Research Landscape Map

(3rd edition 2019/20)

Report for the Our Land and Water National Science Challenge

July 2020

Report for the Our Land and Water National Science Challenge

July 2020

D Houlbrooke[1], R McDowell[2], C Saunders[3], J Turner[4], S Letica[5], T Petch[6], A Judge[7]

[1] OLW Theme Leader Future Landscapes, AgResearch Ruakura, Hamilton

[2] OLW Chief Scientist, AgResearch Lincoln

[3] Past OLW Theme Leader Incentives for Change, Lincoln University, Lincoln

[4] OLW Theme Leader Capacity for Transition, AgResearch Ruakura, Hamilton

[5] OLW Theme Leader Vision Mātauranga, Orangahau Ltd, Dunedin

[6] OLW Science Advisory Panel, Consultant Hamilton

[7] AgResearch Ruakura, Hamilton

Table of Contents

Summary

The development of a third edition of the Research Landscape Map (RLM) for the Our Land and Water National Science Challenge (the Challenge) has delivered three components: 1) a rich understanding of the current research landscape, particularly work that has the potential for medium to high impact to help achieve the Challenge mission; 2) the confirmation of significant research gaps related to critical elements delivering to OLW strategic research priorities, and 3) informed where linkages should exist between Challenge programmes and existing research.

Research providers, funders and stakeholders were asked to supply briefs of all research programmes (live as of July 2019), larger than $50K per annum, which delivered outcomes complementary to the original Challenge strategy. Independent assessors helped assess the projects according to their likely impact in helping to meet the Challenges mission. The process accounted for how well organisations and independent expert assessors scored impact. Outputs from the mapping exercise are available to all.

The third edition of the RLM has an inventory of 149 research programmes. Compared to previous editions of the RLM several factors were noted:

- Overall, there is less investment (13.5%, $13M decrease since 2017?), with decreases in Govt-MBIE, Govt-Other and industry categories but a considerable increase in SSIF (45%, $9M). The decrease is partly compensated by an increase in Challenge funds (not included above) as we commence Phase 2 with an increase in annual funding from ($5 to $12M p.a.) compared to Tranche 1.

- The distribution of funds within the Future Landscapes theme has changed with increases in investment in water quality limits and mitigations and catchment systems and attenuation and aquatic biodiversity and cultural values at the expense of precision agriculture and horticulture, plants for production and farm systems.

- The number of programmes with material collaborative efforts was 43, 50, and 43% for Future Landscapes, Incentives for Change and Capacity for Transition, respectively which is no significant change from 2017.

- Of those programmes who identified enablers (big data, building capacity, connecting with society, knowledge into action, vision Mātauranga) as aiding their outcomes there was a significant improvement in their perceived importance in the Future Landscapes and Incentives for Change Themes.

    o Future landscapes and Incentives for Change themes identified significant increases (P<0.05) in the relative importance of all five enablers between the 2017 and 2019 RLM editions. Capacity for Transition measured no significant change.

- Compared to the 2017 edition of the RLM, the number and investment in programmes scored of moderate to very high likely impact towards the Challenge mission increased for Incentives for Change (n=7) and Capacity for Transition (n=8) but was lower for Future landscapes (n=30).

- The greatest funding source of high to very highly scored projects for all themes is SSIF, while Govt-MBIE accounts for the largest proportion of programmes scored moderate or lower. This is consistent with the second edition of the RLM, but contrasts with the first edition of the RLM which identified most of the investment in low to very low scored programmes as sourced from SSIF funds. This continues to indicate a strategic shift in CRI funds towards the Challenge mission, and a potential lack of alignment to the Challenge for MBIE-proposals

- Using impact as a measure of alignment to the Challenge mission, relatively little investment was found in Phase 2 strategic areas in particular; Novel production systems, Mechanisms that reward sustainable practices, Acting as Kaitiaki, Increasing our social capital, Pressures and barriers.

- A Challenge workplan refresh is currently under way in order to determine the critical elements of research required and prioritise investment in order to most effectively achieve the challenge mission.

1.   Introduction

The Our Land and Water National Science Challenge (OLW-NSC) maintains a research landscape map (RLM) of existing research of relevance to the Challenge strategy[1]. The Our Land and Water National Science Challenge (Toitū te Whenua Toiora te Wai) has a statutory mission to improve production and productivity of the primary sectors while maintaining and improving the state of our land and water resources for future generations. We capture this mission in a vision which looks to *a future where catchments contain mosaics of land uses that are more resilient, healthy and prosperous than today. This is a future in which all New Zealanders can be proud of the state of our land and water* and share the economic, environmental, social and cultural values derived from te Taiao. Te Taiao is the environment that contains and surrounds us. It has four major components, Whenua (land), Wai (water), Āhuarangi (climate) and Koiora (all living communities). It encourages us to aspire to a future where humanity and the natural world sustain each other in an interconnected relationship of respect.

To achieve our mission and vision the Challenge works under three interconnected themes with the following strategic areas:

Future Landscapes

1. Be able to see what diversity is possible, and match land use to what it is suitable for.
2. Understand and model the management of land and water quality.
3. Identify production systems that use healthy land and water to generate high-value products.

Incentives for change

4. Capture and share with the producers more of the value consumers associate with our products
5. Increase and share value based on mechanisms that reward sustainable land use and high-value products
6. Enable communities to identify and adopt sustainable land use practices

Capacity for transition

7. Increase our social capital so that we can have well informed debate about alternative futures
8. Act as kaitiaki, being responsible for our actions within enterprises, in a catchment and beyond
9. Manage pressures and remove the barriers to a transition

The specific aims of the 2019 RLM were:

- Obtain a snapshot of recent/current projects in each of the Challenge's themes
- Identify current level and sources of investment (2017 onwards)

---

[1] https://ourlandandwater.nz/about-us/our-strategy

- Determine relevance of each project assessed as the likelihood of achieving a significant impact towards the Challenge mission within 5-10 years.
- Track metrics to measure success, such as the level of alignment, and inform Challenge key performance indicators.
- Inform the process of identifying and filling research gaps through alignment and investment.

2. Methodology

With limited resources there is a need to assess impact and alignment to the Challenge mission. There exist a number of methodologies with which relevance can be assessed, each with advantages and disadvantages (Morgan, 2014). It should be noted that this **does not** constitute an assessment of the quality of the research or its potential impact on the primary sector in areas that do not so directly align with the Challenge mission and vision.

To construct the RLM, the following project inputs were requested from several organisations (Table 1). These inputs were:

1. Identifiers (organisation name, project titles, funding sources, and magnitude).
2. Timeline (start and end dates).
3. Objectives.
4. Achievement measures.
5. A project's use (1 = very low, 5 = very high) of the Challenge Enabling Themes: Big Data, Building Capacity, Connecting with Society, Turning Knowledge into Action, and Vision Mātauranga (see Appendix I).
6. The organisation's assessment of impact towards the Challenge mission (1 = very low, 5 = very high).

Table 1. List of organisations from which data inputs were supplied.

Government	Industry	NGO	Provider
DOC	AgFirst	Te Arawa river trust	AgResearch
ECAN	BAN	Federated Farmers	ESR
HBRC	FAR	NZ Landcare trust	GNS
MPI	Horticulture NZ		Lincoln Agritech
MfE			Lincoln University
WRA			MWLR
			Massey University
			Motu Research
			NIWA
			Plant and Food Research

			Scion
			University of Canterbury
			University of Otago
			University of Waikato
			Victoria University
			Land and Water Science
			Cawthron Institute

Additional notes to guide organisations in the input of data included:

- Projects were included in the mapping exercise if live during the 2019/20 financial year.

- Projects were not considered for inclusion if they were of lesser value than $50k per annum.

- The magnitude of funding was calculated as total value for the project (and per annum). For on-going Strategic Science Investment Fund (SSIF)-funded projects, the end date was assumed to be June 30th 2020. Funding sources were divided into: Government – via the Ministry for Business, Innovation and Employment (MBIE) and including Challenge funds; Government – via other sources including MPI's and Regional Council funds; Industry related funds such as the Foundation for Arable Research or the Fertiliser Association of New Zealand; Non-Governmental Organisations such as Forest and Bird; Commercial companies; University funds such as the Performance Based Research Fund; and other.

- If more than one theme was targeted, organisations were asked to concentrate funding into the most relevant theme.

Once collated, an additional assessment of programme impact was made by the OLW Science Leadership team plus an independent assessor. The independent assessor filled a gap in expertise and had a strong working knowledge of the challenge as a member of the Science Advisory Panel

Data for impact was analysed using the software product R with analysis dependent upon the question being asked below:

Is there evidence that the mean score for the enablers differ within and between themes?
- Analysed using ANOVA with the main effects as enablers and theme and their interactions. Pairwise differences interpreted as significant at the 5% level using the 'predictmeans' package.

Do the assessors average score differ to the provider score? Do the assessors scores differ based on the provider? And Do the assessors favour a theme?
- Analysed using linear mixed effects model (from the lme4 package) with the main effects being assessor, theme and provider, and their interactions as the fixed effects and project as the

random effect. Pairwise differences interpreted as significant at the 5% level using the 'predictmeans' package.

The outputs from these analyses were used to ensure that the assessment of programme impact towards the Challenge mission and vision was consistent amongst assessors and adjust impact score if it was not. However, we recognise that the assessment is still subject to several caveats including the quality and level of the information supplied (i.e. was there enough to judge impact).

Information is presented at the Theme level, to keep compatibility with the outputs of the first and second RLM, and towards each of the strategic areas from the second RLM. Due to the large size of the Future Landscapes theme, programmes were also mapped (in the accompanying spreadsheet) into one of 10 categories: 1) Plants for production; 2) Animals for production; 3) Water allocation and irrigation efficiency and production benefits; 4) Climate and climate change effects; 5) Precision Agriculture and Horticulture; 6) Soil quality and erosion; 7) Water quality, limits and mitigations; 8) Farm systems; 9) Catchment systems and attenuation; and 10) Aquatic biodiversity and cultural values. Impact to these categories was not assessed, but have been used by other stakeholders in the assessment of research strategies (McDowell et al., 2016).

Direct comparisons between the different editions of the RLM were made using a non-parametric Kruskal-Wallis test (due to skewed data) for the comparison of medians and a one-way ANOVA for the comparison of proportions.

3.   Outputs

As shown in Table 1, data was received from 60, 25, 43 and 94% of government (central + regional), industry bodies, non-governmental organisations, and providers, respectively. The level of input from NGOs and Industry was less than desirable, however this was compensated by having feedback from all science providers, other than Aqualinc, hence providing confidence that we have captured the research being undertaken. The total number of programmes were 119, 14 and 16 for each respective theme. This compares with 172, 22 and 32 for 2017 and 243, 51 and 66 in 2015.

3.1   Metrics

Generalised thematic-based metrics were derived for:
1.   The magnitude of investment by source (e.g. industry vs government – MBIE vs CRI SSIF funds;
2.   The degree of collaboration within a project to other groups;
3.   The frequency and degree of assistance that enabling themes significantly contributed to the outcomes of a programme; and

4. The likely impact (scored 1 = very low to 5 very high by providers) that an enabling theme contributed to outcome of a programme – introduced in the 2nd edition.

These metrics are used to indicate changes during the lifetime of the Challenge. Metrics are reassessed every two years. At the high (Theme) level, it is unlikely that more frequent assessment would be able to highlight specific areas of research requiring realignment.

The hypotheses are that with time, the degree of collaboration and use of Challenge enablers would increase, and that the magnitude and distribution of investment sources would change and become more aligned with the Challenge Themes.

3.1.1 Investment

The total annual investment along with the relevant funding sources is given in Figure 1 apportioned according to each organisation's assessment of alignment. In Future Landscapes and Capacity for Transition themes the major source of funding was from MBIE. Challenge funding as of December 2019 (counted as subset of MBIE funds) comprised an additional 4.41 and 1.35M of funding per annum to these themes and 1.72M of funding per annum to Incentives for Change based on 2018/19 investment. These sums are not included in the analysis below. Crown Research Institute SSIF and industry funding were also a significant source of investment in the Future Landscapes theme. When broken-down further, the majority of 'Govt – other' funding was sourced from the Ministry for Primary Industries. The study of greenhouse gasses (GHG) is not within the scope of the Challenge, although adapting to climate change is.
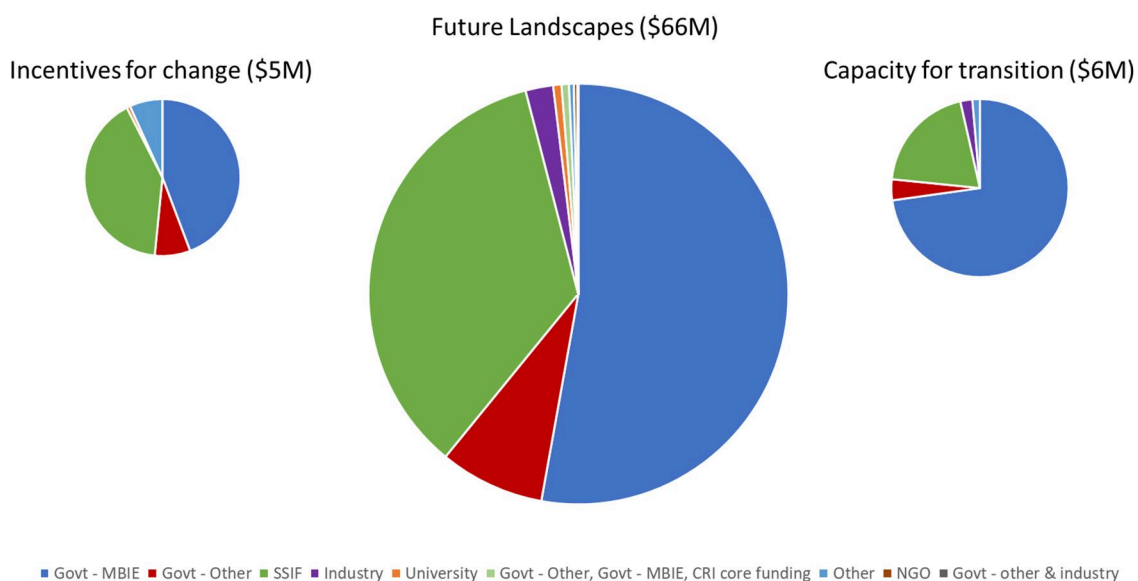

Figure 1. Total annual investment and funding sources apportioned to each Theme. The size of the pie chart is indicative of the magnitude of annual investment.

Changes in funding across the three editions of the RLM are given in Table 2. The main source of the decrease has been fewer funds from Govt-MBIE, Govt-Other and Industry. We have no rationale for the decrease in Govt-MBIE – although as a competitive fund, fluctuations are possible. Decreases in Govt-Other were expected as Primary Growth Partnerships with the Ministry for Primary Industries mature and new applications are assessed as part of a transition of these funds to the newly established Sustainable Food and Fibres Future Fund. Industry funds substantially decreased in the Future Landscapes theme, although an exact reason for this is unclear. However, substantial increases were noted in CRI SSIF funds, especially in the Incentives for Change theme.

**Table 2**. Changes in major funding sources in each theme.

Theme / Funding source	First RLM	Second RLM	Third RLM	Percent decrease from Second RLM[1]
Incentives for change				
Govt - MBIE	$3,811,755	$6,664,399	$2,995,000	-55%
Govt - Other	$2,248,564	$300,000	$498,374	66%
SSIF	$4,150,787	$1,627,000	$2,767,000	70%
Future Landscapes				
Commercial	$3,725,935	$386,437	$185,000	-52%
Govt - MBIE	$25,481,363	$36,721,719	$37,159,106	1%
Govt - Other	$14,301,246	$11,379,226	$5,683,827	-50%
Industry	$11,392,523	$14,121,711	$1,496,904	-89%
SSIF	$24,418,856	$17,012,453	$24,636,139	45%
Capacity for transition				
Govt - MBIE	$5,064,322	$5,179,418	$5,539,603	7%
Govt - Other	$3,525,496	$1,183,000	$289,031	-76%
SSIF	$2,483,374	$1,172,198	$1,510,000	29%
Total	**$100,604,221**	**$95,747,561**	**$82,759,984**	**-13.5%**

[1] Positive number indicates an increase in funding relative to the second RLM.

As a matter of consistency, we compared investments in the Future Landscapes theme by sub-topic from the first and second RLM in Table 3. Shifts have occurred towards water quality limits and mitigations and catchment systems and attenuation and aquatic biodiversity and cultural values at the expense of precision agriculture and horticulture, plants for production, and farm systems. Although speculative, this change coincides with policy signals from the Government for the improvement of freshwater quality.

Table 3. Sub-categorisation of the Future Landscapes theme for the three editions of the Research Landscape Map.

Theme 2 (sub-categorisation)	First RLM	Second RLM	Third RLM
Plants for production	$13,238,035	$9,354,915	$4,198,935
Animals for production	$6,769,818	$730,049	$358,818
Water allocation and irrigation efficiency and production benefits	$11,601,115	$6,800,908	$4,716,844
Climate and climate change effects	$5,691,937	$3,808,890	$3,023,664
Precision Agriculture and Horticulture	$4,092,754	$15,124,695	$5,465,333
Soil quality and erosion	$9,279,587	$6,856,140	$4,246,917
Water quality, limits and mitigations	$8,396,896	$17,305,828	$20,203,671
Farm systems	$10,310,954	$6,061,566	$2,713,321
Catchment systems and attenuation	$6,295,175	$9,827,131	$12,089,890
Aquatic biodiversity and cultural values	$5,550,984	$4,168,515	$13,316,334
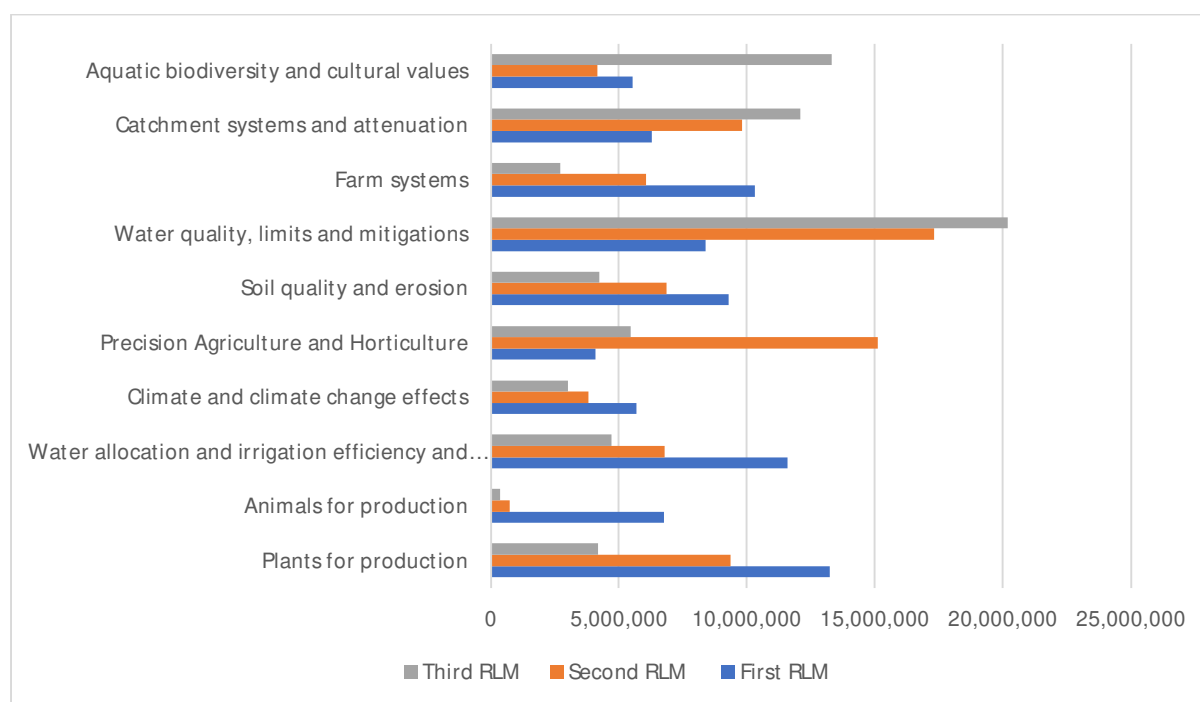
3.1.2   Collaboration

The frequency and number of collaborators as indicated by each theme is given in Figure 2. By difference, the proportion of projects with no indicated collaboration was 43, 50, and 43% for Future Landscapes, Incentives for Change and Capacity for Transition, respectively. This was unchanged (Kruskal-Wallis P>0.05) from the 2nd edition of the RLM at 40% for Future Landscapes, 64% for Incentives for Change and 31% for Capacity for Transition, but increased from the first edition of the RLM, which has an overall proportion of programmes with no collaboration of 23%.
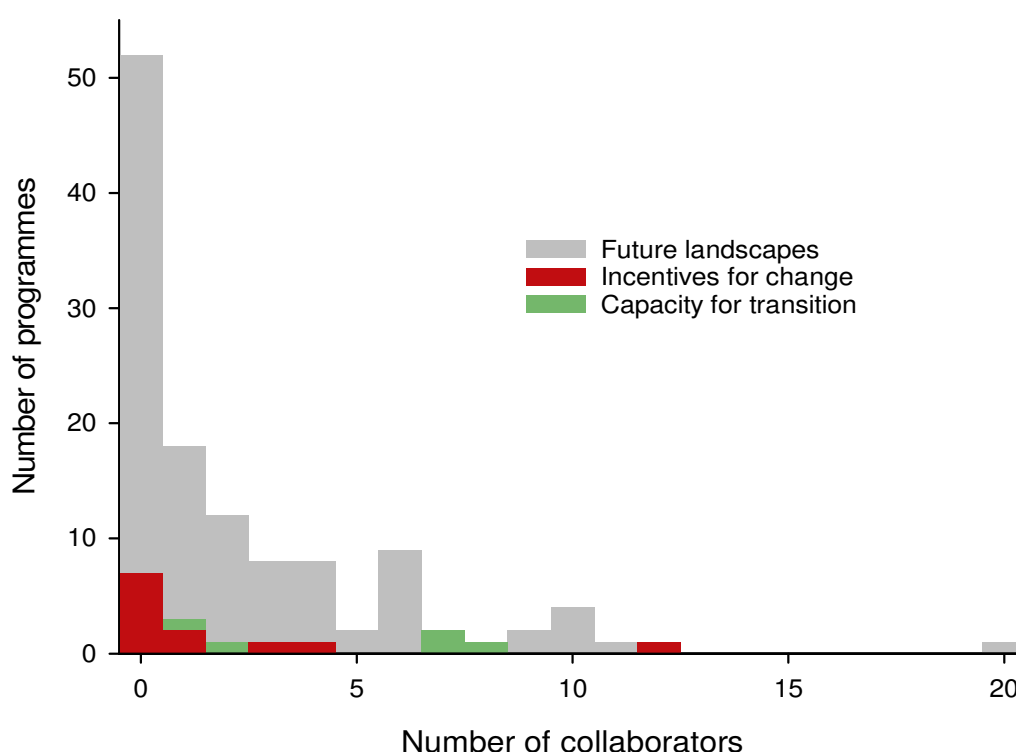

Figure 2. Histogram showing the number of collaborators within projects for each Theme as indicated by organisations.

3.1.3   Use of enabling themes

Providers assessed the relative importance of enablers to deliver outcomes. Mean scores for each theme are given in Figure 3. A score of 3 (out of 5) is considered of moderate importance. A one-way ANOVA indicated significant difference amongst the enablers with knowledge into action perceived to be more important to the delivery of outcomes in Future Landscapes and Incentives for Change than Capacity for Transition. The lower level of use of some enablers could represent the level of understanding of an enabler or that some programmes (and the disciplines used therein) require fewer enablers to deliver outcomes.

Going into more detail between RLM editions, the proportion of programmes who identified the enablers as helping deliver their outcomes in the third edition decreased by 20% for the Future Landscapes Theme but increased by about 20% for the Capacity for Transition Theme compared to the second edition of the RLM (Table 4). However, of those programmes who identified enablers as aiding their outcomes there was a significant improvement in their importance in the Future Landscapes and Incentives for Change Themes (Table 4). A description of each of the enablers is given in Appendix I.
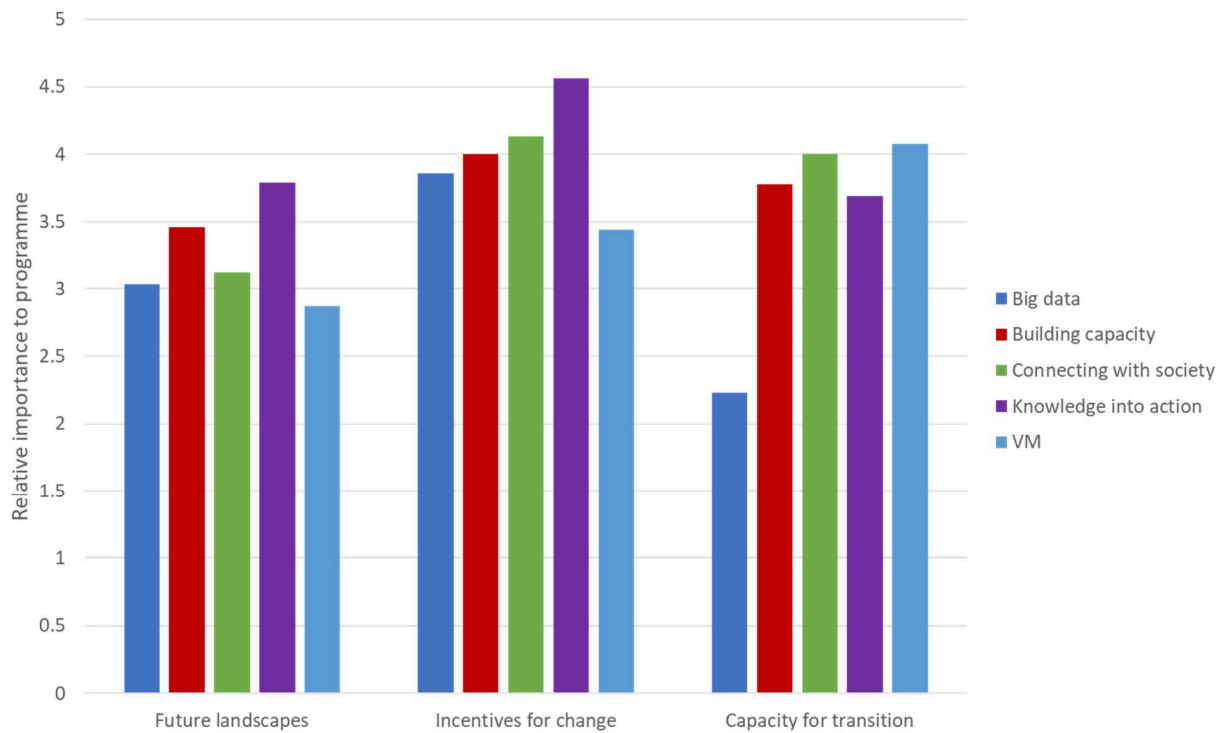

Figure 3. Relative mean importance of enablers to the delivery of outcomes for programmes in each theme.

Table 4. Relative importance, and in parentheses, the proportion of programmes that identified enablers as aiding in the delivery of outcomes in the second and third edition of the RLM. Significant differences between editions for importance are indicated by *P* values.

Theme	Edition	Proportion of programmes identifying enablers in aiding the delivery of outcomes				
		Big data	Building capacity	Connecting with society	Knowledge into action	Vision mātauranga
Future landscapes	2017	2.4 (73%)	3.0 (73%)	2.4 (72%)	3.1 (73%)	2.0 (72%)
	2019	3.0 (53%)	3.5 (54%)	3.1 (53%)	3.8 (53%)	2.9 (50%)
	Difference	0.003	<0.001	<0.001	<0.001	<0.001
Incentives for Change	2017	1.7 (52%)	2.7 (52%)	2.3 (52%)	3.0 (52%)	2.0 (52%)
	2019	3.9 (54%)	4.0 (54%)	4.1 (54%)	4.6 (54%)	4.6 (54%)
	Difference	0.015	0.024	0.007	0.025	0.019
Capacity for Transition	2017	2.3 (58%)	3.6 (58%)	3.8 (58%)	3.4 (58%)	3.6 (55%)
	2019	2.2 (87%)	3.8 (87%)	4.0 (87%)	3.7 (87%)	4.1 (87%)
	Difference	0.842	0.659	0.671	0.543	0.356

3.2 Relevance assessments

In order to assess the impact of current work to the Challenge strategy and mission, scores for impact need to be adjusted for consistent over or under assessment. The collated outputs indicated that for all three Themes the scores provided by organisations were different ($P<0.001$; usually greater) than that given by a group of independent assessors (Figure 4). However, there was no notable bias in the scores of independent assessors ($P>0.01$) (Figure 4). The adjusted scores are therefore those of the independent assessors. Care should be taken in interpreting the results of the scores for individual organisations. Whereas some providers contributed a wide range of projects to the RLM, other providers were narrower in their focus. Where providers were more inclusive there are likely to be a larger number of projects that are less directly aligned to the Challenge, lowering the average score. Hence, a high or low average score should not be taken as a measure of the organisation ability to deliver impact to the Challenge.

Adjusted scores were used to filter programmes that were of moderate or greater relevance (i.e. scored ≥3). By Theme, the numbers of programmes of moderate or greater relevance were 30, 7 and 8 for the Future Landscapes, Incentives for Change and Capacity for Transition themes, respectively. Data for investments in all projects according to adjusted relevance is given in Figure 5. The annual level of investment for projects of moderate or greater relevance was $66, 5, and 6 million for Future Landscapes, Incentives for Change and Capacity for Transition themes, respectively. Therefore, there are $37, 3, and 4 million per annum spent on projects that are projected to have a low to very low relevance on one or more of the Challenge Themes (Figure 6). The distribution of funding sources for high to very high scored projects differs to that seen in Figure 1 for total annual spend. The greatest funding source of high to very highly scored projects for all themes is SSIF, while Govt-MBIE accounts for the largest proportion of programmes scored moderate or lower. This is consistent with the second edition of the RLM, but contrasts with the first edition of the RLM which identified most of the investment in low to very low scored programmes as sourced from SSIF funds. This continues to indicate a strategic shift in CRI funds towards the Challenge mission, and a potential lack of alignment to the Challenge for MBIE-proposals.
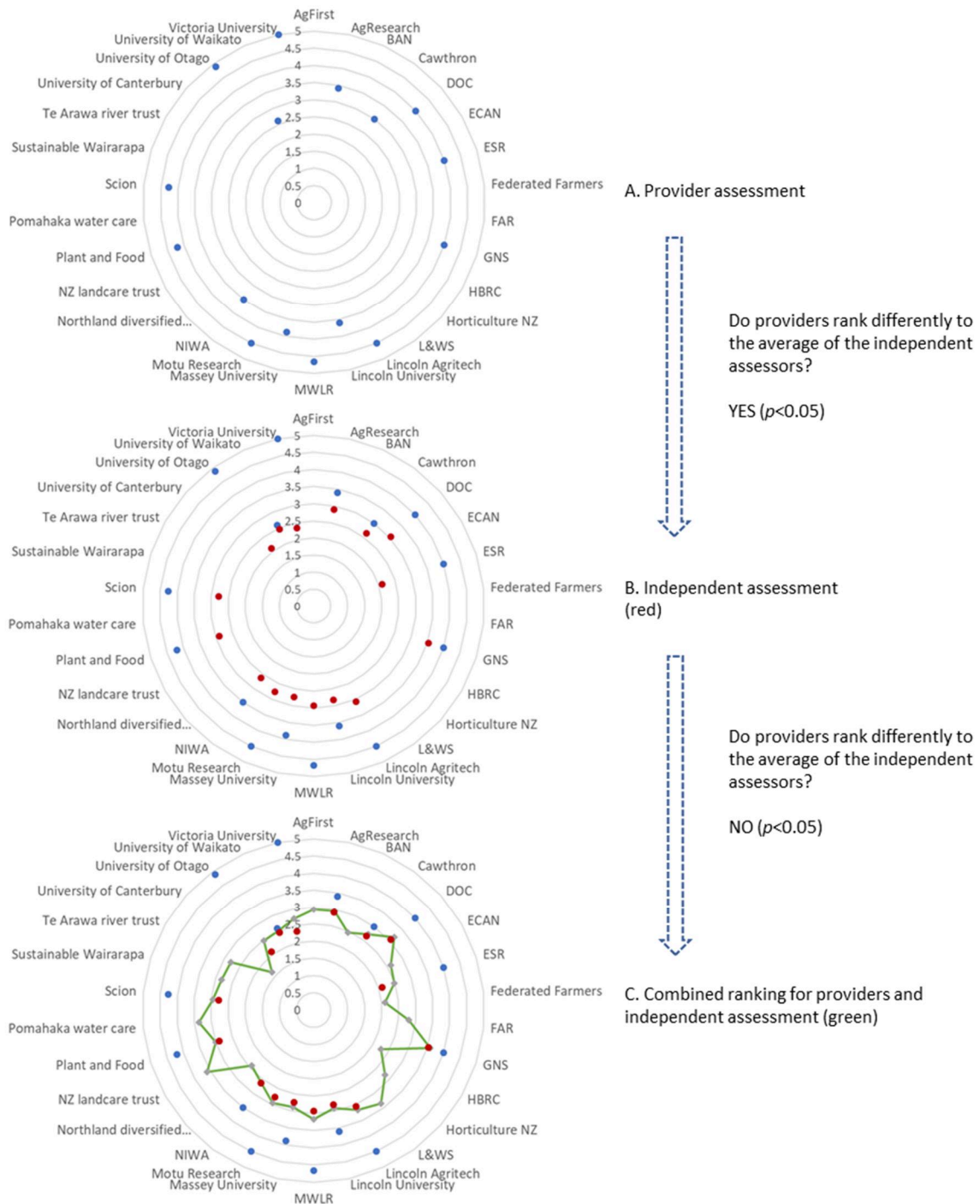
Figure 4. Mean scores for all programmes by organisation as contributed (A) (blue circles), (B) the independent assessors (red circles), and (C) for both after adjustment (green diamonds).
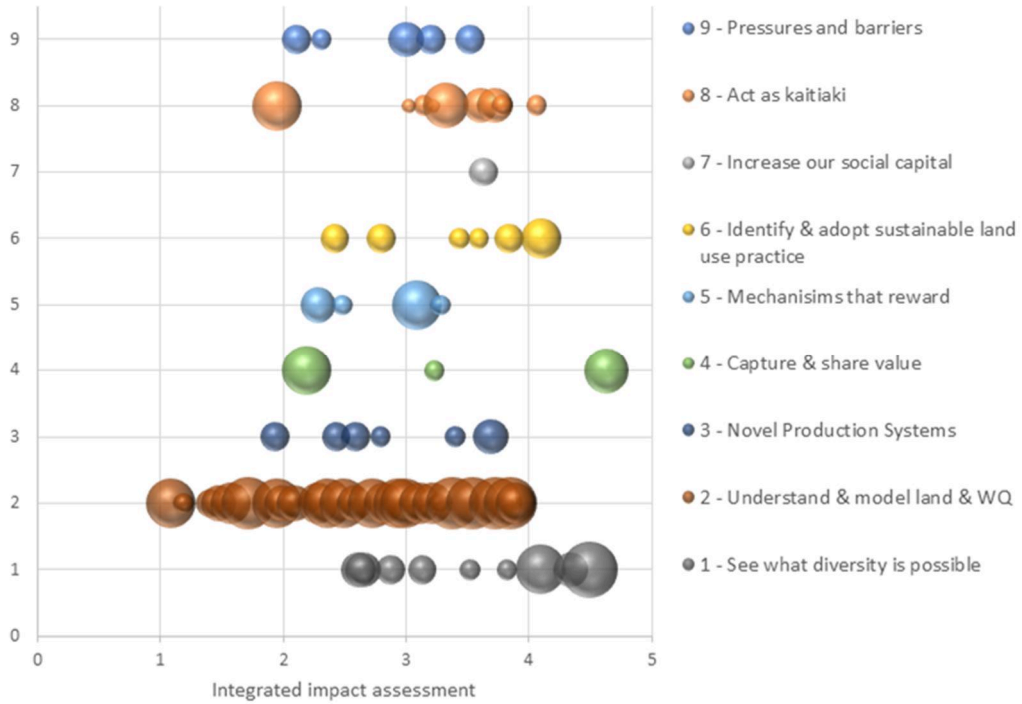
Figure 5. Integrated impact assessment (horizontal axis) and the magnitude of investment for each programmes (represented by the size of the bubble) according to their fit to strategic areas in the Challenge.
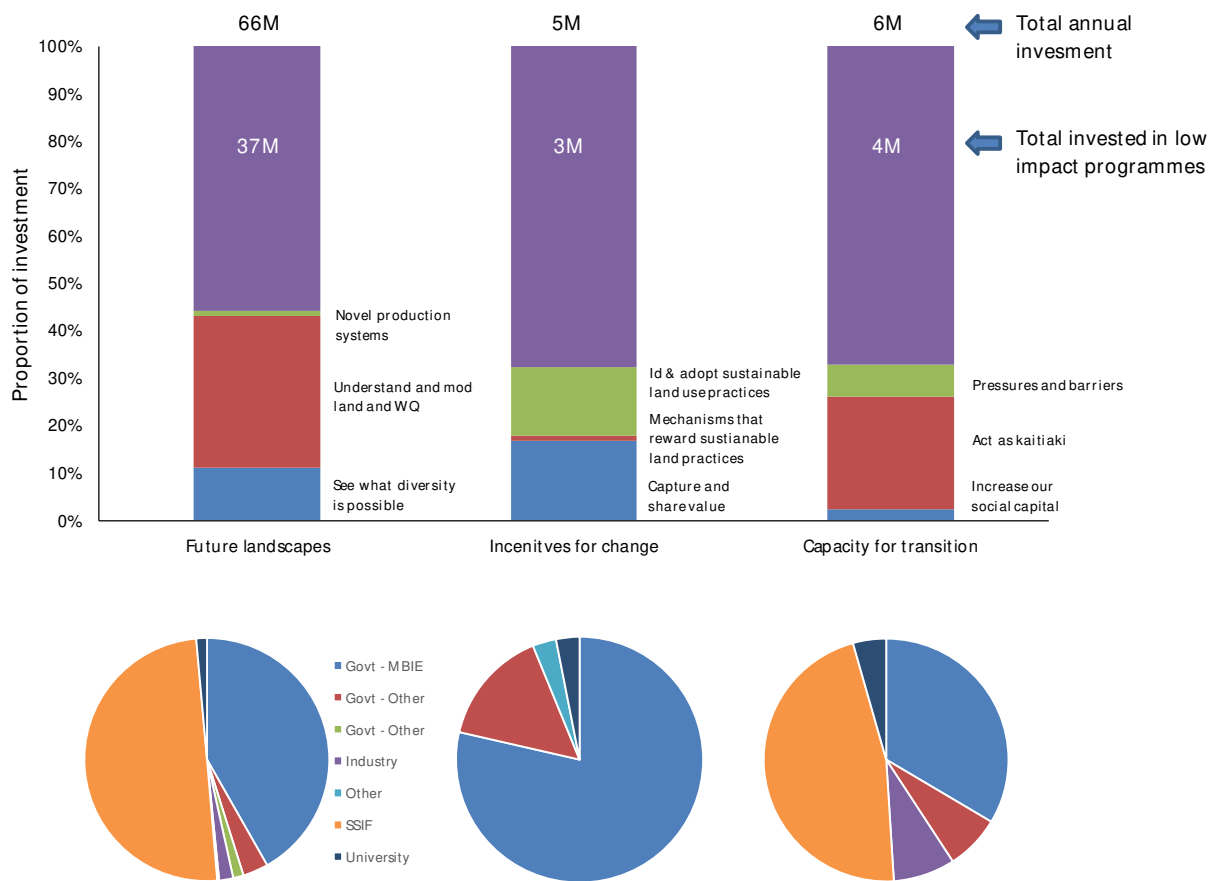
Figure 6. Mean proportional spend by theme and strategic area for moderate to very-highly scored programmes (top). The difference from the total annual spend gives the proportion spent on low to very low scored programmes for each Theme. The high to very highly scored programmes are broken down further by funding source (bottom).

4.   The plan to 2024 and research gaps

Recent disruption caused by Covid-19 has led to a range of opinions highlighting near-term issues and reflections on role of science to solve long-term land and water issues. Commentators note that long-term issues remain, such as decreasing our effect on water quality and reducing greenhouse gas emissions remain the same. However, the disruption with Covid-19 has led to near-term forecasts that there will be increased focus on food security, food system automation, increased demand for nutraceuticals and plant-based commodities.

Despite recent disruptions, the OLW vision remains intact, but we have undertaken a workplan refresh designed to align greater with the need of stakeholders and increase the impact of our investment. As part of a workplan refresh for 2020 the portfolio of OLW investment is currently being re-examined and is presented in Figure 7. For each theme we have developed flagship concepts which describe the critical activity required to achieve the OLW vision. Beneath the flagship

concepts sit critical elements we identified to underpin each flagship concept and represent a research area of strategic importance.

Data for this edition of the RLM were consulted to see if any of the potential programmes listed in the OLW workplan refresh (to 2024 and itself informed by the Challenge Strategy) were already being invested in. The summary of this assessment was that there were many programmes with strong alignment to the different strategic areas and therefore making important contributions to underpinning the flagship concepts of the different OLW Themes (e.g. See what diversity is possible, Understand and model land and water quality, Capture and share value, Identify and adopt sustainable land use practice). However, none of these programmes alone fully address the knowledge and tools required from the critical elements identified in Figure 7 required in order to achieve the Challenge mission and vison. On top of this many of the OLW strategic areas were lacking a critical mass of high impact aligned programmes (e.g. Novel production systems, Mechanisms that reward, Act as Kaitiaki, Increase our social capital, Pressures and barriers). This suggests that additional integration and alignment of OLW programmes with those that exist in these areas along with further OLW investment may be required to achieve the desired outcomes by 2024.

OLW investment makes a significant contribution to the total investment of research aligned to the challenge mission, with approximately 19% of all high impact research derived from the Challenge. This relative contribution is set to potentially increase between now and 2024 as Phase 2 investment from OLW is much greater per annum than in Phase 1.

Challenge vision	In the future, landscapes contain mosaics of land use that are more resilient, healthy and prosperous than today. All New Zealanders can be proud of the state of our land and water and share economic, environmental, social and cultural value from them.		
Theme	**Future Landscapes**	**Incentives for Change**	**Capacity for Transition**
Impact sought by 2030	The vitality of te Taiao is improving in response to our decisions as land stewards.	People and organisations in the agri-food and fibre system are motivated to prioritise the vitality of te Taiao in their decisions and actions.	The agri-food and fibre system is reconfiguring to implement new pathways to resilient, healthy and prosperous land uses that improve the vitality of te Taiao.
Impact sought by 2024	Decisions on individual land-use change and management practices can be made with confidence that they will lead to improvements in the vitality of whenua and wai.	New and modified incentive approaches and value chains are motivating and rewarding people and systems to make better decisions for whenua and wai.	New options and pathways for the vitality of te Taiao are being explored by land stewards and organisations in the agri-food and fibre systems.
Flagship concept	Providing tools for land stewards to assess diverse land use options that match what the land is most suited to, and that support the vitality of te Taiao.	Identifying the rewards, signals and approaches that motivate beneficial behaviours and reciprocal relationships in the agri-food and fibre system.	Working with land stewards and organisations in the agri-food and fibre system to design new options and pathways to achieve future landscapes.
Critical elements needed to address Flagship Concept	1. Be able to see what diversity is possible and match land use to what it is suitable for. 2. Understand and model the management of healthy land and water. 3. Identify high value land use options that support healthy land and water.	1. Describe and understand market and non-market signals. 2. Understand the reciprocal rewards that would motivate change by producers, consumers and other people in the agri-food and fibre system. 3. Identify existing and co-create new approaches and rewards that are leading to beneficial behaviours for future landscapes. 4. Develop indicators and models that connect metrics of land practices to rewards.	1. Demonstration and scaling out and up of options and pathways to enhance te Taiao 2. System reset – Identify, prioritise and co-create agri-food and fibre system leverage points to progress along pathways to land use options and supply chains that enhance the vitality of te Taiao 3. Integration – of Challenge and non-Challenge work in place-based to progress along pathways

Figure 7. Outline of the Our Land and Water workplan refresh 2020.

5.   References

McDowell, R.W., Larned, S., Scarsbrook, M., Schallenberg, M., Hamilton, D.P., 2016. Research Stocktake for the Freshwater Management Information Strategy. Report for the Ministry for the Environment, Mosgiel, New Zealand.

Morgan, B., 2014. Research impact: Income for outcome. Nature 511, S72.

R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Pielke, R.A., 2007. The Honest Broker: Making Sense of Science in Policy and Politics. Cambridge University Press.

Appendix I

Harnessing the power of big data

This looks at the programme's ability to bring together heterogeneous and disparate data generated in science, practice, policy and society, into a dynamic, shared landscape of data that gets more widely used, is easily understood, integrated and analysed. It include elements of data gaps and interoperability.

Capacity building

Capacity building explores the degree with which New Zealand scientists are participating in trans-disciplinary research teams and collaborative processes, building capability through the supervision of students, mentoring new staff or replacing existing staff.

Connecting with society

Many New Zealanders remain sceptical about the value of science. Connecting with society aims to build trust and raising awareness of the value of science to meet society's aspirations around freshwater quality and the social license to operate. It incorporates aspects such as communication via existing outreach and education programmes, digital tools and social media.

Working together to turn knowledge into action

Effective uptake of research is built on a platform of knowledge (local experiential, indigenous and scientific) exchange and co-development between research and stakeholders throughout the process of generating knowledge itself and not divorced from it. The collaborative approach we propose to take will build on this trust and increase the diversity of relationships we can draw on to turn knowledge into action.

Vision Mātauranga

Māori play an active role in the management of land and water resources across New Zealand. The use of VM recognises Treaty obligations, tribal development aspirations and research that is of clear relevance and impact for Māori.