

Our Land and Water Lifetime Narrative

Tangible impacts and scientific breakthroughs

The Our Land and Water (Toitū te Whenua, Toiora te Wai) National Science Challenge (OLW) has worked towards an agri-food and -fibre system that enhances our environment by creating more diverse land uses that improve the health of land, water and people. Our goal was for all New Zealanders to be proud of our genuinely healthy land and water, and for Aotearoa to be world-renowned for its sustainable food and fibre production.

OLW research has demonstrated there are pathways for Aotearoa to transition to an agricultural system that produces fibre and healthy food in ways that improve freshwater quality and can be resilient and prosperous. However, systemic change at all levels of our export-focussed agrifood and fibre system is needed to enable these pathways to be followed at a national scale. OLW has had tangible impacts in three key areas: the development and implementation of freshwater management policy; the actions and capabilities of catchment groups, farmers and farm advisors; and growing value for Māori and non-Māori agribusiness.

Freshwater management

OLW research has determined which of our catchments are most vulnerable to contamination from agricultural land use and why, and which contaminants are of greatest concern. It has provided a national-scale analysis of where the pressures can be lifted through better farm management, and where land-use change will instead be required. For example, one study quantified the size of the gap between the current state of our freshwater and the water quality targets set in current regulations, and mapped this consistently across the entire country. This has identified those catchments and regions where the challenge is greatest, and where mitigation actions (such as riparian planting) alone will not be enough to meet our water quality goals. This information is now accessible to all via a 'scenario builder' tool.

Regional councils have been important end-users of OLW-funded research to support freshwater management. OLW-funded guidance on the meaning and implementation of Te Mana o Te Wai, a core concept in freshwater management that is often misinterpreted, was created through mātauranga Māori-led consultation with regional councils, hapū and iwi. Regional councils have also taken up research that enables water monitoring programmes to be designed to detect freshwater change over short timeframes, sufficient to monitor improvements attributable to on-farm mitigations or land use change. The Ministry for the Environment (MfE) initiated joint OLW–Sustainable Seas research on assessing estuarine health, extending OLW's modelling beyond freshwater systems to determine the land use changes required to reduce contamination in these popular recreation areas.

Supporting land stewards

As it became clear that land-use needs to change to meet New Zealanders' expectations for water quality, OLW focussed on two things: supporting land-use change decisions, and collaborating and engaging with those who can act. It has been critical for research to demonstrate there are pathways to a future for farming that is resilient and prosperous, while improving the health of our environment.

To support land-use change decisions, OLW research investigated a wide range of land-use opportunities for Aotearoa that expand the possibilities beyond those commonly considered by land managers. Research has generated a catalogue of different pastoral, horticultural, silvopastoral and forestry land uses. Their suitability, yield maps, climate change impacts and economic returns have been compiled into a 'Data Supermarket': a one-stop shop for information to inform financially sound land-use decisions. A tool has also been generated to help land managers smooth out labour requirements on their farms by identifying

new land-use opportunities that offer counter-seasonal employment and are suitable for their region. Many other tools, approaches, guidance documents, webapps, and a series of training modules for farm advisors have also been created and tested to support land-use change decision-making.

It was also important for OLW to support the actions and capabilities of rural communities and catchment groups, so they can fulfil their key role in land-use transitions and improving water quality. OLW research was co-designed and undertaken in collaboration with groups leading local initiatives, building motivation through practical demonstrations of effective mitigation measures and supporting them to meet the expectations of their funders. In some catchments, connections were able to be made between tauiwi farmers and tangata whenua with OLW support. Engagement and communication beyond the collaborating groups was facilitated through close collaboration with NZ Landcare Trust, regional roadshows profiling relevant OLW research and promoting research outputs at national and regional agricultural field days. MfE funding for catchment group capability-building programmes was also guided by insights from OLW research.

Impact with farmers, farm advisors and the wider agri-food and -fibre sector was created through a variety of targeted initiatives, including funding 49 small collaborative research projects with farmers and rural professionals to test innovative projects on-farm. Consumer preference analyses have been undertaken biennially to track the increasing value of environmental and cultural credentials, and OLW has sought ways to incentivise and support farmers to produce higher value commodities, with lower environmental footprints.

Growing value for agribusiness

Growing value from our food and fibre exports was OLW's third key impact area. OLW research proved that agribusinesses in New Zealand can meet the needs of consumers overseas through encouraging farm management decisions that have positive environmental outcomes, and researchers created a variety of useful tools to support this. As well as direct uptake by, and impact on, those participating in this research, the results and tools have been shared widely via targeted websites, interactive online tools, webinars and videos.

Māori researchers in a variety of research programmes, oriented to both te ao Māori and biophysical science, have shown how the wider New Zealand primary sector can benefit and learn from the holistic, intergenerational perspectives on land and water, and the traditional farming practises, central to Māori culture. Examples include the development of platforms and tools to support Māori entrepreneurship, a tool to help Māori visualise land-use change, and the use of environmental sensing technologies to connect traditional knowledge and practice on farm to monitoring technology that support the generation of value in market.

In the final 12 months of the Challenge, a synthesis of OLW research was undertaken to demonstrate the outcome of economically feasible land-use change in three catchments with poor water quality due to the current agricultural land use. In each case study, modelling indicated that water quality targets could be achieved, and that converting sheep and beef farms to pine forest was the most profitable way to do this. However, this scenario is unacceptable to many rural communities and farmers who are committed to their culture and way of life, raising questions about intergenerational equity. This research identified key obstacles to initiating more innovative and diverse land-use change, including current economic and climate change policies, and the lack of available data for land uses other than those already common in Aotearoa. These factors must be addressed if progress is to be made.

Success assessed against the NSC Performance Framework

The National Science Challenge (NSC) Performance Framework was developed to monitor and assess progress towards Challenge objectives, through annual reporting to MBIE on seven performance areas: science excellence, best research team collaboration, stakeholder engagement, vision mātauranga, governance and management, public awareness and participation and, very importantly, impact.

OLW has reported annually to MBIE on each of these seven performance areas as required and has received an overall positive response every year. No major concerns with progress or achievements have been raised, and all KPIs were reported as achieved in the final 2024 annual report.

Science excellence has been assessed through the number and nature of academic publications. Over 200 peer-reviewed publications have been produced during OLW's lifetime. The most recent, independently confirmed publication data (for results up to July 2023) indicated that targets for high-quality publications (in the top 10% for citations or top 25% of journals) had been met throughout Phase 2 and exceeded in most years. Targets for domestic collaboration, as evident in publication authorship, were also exceeded in every year of Phase 2, and for international collaboration in all but one year (2021–22, following Covid).

An international Science and Stakeholder Advisory Panel guided OLW towards the highest quality research by reviewing research applications and research directions. In her final address to the Governance Group, the chair of this panel, Professor Maggie Gill from Edinburgh University, observed that OLW had achieved an international profile for doing great science in a different way.

External (Kantar) surveys commissioned by MBIE were completed most recently in 2022, to determine whether the best research teams had been used and whether Māori, as well as non-Māori OLW stakeholders, felt engaged and received value. Survey results showed a significant improvement on Phase 1 survey results (as required) and that OLW's endeavours to extend research through new networks and dissemination pathways had been noticed and appreciated.

Vision Mātauranga performance assessment was measured by the proportion of leadership positions held by Māori in OLW, and by the proportion of annual funding invested in Māori-led or kaupapa Māori research. For Māori leadership, the target of 50% was routinely exceeded. For investment in research, the target of 50% was met mid-way through Phase 2, but was slightly less (42–45%) in the final two years due to the staging of several major research programmes.

The performance of OLW's governance was not assessed through metrics, but by internal assessment of their efficacy and the value of their guidance, which was consistently strategic and well-informed. The single external independent survey conducted in Phase 2 confirmed this internal assessment.

Public awareness and participation were cornerstones of OLW's communications and engagement strategy. Success was evident in the high interest in webinars (e.g., over 3000 registered for webinars in 2023–24) and regional and national events, including a final symposium attended by over 440 people. Public interest grew consistently year-on-year, evidenced by audience growth (e.g. newsletter subscribers grew from 216 in 2016 to 6259 in 2023–24), website metrics (e.g. increase in pageviews from 22,000 in 2018–19 to 257,000 in 2023–24) and media interest (e.g. articles about OLW research increased from 14 in 2017–18 to 294 in 2023–24).

Impact KPIs

National-scale impact is difficult to demonstrate within the short lifespan of a NSC. While OLW research results could be put into action rapidly at a small scale, on a farm or in a single catchment for example, it takes many years for such changes to scale up sufficiently to be reflected in a national-scale metric. OLW modelling shows that using our co-innovation approach that embeds stakeholders in the research, it is likely to take 12 years for OLW-funded innovations to reach their peak adoption. This adoption rate is 30% faster than if research had not used a co-innovation approach (KPI 1.3).

OLW had five impact KPIs (1.1–1.5) and was able to provide 25 specific examples of strong research impact over the past five years (KPI 1.5). These impact case studies included value chain research supporting the development of the Taste Pure Nature country-of-origin brand for lamb and beef that reached hundreds of millions of people in the US and China, and could eventually earn New Zealand hundreds of millions of dollars per year; supporting Ngāi Tahu enterprises selling pounamu and perfume products to unlock value premiums; and demonstrating a reduced-cost method for establishing native forest offering potential national savings of \$10 billion, if even half the 1,000,000 hectares identified as highly erodible pastoral land were returned to native forest using this method.

To assess whether on-farm actions helped improve water quality over time (KPI 1.1), OLW revisited farms in five catchments that were part of a DairyNZ project that began in 2001. Some 67% of water quality trends since 2011 were found to be improving in response to farmers implementing good management practices, including OLW research-informed mitigation actions, and fewer than 20% of water quality trends were degrading. This was despite an increase in intensification.

A biennial analysis of agribusiness' annual reports showed that economic and environmental wellbeing considerations remained consistently high for companies surveyed from 2020–24, while the profile of cultural wellbeing considerations increased over the same period. Farmer participation in farm certification schemes increased over the same period, as did their awareness of environmental wellbeing considerations. These findings suggest the agri-food sector is increasingly oriented toward supporting the environmental and cultural aspirations of New Zealanders, recognising the potential for this to create and share more value with producers (KPI 1.2).

As well as making significant and measurable progress on national scale issues, all NSCs were expected to achieve:

- a culture change in their way of working, creating a new normal of collaborative, interdisciplinary research incorporating Vision Mātauranga principles; and
- greater impact and value from this research, compared with alternative funding mechanisms.

OLW employed a co-innovation approach to research design, integrating a wide range of disciplines and stakeholders in co-design, co-development, and co-production of research. The targets for the degree of codesign and co-production of research were consistently met or exceeded through Phase 2 (KPI 1.4). Empirical performance data from OLW's eight-year implementation indicates this approach increased impact by reducing adoption times and supporting farmers to balance economic and environmental benefits.

Creating space for Māori researchers and practitioners to explore the contribution they could make to the mission, to design kaupapa Māori research approaches and to determine their most beneficial degree of engagement with biophysical research, has initiated a process for both knowledge systems to work together. Improved outcomes for Māori are also evident in the empirical data collected over OLW's journey.

In summary, despite the longer time and additional funding required to support genuine co-design, interdisciplinary collaboration and bicultural collaboration, the OLW performance data has shown clear improvements in the level of stakeholder engagement and rate of uptake of the research. Supporting and resourcing this type of co-innovation and collaboration has resulted in greater impact for the research than would have been expected from more traditional research funding approaches.

Achievement of Gazetted objective

OLW's objective was to enhance the production and productivity of New Zealand's primary sector, while maintaining and improving the quality of the country's land and water for future generations.

We can state with confidence that primary sector productivity has improved during OLW's eight-year lifetime, but there has been less evidence of the desired improvement in environmental quality over this short period. It is impossible to determine OLW's exact contribution to changes that have occurred over the past eight years, but we can assess whether those changes are aligned to our objective.

The total export value for agriculture, fisheries and forestry in June 2014, when OLW's objective was set, was \$37.7 billion (as reported in MPI's Situation and Outlook for Primary Industries) and this remained stable until June 2016, when OLW began funding research. In June 2024, MPI reported actual food and fibre sector export revenue of \$57.4 billion in 2023, forecasting similar revenue for 2024. During OLW's lifetime, primary sector export revenue therefore grew by \$19.7 billion (52%).

Productivity also increased over this period. MPI reports that between 2008 and 2023, total labour and capital inputs for agriculture declined by 5% while output increased 33%, reaching an all-time high in 2023. This productivity growth reflects improvements in on-farm production efficiency as well as the creation of more added value.

OLW research has clearly identified the measures that need to be taken on land for water quality improvements to occur. However, it is difficult to assess national-scale trends in overall water quality for the past eight years given the variability and response lag in freshwater systems. OLW research has shown there is an average five-year time lag between actions taken on the land and their effect on nitrate-nitrogen in rivers, lakes and estuaries. Groundwater will require over 30 years of monitoring (at current frequency) to detect change in the concentrations of nitrate, the key contaminant of concern in groundwater. It is therefore too early to expect to see significant and ongoing water quality improvements arising from actions taken during and in response to OLW research.

Trends in river quality indicators are analysed over 20-year time intervals, due to this temporal variability. Stats NZ and MfE report that between 2001 and 2020, over 50% of routinely monitored sites showed trends of reducing phosphate and suspended sediment concentrations, attributable to improvements in on-farm management. Contaminants that are more difficult to remove by these processes, such as E coli and nitrate, do not yet show such promising results. However, the number of dairy cows reduced by over 10% during OLW's eight-year funding period (Stats NZ). If this continues and alternative land-uses are more benign, reduction in E. coli and nitrate could be expected over time.

What will, or should, lead on from OLW's journey?

OLW has undergone a significant evolution since it began in 2016. Several key departures from traditional research funding approaches were made late in Phase 1 and early in Phase 2, to create a more accommodating environment for the design and implementation of impactful, collaborative, interdisciplinary mission-led research. Behaviours and ways of working that we believe will, or should (with the right support) lead on from OLW's journey include:

- Research collaboration actively extending beyond the main research institutions and academia;

- A deeper understanding of the benefit of Māori world views and knowledge systems in achieving impactful, intergenerational outcomes for all New Zealanders; and
- Valuing a broad range of research outputs that are geared towards creating and empowering change.

Research collaboration beyond the main research institutions and academia

Throughout the Challenge's lifetime, considerable time and resources were dedicated to building trusting, durable relationships among more than 1000 OLW research team members, including career researchers as well as specialists from small consultancies, mātauranga Māori practitioners and practitioners from other sectors with specialist industry- or policy-related skills and knowledge. All who participated in OLW projects had to learn new, inclusive, mission-led approaches. We are confident that many of these partnerships will endure to benefit future mission-led research.

Benefits of Māori world views and knowledge systems in achieving impactful, intergenerational outcomes

Late in Phase 1 of the Challenge a decision was made by the Governance Group to place te ao Māori (a Māori world view) at the heart of OLW, broadening the emphasis on biophysical science to include holistic and interconnected thinking about our environment, in a way that better reflects our Te Tiriti partnership. Consideration of Māori values, that do strongly align with universal values held by many New Zealand farming families, put OLW research programmes more in touch with the needs of both Māori land stewards and rural communities. It also opened up new opportunities for knowledge exchange on how to better care for our whenua and wai.

Valuing a broad range of research outputs

Towards the end of the first phase of the Challenge we recognised that, despite the excellent science being produced, journal publications were not going to be a strong path to achieving impact. We therefore needed to send strong signals to the research community that it was important for us to recognise the value of a range of research outputs, rather than assessing research excellence based solely on publications. Excellent, user-relevant research was better communicated through additional forums, such as pānui, websites, print media, rural magazines, social media, webinars, videos, podcasts, roadshows and exhibits at public events such as agricultural days. Resourcing science communication and rural engagement, both within projects and within the management team, was essential to connect research with its next-users to facilitate research uptake and impact. It is important to emphasise that this is a significant departure from how most of the research sector currently operates. Resourcing communication specialists to work alongside research specialists facilitates the rapid adoption and use of research.

These and many other aspects of the NSC experience provide a strong foundation for supporting future mission-led research. OLW's hope is that the lessons that have been learnt are used in this way, to further develop ways of working that lead to more real-world impacts.

Where next for research?

OLW has identified some logical next steps for research, based on obstacles to progressing the required mitigations and land-use changes, and problems that have become evident in the wider agri-food system. For example, current economic drivers and climate change policies are an obstacle to implementing more innovative and potentially more valuable land uses. These factors are promoting farm conversion to exotic forestry, driving land-use change in a direction that is unacceptable to many rural communities. A review of the implications for rural communities and our landscapes is needed, as well as research to support a better regulatory approach. It is also critical that water quality improvement is not considered in isolation, but is

instead placed in a wider context of achieving improvements in soil health, greenhouse gas emissions, biodiversity, farm resilience and climate change adaptation.

Much of the land-use change needed for the future needs to happen first at farm scale, based on farmers' decisions on what best suits their circumstances. The lack of good data for many of the less common land uses is an obstacle to this type of decision-making. The OLV-funded 'Data Supermarket' provides an existing repository of land-use options that should be utilised for this, but requires funding for its data coverage to be extended and existing data to be kept up-to-date. Building on OLV's collection of such information would be a useful next step for research.

It has also become evident that our agri-food system, geared to export markets, does not serve New Zealanders well. There is inequitable access to healthy food at affordable prices and little incentive for farmers to produce for a domestic market when export markets are more lucrative. A National Food Strategy could be a useful tool to guide land-use change, increase food resilience and diversity, and encourage more local produce to be sold into local markets, building on the foundations of OLV's research.

In summary, OLV research has clearly identified mitigations, land-use changes and pathways for implementation that would lead to improvements in the quality of our freshwaters. The next step is to remove the obstacles that currently prevent farm-scale exemplars of what can be achieved, being scaled up to regional- and ultimately national-scale change. A review of the policies, practices, economic structures and infrastructure elements that stand in the way of farmers making land-use decisions that improve environmental quality, is now needed.

Challenge Lifetime Narrative – social media summary

As New Zealanders, we are all closely connected to our rivers, lakes and estuaries, and we all love our food. Our Land and Water's mission was to find new ways for our farmers, growers and food businesses to create a future where our land use is smarter, farmers are rewarded for environmental stewardship, and our waterways are cleaner. With research that supports action to improve our water quality, collaborate in catchment groups, elevate the value of our food, and explore new land use opportunities, there are new pathways for farming in Aotearoa to become healthier, more prosperous and more resilient.

Explore the 900+ tools and resources developed for all the different groups who care for our water:

<https://ourlandandwater.nz/resource-finder/>

Learn more with Our Land and Water's three online courses: <https://ourlandandwater.nz/learn/>

Discover the outcomes of Our Land and Water's work: <https://ourlandandwater.nz/outcomes>

[MBIE note: Can be shared with this video: <https://vimeo.com/957463712> – please download via Vimeo link]