwick Photography Page 26: Daniel Lehrke Design Page 27: Your123, Adobe Stock / Dave Allen, NIWA Other images: Supplied

Contents

| Executive Summary | 1 |
|--|----|
| Our Research Structure | 2 |
| Our Impact Goals | 3 |
| Highlights and Achievements | 4 |
| Future Landscapes | 5 |
| Incentives for Change | 7 |
| Pathways to Transition | 8 |
| Rural Professionals Fund | 9 |
| Impact case study 1: Framework for identifying faecal sources | 10 |
| Scientific Quality | 12 |
| Recognition for OLW scientists | 13 |
| Best Research Teams | 13 |
| Funding Distribution | 15 |
| Aligned Funding | 15 |
| Impact Case Study 2: Rural hubs initiative at MPI | 16 |
| Mātauranga | 18 |
| OLW's Māori research partners | 19 |
| Pūhoro STEM Academy | 20 |
| Impact Case Study 3: Ngāi Tahu Farming and regenerative agriculture | 21 |
| Stakeholder Engagement | 23 |
| Public Outreach | 24 |
| Research in plain language | 25 |
| Events | 26 |
| Impact Case Study 4: Physiographic science at Northland Regional Council | 28 |
| Governance | 30 |
| Planned Research for 2021–22 | 31 |

Executive Summary

Our Land and Water (OLW) is working towards an agri-food and fibre system that enhances the vitality of te Taiao, through a diverse mosaic of land uses that improve the health of land, water and people. Our goal is for all New Zealanders to be proud of our genuinely healthy land and water, and for Aotearoa to be worldrenowned for its sustainable food and fibre production. OLW is hosted by AgResearch and supported by 16 partner research organisations.

In this financial year, OLW contracted 9 new research programmes and projects, and 15 Rural Professionals Fund special projects. To extend the impact of previous research, OLW also funded 5 small extension projects.

Major achievements in 2020–21 include:

Launching two major interdisciplinary research programmes: Whitiwhiti Ora / Land Use Opportunities (\$8m) and Pohewa Pae Tawhiti / Visualising Horizons (\$3.6m). Both seek to provide land stewards with the tools and information they need to make land-use change decisions that align with freshwater and climate policy changes.

Funding 15 rural professional-scientist-farmer collaborations to rapidly test novel ideas for significantly improving agri-food and fibre farming systems, through the inaugural round of the Rural Professionals Fund. Projects ranged from using drones to monitor on-farm environments, to growing bananas for dairy stock feed.

A significant increase in investment in Māori-led research, and in Māori researchers and contributors within OLW programmes. Māori-led research makes up almost half (45%) of OLW contracted research.

Prestigious recognition for the OLW website, which was awarded the 'Best Science Website 2020' by WebAwards 2020. The previous year's science winner had been the Smithsonian Natural History Museum.

Notable science findings and impacts in 2020-21 include:

A white paper on what regenerative agriculture could mean in a New Zealand context, which drew attention and commentary from scientists, primary sector stakeholders and media, and was used to inform MPI's thinking and initial hui on this topic. OLW co-funded this research, which brought together more than 70 organisations and 200 farmers, growers, agri-consultants, bankers, retailers, and other interested parties, to identify and prioritise research needs for regenerative agriculture in New Zealand.

A user-friendly interactive map showing which NZ rivers, lakes and estuaries are under the greatest pressure from agricultural nitrogen contamination. It can also be used to show how much the adoption of all possible on-farm mitigation actions would ease this pressure by 2035. The map is underpinned by data, modelling and analysis from two OLW research programmes, and is accessible to all New Zealanders.

The discovery that dissolved organic phosphorus leaches faster and deeper through the soil profile than inorganic phosphorus. This was found to be particularly the case in the stony, irrigated soils often used for dairying, and has prompted Environment Canterbury to alter their groundwater monitoring to detect and manage this leakage.

In 2021–22, OLW anticipates launching a further 9 new research initiatives, including the large Place-Based Pilots of Land-Use Change research programme (\$7.5m), and a second round of the Rural Professionals Fund.

Our Research Structure

OLW has been operational for five years, and the 2020–21 year represents the second year of the second phase of funding (2019–2024).

In 2020–21, investment planning continued to be guided by the KPIs, the OLW Research Strategy (2019–2024) and the most recent revision of the Research Workplan (2020–2024). OLW contracted 9 new research programmes and projects, and 15 Rural Professionals Fund special projects. To extend the impact of previous research, OLW also funded 5 small extension projects.



Our Impact Goals

FUTURE LANDSCAPES

Flagship Concept:

Providing tools for land stewards to assess diverse land use options, to identify the best land use to support the vitality of te Taiao.

INCENTIVES FOR CHANGE

Flagship Concept:

Theme Impact by 2024:

Decisions on land-use change and management confidence that they will lead to improvement in te Taiao.

Theme Impact by 2030:

The vitality of te Taiao is improving in response to our decisions as land stewards.

Theme Impact by 2024:

Theme Impact by 2030:

PATHWAYS TO TRANSITION

Flagship Concept:

Working with land stewards/

Theme Impact by 2024:

to enhance te Taiao are being explored by land stewards and organisations in the agri-food and

Theme Impact by 2030:

The agri-food & fibre system is reconfiguring to enable prosperous land uses that



TO AND

Highlights and Achievements



4

4

20

Mar St



FUTURE LANDSCAPES

The anticipated impact of Theme 1 research (Future Landscapes) is that decisions on land use change and management practises can be made with confidence that they will lead to improvements in te Taiao. The following achievements signal progress towards these anticipated Theme 1 impacts.

In December 2020, OLW released an **interactive map** showing nitrogen loads in catchments across Aotearoa, identifying the most at-risk catchments and the actual and potential effects of on-farm mitigations. The map is underpinned by data, modelling and analysis from two OLW research programmes, and is accessible to all New Zealanders (see tinyurl.com/olw-map). This has subsequently been used in media articles and by MfE to inform policy development on nitrogen load limits.

The two keystone research programmes of the Future Landscapes theme **(Land Use Opportunities/Whitiwhiti Ora and Pohewa Pae Tawhiti/Visualising Horizons)** launched in December 2020 and January 2021, respectively. Both involve multi-organisation research teams, stakeholders and end-users including Māori agribusiness, central and local government, industry bodies and rural banks. Anticipated completion time is mid- to late-2023.

OLW prepared an important guidance document on **designing effective Farm Environment Plans** (FEP), for government, regional councils, primary industry bodies, farm consultants and advisors, farmers, and growers. The document was made widely available in March 2021, providing guidance on the type of information required for a FEP and how to collect this, and providing links to key OLW research documents which provides supporting information and evidence.

Two working groups set up to investigate novel **monitoring designs and technologies** to track short-term measurable changes in te Taiao completed their research in March 2021, having identified a range of options for improving the ability of monitoring to detect change. The next step is to work with regional councils and other monitoring and resource management entities, to design novel monitoring approaches that can meet the requirements of the NPS Freshwater Management, including those specific to protecting Te Mana o Te Wai.

A third monitoring-focussed working group on **enacting Te Mana o Te Wai** has operated in parallel, using Māori knowledge and reporting systems. This is anticipated to report back in September 2021.

Together with Deep South and Resilience to Nature's Challenges NSCs, OLW hosted a **rolling symposium on drought**, climate change and primary sector resilience. Three short background webinars were given over 3 weeks in May 2021, presenting the latest climate projections, drought resilience research, and land-use science. This was followed by a one-day workshop at Te Papa to generate evidence-based conversation around future drought policy and adaptation options.

The discovery that dissolved organic phosphorus leaches faster and deeper through the soil profile than inorganic phosphorus – particularly in the stony, irrigated soils often used for dairying – prompted **Environment Canterbury** to alter their groundwater monitoring to detect and manage this leakage.

Land Use Suitability research predicted that by 2050 wine grapes would flower earlier and reach ripeness 1–2 weeks earlier than currently, requiring the industry to plant different cultivars or plant in more southerly regions.

A national **map of soil phosphorus** was created, which showed significant enrichment and risk to water quality, predicted to take 26–55 years to decline to environmentally acceptable levels if no further phosphorus was added.

As part of an open data and open access policy, OLW made over 70 years of data publicly available from the world's longest running **grazed irrigation** trial.

We found that increasing the length of grazing from 1 to 2 days by dairy cattle on a wet pasture led to decreased soil macroporosity (by up to one-third) and hydraulic conductivity (up to 96%) and increased phosphorus losses up to 400%. This emphasises the need to minimise the time cattle spend **grazing wet pastures**.

A method to categorise dairy farms into 'typologies' was developed from **Sources & Flows** research, with 20 typologies covering two-thirds of land used for dairy farming in New Zealand. These were found to be useful for improving estimates of contaminant losses from farms to water.

A joint iwi and Department of Conservation (DoC) project in the Arahura catchment of the West Coast, a highvalue catchment for greenstone, has used physiographic layers developed by **Physiographic Environments of New Zealand** research to identify risks and pressure for the catchment, and enable pinpointing of run-off locations so people can create structures to reduce discharges.

The **physiographic approach** is also being used by: Living Water (a collaboration between DoC and Fonterra) to prioritise high-risk areas in four catchments; Southland District Council to identify new options and guidance for wastewater discharge and waste application, and inform strategy for the purchase and retainment of land; and Great South as part of its 30-year catchment and farm transition plan.

Te Kāuru (Eastern Manawatū River) hapū collective are using capability gained through their involvement with **Faecal Source Tracking** research to undertake predator control in the Mākirikiri Reserve and monitor enhanced biodiversity and bird populations by point counts and botanical surveys.

The **Faecal Source Tracking** project confirmed the same E. coli subtypes found in pests like possums are also found in our environment, indicating that pests potentially have a role in faecal contamination of freshwater.

We compiled a **global database** of diffuse loads and yields of dissolved and total N and P, that can be used to improve nutrient use efficiency on farms, globally.

Our rivers would be in far worse condition today if farmers had not adopted better practices between 1995 and 2015, **Sources & Flows** researchers found. Farm action reduced P and sediment losses by about a quarter, and prevented 45% more nitrogen from entering rivers from dairy-farmed land. However, this was not enough to offset increases in N losses due to the 40% expansion of dairy land over the same period.

If all known mitigation actions were fully adopted by all pastoral farmers by 2035, **Sources & Flows** research estimated that the potential load of N and P entering rivers could decrease by one-third.

Grazing winter forage crops was found to increase annual soil loss by up to 1200%, compared to pasture grazing.

Nitrogen loads were found to exceed current regulations in 9 of the 15 regions, found **Land Use Suitability** research. At least 43% of agricultural land is in catchments under pressure from excess nitrogen.

A new lake classification system was developed by **Land Use Suitability** research, linking specific lake types to stressor-response relationship shapes, to assist with managing lake eutrophication. We summarised this research into a short Research Findings Brief for freshwater managers, regional councils, policy makers, catchment groups and farm advisors. Using Lake Hayes as an example, we showed how this research can help prioritise actions to prevent and reverse degradation.



INCENTIVES FOR CHANGE

The anticipated impact of Theme 2 research (Incentives for Change) is that new incentive approaches and value chains are motivating people and organisations to make better decisions for te Taiao. The following achievements signal progress towards these anticipated impacts.

200+ representatives of New Zealand's agri-food system identified 17 research priorities to better understand the potential for **Regenerative Agriculture** in New Zealand, in a white paper that stimulated an intense conversation in the primary sector media over the value of regenerative agriculture for the country, and the need for scientific evidence to back up the many claims that are made.

The **Regenerative Agriculture** white paper also informed MPI's initial hui on this topic, in which people representing organisations including Miraka and FAR acknowledged and articulated some key points from the white paper, such as the need to work with the current momentum of change in the farming sector, and to take an integrated, un-siloed approach to RA science.

A think piece to explore the meaning and application of the Māori concept of **Tauutuutu**, approximately translated as 'reciprocity or giving/paying back to maintain balance', was initiated to provide a strong foundation on which to explore how this concept might be used to inform and design new ways to relate food and fibre production for the health of te Taiao.

Millennials are now the largest demographic segment of the US wine market, found **Rewarding Sustainable Practices** research. This signals that sustainable certification schemes may need to change. For example, for New Zealand Sauvignon Blanc, millennial consumers were willing to pay significantly more for sustainability attributes, whereas baby boomers placed more emphasis on country-of-origin attributes.

NZIER funded an update of the **Indicator Working Group**'s resilience indicators analysis for Census 2018 data, which formed the basis for Insight 86: Targeting support for rural communities in the COVID-19 recovery (May 2020).

To make farm environment plans a more effective tool for improving waterways, the **New Models of Collective Responsibility** programme team proposed a 4-step approach to link plans within catchments. This proposal was covered by media, and other researchers then collaborated to create OLW Guidance: Designing Effective Farm Environment Plans, which was well-received by MfE and NZ Landcare Trusts.

New research has identified potential standard measurements for on-farm actions to improve water quality. This will allow small pieces of information from multiple farms and restoration projects to be connected in our **Register of Land Management Actions** project, giving a big picture of the hard work being done by farmers all over Aotearoa New Zealand.

A suite of indicators for land management actions was identified by the **Register of Land Management Actions** programme, which could be standardised and widely used to improve water quality.

An exercise with the Catchment Forum group of the **New Models of Collective Responsibility** programme tested an influential theory in academic and policy circles, and found it needs to be re-interpreted for catchment groups in Aotearoa.



PATHWAYS TO TRANSITION

The anticipated impact of Theme 3 research (Pathway to Transition) is that new options and pathways to enhance te Taiao are being explored by land stewards and organisations in the agri-food and fibre system. The longer-term impact is that the agri-food and fibre system is configuring to enable resilient, healthy and prosperous land uses that improve the vitality of te Taiao.

There is currently less research funded in this theme, which is a consequence of needing to wait until information has been made available by Themes 1 and 2. Nevertheless, there were some significant achievements in this theme in the year to June 2021:

The inaugural round of the **Rural Professionals Fund** drew over 30 applications in August 2020. There were 15 successful applicants, with projects ranging from the use of drones for on-farm environmental monitoring to growing bananas for stock feed. The 6-month projects end in June 2021.

OLW hosted a webinar series, **Better Together**, in November/December 2020 highlighting the OLW vision for a more diverse, resilient, healthy landscape by 2030, what the data is currently telling us about our water, and how to bring people together to foster more diverse land uses and create effective farm plans.

A celebration of the completion of the 2020–21 summer internship programme for the **Pūhoro STEM Academy** was held in February 2021. OLW sponsored 17 internships, as well as supporting the general Pūhoro STEM initiative. The OLW Directorate staff were invited to attend the celebration and presentations by the interns on their summer research projects. All were aligned with OLW's objectives, and the quality of the research was exemplary.

Participatory research and **extension programme** were found to create lasting change and learning among farmers, highlighting the importance of feedback loops. This research identified four types of logic that guide farming culture, providing understanding into how traditional farming culture can be a barrier to change.

Lincoln University is using the **Whenua Life Values** online tool to help students learn about Māori agribusinesses and how they evaluate business opportunities.

We created a reference tool to support communication about land management actions, and enable land managers to filter information to present the most relevant actions for their farm system and issues. This was picked up by DairyNZ and its development into a more sophisticated action prioritisation tool was funded by the **Rural Professionals Fund**.

A paper from the **Storying Kaitiakitanga** project highlighted that kaupapa Māori principles underpinning Māori food production can lead to a range of connected outcomes, such as oranga (human health and wellbeing), tātai hononga (building social capital), tiaki taiao (maintaining or enhancing natural capital) and öhanga (growing economic capital).

The co-leaders of the **Storying Kaitiakitanga** project were awarded a Marsden Fund grant for Kai Ora: Food for Hope and Wellbeing, a research project that further examines the growing symbolic and social significance of Māori food stories and develops storytelling practices to extend their transformative potential.

In March 2021, OLW again supported the annual **Open Farms** event, and funded a survey of 263 farm visitors (more than 80% of whom were urban dwellers) as well as 25 host farmers. The survey reinforced previous findings that urban consumers and farmers share a similar vision of what constitutes sustainable farming. Further key insights this year were that there is also a shared perception of the main obstacle to achieving this vision – large market players, such as supermarkets. Urban visitors believe that buying direct from a farmer is the best way around this. Most urban respondents said they were not willing to pay more for sustainably produced food, considering food from the supermarkets too expensive already. Notably, OLW research in the Incentives for Change theme in May 2021 indicated that overseas consumers in our key export markets are willing to pay more for sustainably produced food. This further demonstrates the difficulties of changing land use to meet the needs of our export markets, without disadvantaging domestic markets.



Rural Professionals Fund

The inaugural round of the Rural Professionals Fund drew over 30 applications in August 2020. This contestable fund aims to connect rural professionals, farmers, and researchers to develop or test new ideas relating to improved land use and water management. The purpose was to provide an opportunity for new ideas to be trialed in a low-risk setting, and to build stronger relationships between researchers and the rural sector.

There were 15 successful applicants, funded at up to \$50,000 each, covering a wide range of 6-month projects ranging from the use of drones for on-farm environmental monitoring to growing bananas for stock feed. Feedback from participants was positive, and several projects are now looking for funding from other sources for further development.

The 6-month projects ended in mid-2021, with the research results to be distributed through the NZ Institute of Primary Industry Managers' as well as via the usual OLW outreach mechanisms. NZIPIM is a partner in this initiative, which is attracting even greater interest in the 2021–22 RPF contestable funding round, which increases the duration of the projects to 9 months and the investment to \$75k per project.

Regional authorities now have a framework for identifying sources of faecal contamination



Regional and city council staff now have a documented process to follow when faecal contamination is identified in freshwater, created by ESR researchers involved in the Faecal Source Tracking research project funded by Our Land and Water (OLW).

The framework sets out a series of logical steps to help councils identify contamination sources when Escherichia coli (E. coli) recreational water quality guidelines are exceeded, and guides council staff toward what can be done to mitigate the contamination. It also shows councils what to do when the source of faecal pollution can't be identified, or when actions to mitigate pollution don't work.

For example, Tasman District Council was finding high levels of microbial contamination in a beach area. Various mitigations had been applied, but water quality measurements still exceeded guidelines. Following the framework, the council decided the logical next step was additional sampling to investigate historical sources of Escherichia. The framework replaces previously informal, undocumented decision-making processes, and helps councils fulfil a requirement introduced by the National Policy Statement for Freshwater Management 2020, whereby they need to prepare an action plan when water quality indicators (such as E. coli) exceed criteria. The framework will streamline and clarify decision-making within councils, reducing the workload burden on staff, particularly in resource-constrained regional authorities – and ultimately, contribute to safer recreational swimming in Aotearoa's rivers, and improved water quality for future generations.

This initiative was set in motion when, in 2020, the Ministry for the Environment (MfE) funded an ESRled freshwater survey aiming to better understand the relationship between the presence of pathogens in freshwater, E. coli indicators, and people getting sick. Current recreational freshwater public health guidelines are based on a similar Quantitative Microbial Risk Assessment study conducted 20 years ago when faecal source identification was not available. Researchers at ESR, along with Faecal Source Tracking research lead Dr Adrian Cookson, an AgResearch senior scientist, recognised an opportunity to add value to the MfE survey by contributing knowledge and methods from their OLW research, and to extend its uptake by helping councils identify and mitigate faecal pollution sources.

The researchers were supported by a round of OLW 'impact extension' funding in July 2020, for small projects aiming to increase the impact of completed OLW research. This OLW funding opportunity is unique to the National Science Challenges, enabled by the nimble nature of the Challenges, the close connection between funder and researcher, and the mission-led impact focus.

As part of the MfE survey, ESR took water samples from 16 sites with historically high levels of E. coli and tested for E. coli by Colilert, pathogens and faecal sources. The impact extension funding enabled AgResearch to use a 'finer tooth comb' to undertake E. coli population-based studies and identify subtypes of E. coli in the Colilert samples. A Pūhoro STEM Academy intern contributed to the analysis and sub-typing of 840 E. coli. Researchers identified two types of naturalised Escherichia: one not derived from mammalian faecal sources; the other from aged faecal sources, and importantly still associated with waterborne pathogens.

Another key finding was that flow-weighted measurements of E. coli were helpful in narrowing down major contributors to contamination, a technique not yet widely implemented. For example, there might be the same concentration of E. coli per 100ml in water from both a stream and a river, but the river is likely to contain much more E. coli because of the higher volume of water. The OLW funding then supported ESR scientist Dr Meg Devane and a team led by Dr Brent Gilpin to refine its proposed three-step framework for the assessment of recreational water quality, to provide guidance for regional authorities. The framework includes a step-by-step guide to identifying the source of faecal contamination (Step 2); decision trees outlining steps for identifying human, livestock, avian and mixed sources of faecal contamination; and advice and additional tactics if the source of contamination cannot be identified. If interventions cannot be implemented or are ineffective, Step 3 provides a strategy for health risk assessments.

Scientists from eight regional councils, members of hapū and rūnanga, and community groups provided input on the framework, via case studies of faecal contamination scenarios. Between October and December 2020, feedback on the initial framework was sought via webinar with regional councils via the SWIM (Surface Water Integrated Management) special interest group. Additional SWIM webinars to share findings from the OLW projects are planned for 2021.

Contact: Dr Meg Devane, ESR

Scientific Quality

OLW is performing well according to standard metrics used to assess science quality. With Phase 2 research still to reach maturity, and some programmes only just underway, we are satisfied with both the number of journal publications in 2020–21, and the proportion published in the top journals in their field.

45 articles were published in academic journals since our previous annual report. 35 were published in 2020–21, and a further 10 publications related to the previous financial year.

51% of published articles were in the top 25% of journals in their field worldwide – including 3 in the Nature publishing group (MBIE Bibliometrics assessment for 2020–21 pending).

50 other science outputs were delivered, including 28 presentations by OLW researchers at conferences.

7 large research programmes are underway, 2 of which commenced their research within 2020–21.

 $\frac{3}{2}$ working groups and $\frac{2}{2}$ think pieces were initiated, 2 of which completed their research within 2020–21.

3 OLW researchers were invited to give keynote presentations at domestic conferences (international conference participation is severely curtailed by Covid-19).

15 Rural Professionals Fund projects were underway in 2020–21, to be completed by June 2021.

90% of our Phase 2 research investment has been committed.

The risks created by Covid-19, such as delays and barriers to planned collaborations, have largely been managed successfully to date. International collaborations have had to be scaled back as a result of Covid-19.

The ongoing role of various OLW researchers and Directorate staff on **Essential Freshwater** advisory groups (Science and Technical, Freshwater Leaders, Kahui Wai Māori) reflects positively on the value of their advice to central government stakeholders.

The OLW website was judged **best science website for 2020** at the international WebAwards 2020, based on presentation and accessibility of science and research information to a diverse audience. This increases our confidence that people can access and understand new OLW science and research information.

Recognition for OLW scientists

OLW-funded researchers Professor Caroline Saunders and Dr Garth Harmsworth were made fellows of the Royal Society of New Zealand, in recognition of their respective major contributions to their fields of science. Caroline Saunders served as a science theme leader for OLW until 2020.

OLW chief scientist Professor Richard McDowell was made the new editor-in-chief of the Journal of the Royal Society of New Zealand.

Associate Professor Krushil Watene, a researcher in the New Models of Collective Responsibility programme, was appointed to the Advisory Board of the 2020 United Nations Human Development Report alongside some of the world's leading economists and humanitarian thinkers.

Best Research Teams

Choosing the best research teams is the first step to ensuring research excellence. OLW research teams bring people together from a range of disciplines, from across universities, all of the CRIs, businesses, industry bodies, Māori, government and non-government organisations, private citizens and regional councils.

Stakeholders are collaborators and co-innovators in all our research design and implementation, either in advisory or research roles. Including stakeholders in research teams helps to break scientists out of their routine ways of thinking and working, promotes cross-fertilisation of perspectives with respect to both problem definition and study design. Stakeholders can also provide strategic insights for achieving higher impact to the research and help identify capability gaps.

10 collaborating organisations per contracted research programme (down from 16 in 2019–20, but up on all previous years: 6.6 in 2018–19, 5.3 in 2017–18 and 3.5 in 2016–17), reflecting our strategy to extend participation in OLW research beyond the collaborating parties, and the increasing diversity of research being undertaken.

78% of journal publications involved authors from different institutes or organisations in New Zealand (similar to 80% last year).

21% of journal publications in 2020–21 included an international collaborator.

37% of journal articles were co-authored with stakeholders over 2020–21, ensuring OLW science is relevant and applicable.

45% of OLW investment includes either Māori-led or kaupapa Māori research, up from 13% at the end of Phase 1. On an FTE basis, Māori researchers make up roughly 20% of OLW researchers, in line with previous years. All six major research programmes have a te ao Māori lead.

Stakeholders led or co-led 2 think pieces, 1 large research programme and 3 working groups.

14% of researchers in programme teams (excluding stakeholder members) are early career scientists, postdocs and students.

4 post-graduate students and 2 post-docs are supported within OLW research programmes.

Quarterly meetings are held with Ministry for Primary Industries and the Ministry for the Environment to discuss research capability needs, particularly about the anticipated development of policy affecting land and water management.

4 dedicated leads are required in large research programmes, accountable for: science excellence, te ao Māori, implementation of the research, and project management. We expect 0.25FTE to be dedicated to each role.

Key international partnerships include:

- CSIRO (Australia) using and adapting their ADOPT modelling programme to assess and reduce the time to peak adoption of OLW research
- Agriculture & Agri-Food Canada was connected to OLW soil microbiome research, resulting in a publication in a Nature journal and collaboration between AgResearch and the International Bioeconomy Forum.
- OLW withdrew from the Temperate Agriculture Network due to Covid-19 travel restrictions. There is a risk that OLW will be unable to re-establish important international connections by 2024.

Funding Distribution

OLW collaborated with significantly more organisations in 2020–21 than in previous years. Funding is being distributed more widely, beyond large research institutions.



Number of Organisations Receiving Funding



Aligned Funding

We collect and analyse data from our Challenge Parties for research of relevance to the OLW mission every two years, via our Research Landscape Map report. This report identifies current investment, determines the impact of each programme towards the OLW objective within 10 years, and informs the process of identifying and filling research gaps. 2020–21 represents a gap year between Research Landscape Map reports, so we have no data to quantify change for this report.

However, continuing the trend observed in the last report, we have observed an ongoing increase in CRI-funded programmes aligned with the OLW objective.

One of the most significant changes is evident in the major restructure of AgResearch's Science Plan, which now mirrors OLW's approach, focusing their efforts in value chains and transforming land use. We have seen AgResearch research in soil microbiomes take up where OLW-funded Phase 1 research (\$1m/yr) left off.

There is a new pan-CRI initiative to build on the findings of the OLW co-funded white paper on Regenerative Agriculture. This is a good example of the use of think pieces to undertake the preliminary work to create an evidence base to support the development of research programmes, and proposals for further funding. This strategy enables OLW to concentrate on core investments, while leveraging other funds to create aligned work programmes. In this case, up to \$20m in MPI's SFFF.

We estimate that there was \$29,000,000 of aligned research funding in 2020-21.



Resilience indicators influenced and supported rural hubs initiative at MPI

The Ministry for Primary Industries (MPI) established 16 rural community hubs in remote communities over 2019–21, an initiative that was influenced and guided by Our Land and Water (OLW) research on rural resilience.

Rural hubs are a new initiative in New Zealand to support rural communities to build social relationships. MPI provides funding to help a community group access or rejuvenate a space like a community hall, employ a co-ordinator, undertake strategic planning, or connect with organisations that can provide services or resources. For example, Te Riu o Waiapu Trust (a collective of eight marae and hapū groups) had been delivering community activities such as singing and computer classes from an unused school building in Tikitiki, Gisborne. MPI rural hub funding enabled the group to pay a co-ordinator and develop a wider programme.

The rural hub initiative forms part of a strategic shift within MPI to widen its support for farmers and their families to include all the networks of people who make up rural communities in New Zealand, such as those who run shops, work in schools, and provide services. Research by the OLW-funded Indicators Working Group was used within MPI to inform and justify the rural hub initiative. The book Heartland Strong, a joint output from this research and an aligned AgResearch programme, Resilient Rural Communities, was also used by MPI staff to guide their understanding of the needs of rural communities and gain support for the strategic shift.

Paul Chantrill, senior regional analyst in the Rural Communities & Farming Support Directorate at MPI, was a key person leading the rural hub initiative. "The idea to focus on community issues and challenges came strongly from the research," he says. "The critical thing the research helped us do is come up with a practical project that helps diagnose and deal with core challenges for rural communities."

Rural communities need to thrive because they are crucial to our wellbeing as a country. However, they face increasing challenges, including social isolation, accessing services, and complexity in managing environmental issues.

For OLW to achieve its objective to maintain and improve our land and water quality for future generations, some land-use change will be necessary in some parts of New Zealand. This could impact jobs, services and social cohesion in rural communities. Initiatives such as rural hubs can support the process of change by helping rural communities adjust and respond positively.

Dr Bill Kaye-Blake, principal economist at the New Zealand Institute of Economic Research, was involved in the Indicators Working Group and Resilient Rural Communities. He says providing a framework and indicators for measuring resilience was important for having a policy impact. "From a public policy perspective, 'what gets measured, gets managed'," says Dr Kaye-Blake. The research tackled the question, how can we tell if a rural community is resilient? It developed a method to measure rural community resilience using Statistics NZ data, and a framework to assess community perception of resilience across six dimensions (social, economic, cultural, environmental, institutional, external). Investment from OLW allowed the aligned research to focus on measuring resilience – a unique opportunity due to the National Science Challenge mandate to improve research alignment and reduce duplication.

The research showed how available data could be used to understand rural communities, and that external data alone isn't enough: it is important to engage with communities and understand them from the inside. A key finding was that strong resilience in one dimension can compensate for weak resilience in others. The research can help rural communities identify different ways to grow resilience based on their own characteristics.

"The powerful thing about the research was that it showed opportunities to respond to what had been lost from rural communities – especially social capital, bonding, and cooperation," says Chantrill. "Supporting rural hubs was an important, practical way we could support those community threads and bonds."

"It was important that research was done and brought to government attention, so we could find effective ways to support rural communities more directly. Some initial work had been done, but had not progressed to funding a rural hub. The book and the research provided impetus to look at practical ways to make a difference."

MPI plans to increase the number of rural hubs across New Zealand to 22 over the next year and is working with AgResearch to further quantify challenges for rural New Zealand, so government can provide appropriate support.

Contact: Dr Bill Kaye-Blake, NZIER

Mātauranga

Over the past year OLW continued to invest significant time and care in strengthening relationships and building meaningful opportunities for Māori researchers and Māori practitioners to contribute to OLW science and thought leadership.

All relationships with Māori entities within a research programme are co-ordinated, guided, and overseen by a te ao Māori leader or Māori co-lead. These roles are held by senior Māori researchers or practitioners who have extensive experience working with Māori.

In the last year 48 mātauranga Māori experts worked directly on OLW funded research. Six of these Māori researchers work on more than one OLW programme; half are working with OLW for the first time.

In 2020-21, 5 new OLW-funded research initiatives demonstrate a very strong integration of mātauranga Māori and are Māori-led or co-led:

The Pohewa Pae Tawhiti research programme focusses on way to visualise existing Māori knowledge of relevance to land use and Māori agribusiness

Matatau Whenua is a kaupapa Māori research project that is coupled to Pohewa Pae Tawhiti to develop new Māori knowledge and collate historical oral narratives for specific land sites within Te Arawa.

The **Enacting Te Mana o Te Wai** working group is developing guidance for ensuring integrity when implementing new policy priorities.

The **Tauutuutu** think piece looked at successful Māori agri-food enterprises that operate from a deep foundation of tauutuutu, which loosely translates as reciprocity or maintaining balance. In 2021–22, OLW will develop a broader programme of work to look at the active extension of tauutuutu as a national approach.

The **Place-Based Pilots of Land Use Change** working group co-designed two research programmes (\$7.5m) to fast-track and extend the uptake of pilot-scale examples of land uses, management, practices and value chains that improve the vitality of te Taiao.

OLW Te Kaihāpai Māori (Naomi Aporo) and Kaiarataki Māori (Selai Letica) engage with all te ao Māori programme leads and Māori co-leads at least monthly to discuss issues, concerns, and opportunities, and assess resourcing for mana whenua participation.

OLW has focussed on ensuring Māori researchers have sufficient resourcing to support non-Māori staff to achieve a higher level of cultural capability where appropriate. Programmes are encouraged to create a te ao Māori development plan for Māori and non-Māori researchers. The Rewarding Sustainable Practices programme is planning a 4-part workshop series run by Māori researchers and knowledge experts, for example.

OLW has been host of the Rauika Māngai since early 2021, and the OLW Kaiarataki is currently the Deputy Chair. In 2020-21 Rauika Māngai developed and released 2 reports: A Guide to Vision Mātauranga; and Te Putahitanga: A Te Tiriti-led Science System. A Vision Mātauranga assessment tool has been developed and is being tested on OLW's existing research.

OLW sponsored a new Māori PhD scholarship at the University of Otago as part of the Pā to Plate research project in Northland. OLW is also providing full support to a Māori PhD student at the University of Otago for their thesis entitled "Kāinga, Hura and Kai: A cultural response in the face of a changing climate".

OLW's Māori research partners

Māori stakeholder groups that were involved in OLW research in 2020-21 span the length of Aotearoa and include:

Northland hapū, marae and whānau growing collectives

Oromahoe and Te Tii marae through the Waitangi catchment group

Te Arawa Primary Sector Group

Te Arawa Lakes Trust

Ngāti Rangiwewehi

Miraka

Ngāti Porou (Waiapu catchment hapū)

Tātau Tātau o Te Wairoa

Ngāti Raukawa

Te Tauihu Te Taiao Kaitiaki rōpū (including Ngāti Rārua, Te Ātiawa, Ngāti Apa ki te Rā Tō, Ngāti Koata, Ngāti Tama, Rangitāne, Ngāti Kuia)

AuOra (Wakatū Incorporation)

Mea (Ngai Tahu)

Te Kāuru hapū collective

Of the entities and collectives identified, Tātau Tātau o Te Wairoa, Ngāti Rangiwewehi, Ngāti Porou, and Ngāti Raukawa are new to OLW in the last 12 months.

Further discussions are currently underway with 6 Māori entities and iwi or hapū groups for research programmes that are currently in development for this coming financial year.



The New Models of Collective Responsibility research programme held a Catchment Forum field trip in the Pourakino catchment, March 2021, hosted at Takutai O Te Titi marae, Colac Bay.

Pūhoro STEM Academy



OLW continues its strong commitment to the Pūhoro STEM Academy's transformational kaupapa for Māori pupils in STEMM (Science, Technology, Engineering, Mathematics and Mātauranga), from Year 11 through university.

This kaupapa continues to demonstrate academic excellence and provides a critical pipeline of Māori research talent into land, water, and agribusiness science.

There were 1070 Pūhoro students in the 2020 academic year, up from 800 in 2019, affiliated to 85 iwi and 23 schools.

This year OLW also supported 17 summer internships for Pūhoro students, hosted by city/regional councils and research institutes on topics ranging from freshwater macro-invertebrate indexing to vineyard disease control and land management register tools.

OLW has committed to continue to sponsor the Pūhoro STEM Academy and its internship programme through 2024, and is providing 2 Masters scholarships for research aligned to OLW priorities.

The Pūhoro STEM Academy has recently transitioned to be independent of Massey University, enabling greater reach across Aotearoa.

Ngāi Tahu Farming is exploring regenerative agriculture with an evidence-driven approach



Ngāi Tahu Farming is designing a farm-scale trial that will transition an iwi-owned dairy block to regenerative agriculture principles and practices. This trial will see Ngāi Tahu Farming monitor and measure multiple variables, to build a data set of information that demonstrates the difference between its conventional and regenerative dairy systems. The farm-scale trial will build on a completed trial of regenerative practices on an iwi-owned 114-hectare dairy support block.

The design of the dairy system trial has also spurred discussion about te ao Māori and farming values within Ngāi Tahu. A new iwi consultancy group has been formed for the purpose of helping Ngāi Tahu shape the mātauranga Māori principles in the trial, and to help filter information coming out of the trial back to the iwi. The decision to undertake these trials, applying a scientifically rigorous approach, was influenced by Ngāi Tahu Farming's earlier collaboration on Farm Soil Health with the Next Generation Systems research programme, led by Dr Robyn Dynes, strategy lead and senior scientist at AgResearch, and funded by Our Land and Water (OLW). Another important influence came from frequent consultation with Dr Gwen Grelet, senior scientist at Manaaki Whenua – Landcare Research, the lead author of an OLW-funded white paper on regenerative agriculture in New Zealand.

Ngāi Tahu Farming has been exploring regenerative agriculture for 24 months, says Rhys Narbey, general manager of sustainability and assets at Ngāi Tahu Farming, triggered by a single sentence in the Farm Soil Health report summarising the Ngāi Tahu research collaboration: "All soils rated poorly in soil biological indicators, and may require action beyond standard practice to create an environment to enhance soil biology and the services they provide." "When you sum up the report, that one sentence meant the most," says Mr Narbey. "That led us to exploring regenerative agriculture farming practices, and we have since implemented a trial on one of our support blocks."

The lead author of the Farm Soil Health report was Dr Nicole Schon, AgResearch scientist, with co-author Ants Roberts, Ravensdown chief scientific officer. With the support of AgResearch communications staff, Dr Schon developed a 'soil health dashboard' illustration to help Ngāi Tahu clearly communicate the research results to iwi trustees, decision-makers, and marae communities. "We used the illustrations and report to help get others on board" for the regenerative trials, says Mr Narbey. "It wasn't a very hard sell. Our shareholders are really supportive of more holistic approaches."

Ngāi Tahu Farming's whenua has stony silt loam soils and a long history under pine plantation. The iwi entity joined the Next Generation Systems research programme with a goal to maintain the life-sustaining capacity of soils during the change from forestry (P.radiata) to dairy farming, and to build knowledge of baseline soil fertility and health to inform its longterm plans.

OLW's holistic understanding of the agri-food and fibre system and its place within te ao Māori empowered the research team to address questions of importance to Ngāi Tahu Farming, and bring together the right team to assess baseline soil health and explore new ways to present findings.

The research involved sampling from a chronosequence of five sites previously from Eyrewell Forest, north of the Waimakariri River near Christchurch, including a site still in forest and a site out of forestry for more than 10 years. Soil health was assessed in May 2019 against target ranges suitable for high-producing pasture agriculture. The closer to these targets, the better the soil health status. The key finding of the research was that the conversion of pine forest to irrigated dairy pasture tended to improve soil health. The soil health score was highest at the sites that had been out of forestry the longest. However, even the site with the highest soil health score was poor in soil biological indicators, with the number of earthworms remaining low. These results suggested opportunities to accelerate soil health improvement, such as understanding how regenerative agriculture might influence a faster increase in some aspects of soil health.

This finding has important implications for the OLW objective to maintain and improve the quality of the country's land for future generations, because of the potential impact on soil health of increasing land use change to forestry.

Contact: Dr Nicole Schon, AgResearch

Stakeholder Engagement

Engagement with stakeholders underpins the transformational change required to achieve the Our Land and Water (OLW) objective and is essential to our success. In 2020–21 we worked to extend OLW stakeholder networks and build OLW's reputation as a trusted independent source of information among people within the agri-food and fibre system.

All new research proposals must now use a template which prioritises impact as a key deliverable, and demonstrate meaningful engagement and co-design with end-users who can provide a key pathway to impact. All new OLW-funded large research programmes are required to have a dedicated implementation lead on their leadership team, and to integrate their impact, stakeholder engagement and strategic communications planning into an overall Impact Plan. A standard template for this was created in 2020–21.

In 2020 OLW commissioned KPMG to prepare a report on Engaging Agribusiness, to help OLW researchers amplify their research impact and increase knowledge uptake through better understanding of stakeholder perspectives. This recommended better options for the delivery of useable resources, among other initiatives.

OLW issued three open calls for Expressions of Interest to enable stakeholders to participate in working groups.

Thirteen of 15 OLW-funded research programmes (not including the 15 Rural Professionals Fund projects) reported constructive engagement with sector body, agribusiness, iwi, government or regional council collaborators this year. Examples of OLW-funded research being co-created or applied by stakeholders include:

The **Regenerative Agriculture** think piece undertook extensive collaboration and consultation with more than 70 organisations and 200 people including farmers, growers, agri-consultants, industry bodies, banks, retailers, and NGOs, to identify and prioritise research needs for regenerative agriculture in New Zealand.

The **Whitiwhiti Ora: Land Use Opportunities** research programme met DairyNZ, Overseer, MPI, BNZ, ANZ, ASB, AgFirst, Ballance and Ravensdown during its co-design phase. In the Wairoa case study, WWO is working with tripartite partners of Wairoa District Council, Hawke's Bay Regional Council and Tatau Tatau o te Wairoa, who have jointly agreed that the Wairoa River should be the research focus.

The **Pohewa Pae Tawhiti** research programme is working with Te Arawa Trust and Te Arawa Primary Sector to define the purpose and scope of the research, and with Tuwharetoa Farm Collective and Te Hiku Collective on testing the PPT Framework once developed with Te Arawa.

An impact broker was appointed to the existing **Rewarding Sustainable Practices** research programme to increase engagement with and knowledge transfer to SMEs for the remainder of the project, contributing to the programme's goal to see 10 companies transform supply chains into value chains by 2022.

The **Environmental Monitoring – Design and Environmental Monitoring – Technologies** working groups accommodated over 25 sessions with regional councils (and associated special interest groups) and central government, which proved crucial to the success of the project, helping identify end-user needs, potential case studies, and initiate potential implementation in the Kaipara catchment.

The **Enacting Te Mana o te Wai** working group brought together the CEOs of three district councils at the top of the South Island, which will now lead to the co-design a new multi-council collaboration to implement Te Mana o te Wai in their region.

Environment Canterbury will include dissolved organic phosphorus (which contributes to algal growth) in its groundwater monitoring network for the first time because two OLW-funded papers showed it was leaching through soil and current regulations were not preventing this.

Public Outreach

Public communication and outreach are central to OLW, with effective outreach regarded as a key to success and a critical component of the National Science Challenges. Our intention is for OLW to connect science with land stewards, making our knowledge, research outputs and resources accessible to all.

In 2020–21 OLW researchers recorded 37 public outreach or participation activities related to their research. In addition, Rural Professionals Fund projects completed over 20 public presentations, field days or workshops, reaching hundreds of farmers.

The New Models of Collective Responsibility research programme was particularly active in public engagement, with Pā to Plate project team member Paul Voigt organising three market festivals in Tai Tokerau to promote the project and making over 20 field visits throughout the region.

A 60% increase in media coverage in 2020–21 saw 91 mentions of OLW (or OLW research) in mainstream, industry, and rural media, up from 57 last year.

The OLW website won an award for 'Best Science Website 2020' in an international web marketing competition. The previous year's winner was the Smithsonian Natural History Museum. It is now 2 years since the website was re-built, and user numbers have increased 361%. Year-on-year, three important website metrics almost doubled:



We published 36 news articles on the OLW website this year, 17 of which summarised research findings and academic outputs in plain language. These research summaries were also emailed directly to stakeholders with an interest in the research or the ability to put findings into action.

Audience numbers across all OLW-owned channels also increased in 2020–21: Twitter followers by 33%, Facebook followers by 35%, LinkedIn followers by 276%, and e-newsletter subscribers by 78%.

In September 2020 we engaged an agency, Grassroots Media, to run the OLW Facebook page. This resulted in a 57% increase in organic reach, 30% growth in engaged users, and 82% increase in OLW website sessions via Facebook referral.

OLW is an exhibition partner for the Te Taiao Nature exhibition that opened at Te Papa in May 2019, sponsoring 4 interactive exhibits and consulting on freshwater science. The exhibition has had more than 1 million visits since its opening, and with over 500,000 visitors in 2020–21 it was again the most visited exhibition space in the museum.







Research in Plain Language

The MBIE 'Stakeholder Perspectives of the National Science Challenges' survey indicated demand for digestible, targeted information and interim results from OLW. In response, through 2020-21 OLW issued 5 Research Findings Briefs to summarise and synthesise published academic findings, and 1 OLW Guidance to share practical interim results and expert opinion.

Consumer Willingness-to-Pay for Sustainability and Other Attributes (April 2021)

Understanding Cause and Effect Relationships in Aotearoa's Water (March 2021)

Designing Effective Farm Environment Plans (March 2021)

Assessing the Effectiveness of On-farm Mitigation Actions (Dec 2020)

Quantifying Excess Nitrogen Loads in Fresh Water (Dec 2020)

Revealing Groundwater's Denitrification Capacity (Sept 2020)

Events

Open Farms

Open Farms is an initiative to reconnect urban and rural Kiwis through a nationwide open farm day, held on 21 March 2021.

OLW sponsored the event for the second year, alongside MPI and Beef + Lamb NZ. There were 2705 visitors to 37 host farms, a small drop from 2020 due to postponement following the February Covid-19 lockdown in Auckland.

OLW sponsors and supports this initiative because it aligns with our goal to improve the quality of public debate about the future of land use in New Zealand, as does the associated media activity and content generation.

Open Farms also provides OLW with a platform for research to better understand the New Zealand-specific urban-rural engagement process and urban perceptions of a sustainable food system, via participant surveys.

This year OLW designed a survey completed by 263 farm visitors (more than 80% of whom were urban dwellers) as well as 25 host farmers. A key finding from the past two years' surveys is that that spending time on farm increases visitor appreciation for the complexity of farming, connectedness to farmers, and positivity about the environmental sustainability of farming.

The survey this year reinforced previous findings that urban consumers and farmers share a similar vision of what constitutes sustainable farming. However, further key insights this year were that there is also a shared perception of the main obstacle to achieving this vision – the large market players, such as supermarkets, and that urban visitors believe that buying direct from a farmer is the best way around this. Most New Zealand urban consumers are not, however, willing to pay more for sustainably produced food, considering food from the supermarkets to be too expensive already.

Notably OLW research in the Incentives for Change theme in May 2021 indicated that overseas consumers in our key export markets are willing to pay more for sustainably produced food. This further demonstrates the difficulties of changing land use to meet the needs of our main (export) markets, without disadvantaging domestic markets.

Our survey summary and infographic of survey results were covered in the mainstream media and received good engagement on social media.



Sustainability through farmer-citizen connection

In March 2021, New Zeeland's second national Open Farms day save 2700 Kivis visit 37 farms across the country. Post-event social science research by the Our Land and Water National Science Challenge adds a new perspective to the wider story of sustainable faming:

Urban visitors and host farmers share a similar vision of sustainable farming, and urban visitors see direct-from-farmer food purchasing as their most impactful sustainable action.

A shared vision of sustainable farming



Better Together

OLW hosted a webinar series, Better Together, over 4 weeks in November/December 2020. Each week, over 1 hour, between 3 and 6 short presentations were given, highlighting the OLW vision for a more diverse, resilient, healthy landscape by 2030, what the data is currently telling us about our water (including the nitrogen maps described below), and how to bring people together to foster more diverse land uses and create effective farm plans.

The integrated communications campaign included the 4 webinars, 2 Research Findings Briefs on catchment pressure and mitigations, the launch of an interactive pressures map, 3 web articles, and media engagement. The purpose was to communicate a package of OLW research that suggests where land-use change will be necessary and describe emerging science that will inform how to collectively manage this. The webinar series was in place of an OLW biennial symposium, and proved to have greater reach with over 460 registrants, of which 70% were new contacts for OLW. We successfully reached the target audiences of central and regional government, dairy industry, farmers, and farmer support organisations, indicating that the webinars are an effective channel for public communication.



Growing Kai Under Increasing Dry

The 'Growing Kai Under Increasing Dry' rolling symposium was a pan-Challenge collaboration. OLW, Deep South and Resilience to Natures Challenges collectively trialled a new public outreach format to initiate a conversation about adaption to climate change (specifically increasing drought) in the agribusiness sector.

The rolling symposium constituted a series of three webinars, followed by an in-person symposium/ workshop at Te Papa in May 2021. The workshop invited participants to contribute their ideas on how the primary sector can best develop resilience to increasingly frequent drought, under a changing climate. The format allowed relevant NSC research to be shared via webinar prior to the workshop, while the in-person nature of the symposium enabled a



wide-ranging, well-informed stakeholder discussion of the issues. Across all four events, there were 495 participants in total, of which many attended more than one event, with 336 being new contacts for OLW.

Physiographic science is helping Northland Regional Council build better maps, models, and monitoring networks

Physiographic Environments of New Zealand Alpine Bedrock (Strong) Bedrock (Weak) Oxidising soil & aquifer Reducing soil & aquifer Oxidising soil & reducing aquifer Reducing soil & oxidising aquifer Riverine Wetlands

Physiographic information has helped scientists at Northland Regional Council (NRC) deepen their understanding of the most important drivers of water quality variation in their region. The physiographic approach is contributing to council work that, ultimately, will help the region's land stewards identify the most effective mitigation actions for their land, and inform council remediation work in environmental hotspots with high recreational value, such as the Kaipara and Hokianga Harbours.

For example, a 2020 catchment study for Hokianga Harbour used physiographic layers to assess the contaminant load for the Hokianga Harbour and develop risk maps to help inform the priority catchment areas to mitigate land-use impacts. 'Physiographic' zones are landscapes with similar attributes that influence water quality, such as climate, topography, geology and soil type. Using a physiographic classification helps us better understand how contaminants move through the landscape. Ten physiographic environment classifications and underlying driver layers were developed by the Our Land and Water (OLW) Physiographic Environments of New Zealand programme (PENZ), led by Dr Lisa Pearson and Dr Clint Rissmann of Land & Water Science.

Manas Chakraborty, freshwater scientist at NRC, describes the physiographic maps as a useful "cheat sheet" that creates clarity on how the region's landscape attributes contribute to water quality. In particular, the approach has helped council scientists understand the hydrology pathways taken by contaminants, and the oxidation-reduction ('redox') processes in the underlying soil and geology.

"For example, the maps explain why the region has very few waterways that are high in nitrate," says Mr Chakraborty. "Two-thirds of the catchments in our region are classified as 'reducing' environments. That's why Northland looks good for nitrate toxicity in our waterways – but the organic and ammoniacal forms of nitrogen are relatively high, and this can be oxidised instream while moving downstream further towards the estuary." NRC has been making use of physiographic science since 2019, often in combination with additional high-resolution radiometric data from a 2011 mineral exploration survey in the region. This combinedmapping approach contributed to the council's 'wetness gradient layer', which is helping identify saturated land and delineate wetlands across the region, and to an erosion susceptibility risk assessment, which is helping prioritise afforestation in erosion-prone areas.

Physiographic attribute gradients, in combination with the high-resolution data and detailed water quality information, were used to develop a water quality attribute prediction model for the region in 2020, to help the NRC understand its obligations under the National Policy Statement for Freshwater. As part of that work, NRC used its predictive modelling algorithms to show the combination of physiographic layers driving water quality, says Mr Chakraborty. "For example, high E.coli could be explained by high run-off risk and artificial drainage on highly erodible land with intensive land use."

"That in-depth understanding we now have comes from the physiographic model. Even if it didn't give, at reach scale, the exact values that match observed values, it still helped us understand what is actually happening in terms of water quality process. In future we'll be able to use the refined model at farm scale to identify the right mitigations in the right places for better water quality outcomes."

NRC scientists realised much of the uncertainty in the model came from unmonitored headwaters in bigger catchments. To enhance the predictive model, in 2021, NRC reviewed its water quality monitoring network and used physiographic process maps to identify where additional monitoring sites were required. "We tested our river monitoring network to see if it represented the physiographic variation across the region," says Mr Chakraborty. "This told us that introducing a few additional long-term monitoring sites would give us useful information, and indicated a need for testing some new attributes, such as dissolved organic carbon." Due to the high level of stakeholder collaboration mandated by the National Science Challenges, OLW was uniquely suited to support this research. Seven regional councils collaborated in the PENZ research project and are now applying PENZ-developed science across New Zealand. The approach is being utilised by organisations in Southland (Thriving Southland, Great South, Southland District Council), on the West Coast (Department of Conservation), Bay of Plenty (Bay of Plenty Regional Council), and in Canterbury (Living Water).

The PENZ team has almost completed an SFFF-funded web-based tool for farmers, LandscapeDNA, to help farmers identify the inherent risk of contaminant loss, better optimise their land management, and identify which mitigation measures are most likely to be effective.

Contact: Dr Lisa Pearson, Land and Water Science

Governance

Governance and management arrangements for Our Land and Water (OLW) have deliberately remained as stable as possible throughout this financial year, to realise and optimise the significant changes made in 2019–20 when the Kahui and Governance Group were combined. The relationship with OLW host AgResearch remains constructive and supportive.

An external review of OLW's governance was completed by EQI Global in June 2021. The review concluded that the Governance Group members, Stakeholder and Science Advisory Panel members and the Challenge host are all strongly engaged with, and contribute to, the OLW vision and purpose.

Governance Group

Governance of OLW is through a single Governance Group, in which at least 50% of the membership are required to have a deep understanding of te ao Māori perspectives. In 2020–21 two new members joined the Governance Group: Dr Andrew Watene (KPMG) and Iain Maxwell (Hawkes Bay Regional Council).

Evidence of the OLW Governance Group's attention to strategic leadership includes their commitment to actively guiding the Directorate towards actions that will optimise the impact of OLW research at the end of Phase 2 (June 2024). They have also raised the issue of planning for an uncertain post-2024 future through the NSC Chairs meetings hosted by MBIE.

Science & Stakeholder Advisory Panel

In 2021 the OLW Science Advisory Panel (SAP) was refreshed to broaden its scope and expertise by including leading scientists and stakeholders with experience of land steward needs and perspectives, and in te ao Māori, mātauranga Māori and Māori agribusiness needs and opportunities.

The 8-member group is now referred to as a Science and Stakeholder Advisory Panel (SSAP). It includes 4 research scientists and 4 experts in science implementation, with 4 based in Aotearoa and 4 overseas. The SSAP retains chair Professor Maggie Gill (University of Aberdeen) and member Dr Tony Petch (NZ) and adds 6 new members: Dr Andrew Ash (Australia), Dr Benjamin Dent (UK), Dr Dave Clarke (NZ), Anake Goodall (NZ), Professor Laurens Klerkx (Netherlands) and Dr Jane Kitson (NZ).

Management

Increased resourcing for the 4 science leaders enabled a step change in their management of research and interaction with all members of the Directorate, which has increased the transparency of OLW processes and priorities.

Due to ongoing Covid-19-induced limitations on travel and in-person workshops, the need for full time administration support decreased to the point where this has been replaced with a minimal part-time position, with few negative effects.

OLW has successful upgraded our use of the Smartsheet reporting platform to allow research teams to record their progress on a quarterly basis. This system simplifies research audits and enables OLW to provide formal feedback and easily access information such as milestones and deliverables.

Challenge Parties Group

The Challenge Parties Group (CPG) membership has been stable throughout 2020–21. A revised CPG Collaboration Agreement was signed in September 2020. There was consistently high attendance at four Zoom meetings in 2020–21, and constructive discussions.

Planned Research for 2021–22

OLW anticipates launching 9 new research initiatives in 2021–22, including the large Place-Based Pilots of Land-Use Change research programme (\$7.5m), and a second round of the Rural Professionals Fund.

In April 2021, in a one-day workshop involving all OLW Theme Leaders and Directorate staff, a critical assessment of past and current research was undertaken to identify any gaps or shortcomings in research delivery that could ultimately compromise our ability to deliver the Challenge objective. Using the outcomes of this workshop, a suite of 4 research investment proposals designed to minimise potential risks to achieving effective impact were submitted for Governance Group approval in May 2021. The new research investment is designed to:

- 1 Test OLW's hypothesis that a 'mosaic land use' model will lead to improved environmental, economic, cultural and social outcomes, under new Climate Change Commission and NPS-Freshwater Management policy requirements.
- 2 Provide a more holistic assessment of the effects of land use change, integrating the effects on natural systems with the effects on farmers, consumers and agribusiness enterprises.
- 3 Identify and reconcile the signals land stewards respond to when considering land use change, with those prioritised by researchers, policy makers and regulators.
- **4** Engage land use change decisions and cultural food perspectives with the National Food Strategy conversation currently underway in Aotearoa.

Another major new investment has been made in response to the growing awareness of the importance of estuarine environmental health and the need for its protection. OLW was invited to collaborate with Sustainable Seas NSC and MfE to commission research that connects catchment contaminant loads to estuarine health, as assessed through biophysical attributes and mātauranga Māori values. We anticipate a research start date of September 2021.

As of 30 June 2021, just under 90% of the Phase 2 research budget has been allocated to planned research initiatives. OLW intends to hold \$1.5m aside for "new investment opportunities" which may arise across the research investment horizon over the next 2.5 years.

Contact Us *E:* ourlandandwater@agresearch.co.nz *Learn More W:* ourlandandwater.nz



twitter.com/OurLandandWater **facebook.com**/OurLandandWater