

GROWING KAI UNDER INCREASING DRY

How does the primary sector in Aotearoa adapt to a changing climate with a changing drought profile?



Advice to central and regional government, industry bodies, and the research, science and innovation community on what is needed to better support primary sector adaptation to climate change, particularly drought.

Summary of joint National Science Challenge rolling symposium (May 2021)

THE DEEP SOUTH

Te Kōmata o Te Tonga

RESILIENCE TO NATURE'S CHALLENGES

Kia manawaroa – Ngā Ākina o Te Ao Tūroa

OUR LAND AND WATER

Toitū te Whenua, Toiora te Wai

ACKNOWLEDGEMENTS

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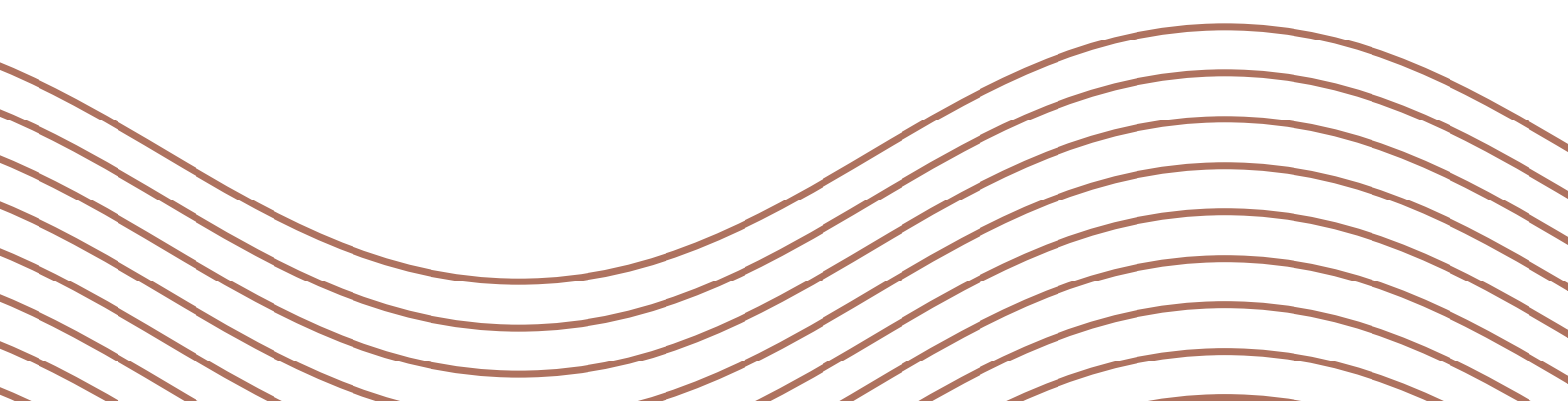
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“Change is hard – messy in the middle, beautiful in the end.”

Fraser Avery — Farmer



FOREWORD FROM THE CHALLENGE DIRECTORS

We know enough about the likely impacts of climate change to start planning a primary sector transition. Our vision is for the farmers and growers of Aotearoa New Zealand to be well supported to prepare for our changing climate, so they can start assessing options about how they want to adapt.

The short-term impact of weather variability is usually the most pressing concern on farms, but the more extreme weather events related to climate change could carry the people who grow our food and fibre toward an uncertain future. Drought is expected to become more frequent and intense, even under moderate climate change. Under more intense drought, farming becomes more difficult.

People who farm will have less flexibility and more constraints in a future of intense and frequent drought, making long-term planning increasingly challenging. This could trap people who farm in a crisis-response cycle where decisions are made 'just in time', creating vulnerability in farming systems. Constraints under future drought could also reduce the range of adaptation and land-use options farmers and growers are able to consider, potentially locking them into land uses that no longer suit their circumstances or environment. This will have a significant impact on the people who grow our food and fibre, the animals they care for, and rural communities.

Long-term planning to adapt food and fibre production to a changing climate must involve the whole primary sector, but may best be led by informed and proactive people in industry bodies and regional councils, who can help farmers and growers navigate towards resilient and flexible land uses and practices. Planning needs to start now, so that Aotearoa is prepared and resilient in the face of future climate extremes. Honest, direct conversations within communities, and scenario planning for possible climate futures, can ensure that people who farm remain in the driver's seat.

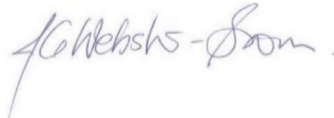
This report summarises a discussion held over a series of three webinars and a one-day symposium to kick-start a research-based conversation about climate change adaptation in the agri-food and fibre sector. Organised by three National Science Challenges – Resilience to Nature's Challenges, Our Land and Water, and The Deep South Challenge – this initiative provides the foundation for people in regional councils, industry bodies, government and science to identify and expand how they can support farmers to continue to grow food sustainably as the climate changes. We look forward to continuing to support this conversation.



Dr Mike Williams

Director

*Deep South Challenge:
Changing with our Climate*



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EXECUTIVE SUMMARY



Figure 1: Illustrated Summary of Symposium Presentations.
Credit: Pepper Raccoon Design.

In May 2021, a rolling symposium on primary sector adaptation to climate change, titled Growing Kai Under Increasing Dry, was organised by three National Science Challenges. The purpose was to connect Aotearoa New Zealand’s farmers and growers, the agri-food and fibre sectors, policy-makers, and researchers, to enable conversations about options for adapting to climate change. The underlying pretext was that planning now would increase sector resilience in a changing climate. The following key insights emerged:

1. Adaptation will not be easy, but the benefits are unquestionable in terms of protecting the economic viability and benefit of primary production, farmers’ and growers’ mental health, and the environment.
2. Climate change and drought are inevitable, and will increasingly impact primary production over

the coming decades. Adaptation has already begun, but this has been incremental and is not enough to cushion future impact. More transformational change is required.

3. People are at the heart of climate change adaptation, and we have a national responsibility to support farmers in meeting the coming challenges, not least because of the mental health implications. Existing strengths and weaknesses will inform outcomes, and policy that recognises these will be key for enabling farmers.
4. Wide-ranging collaboration across domains and sectors is required, with efforts aimed at both short- and long-term horizons, and focused on both national and regional geographies. Careful attention to communication and language will support partnerships.

Six springboards for accelerating adaptation were identified through presentations and discussions. These highlight different layers of action that intersect to form a total climate change adaptation response, on-farm as well as within the research, science and innovation system, and government.

1. Shift from short-term event response to long-term planning
2. Connect research and on-farm practice
3. Connect policy with research and on-farm practice
4. Identify and drive national and regional initiatives to support change
5. Enable behaviour change
6. Bring more diversity into farming activities

In terms of specific actions that can be taken as part of adaptation, it is useful to take a big picture view, separating these into: Incremental Adaptation – actions farmers and growers can take on-farm; *Systems Adaptation* – actions that need to be led primarily by government, industry bodies and the science and innovation system, in partnership with farmers and mana whenua; and *Transformational Adaptation* – novel actions that can be informed by National Science Challenge research, such as exploring new or unusual land-use opportunities.

Finally, following the Growing Kai Under Increasing Dry events, the three National Science Challenges have developed guidance for five groups:

- **Farmers and growers.** This group is best placed to implement incremental adaptations on-farm and within catchments, while also contributing to work in systems and transformational adaptation informed by industry bodies and researchers, and enabled by regional and central government.
- **Industry bodies.** As conduits for adaptation, these representative organisations can support all three types of adaptation through supporting collaboration and ensuring effective communication between farmers, researchers and policy-makers. They can take a strong advocacy and support role.
- **Researchers.** Charged with creating new possibilities for on-farm adaptation, researchers are key to new tool development. Further, they can inform evidence-based decision-making that leads to the transformational change needed in the face of increasing climate change impacts.
- **Central government.** Central government can apply two levers in particular—regulation and funding—to support adaptation at incremental, systems and transformational levels. Effective policy will be flexible and enabling, and there is good support for ensuring researchers are properly funded to create on-farm impact through providing adaptation tools.
- **Regional government.** This sector has an important role to play in ensuring a more localised response is rolled out in addition to a national-level approach. Clear scenario planning and a focus on community resilience are highlighted as key tasks.

We acknowledge a key subset of the farmer and grower community is missing from this guidance:

Mana whenua — As farmers and growers with distinct approaches and knowledge, mana whenua are well-placed to implement incremental adaptations on-farm and in catchments. We have heard that mana whenua are leading transformational adaptation for the broader sector, drawing on the mātauranga held by Māori agri-business advisors, industry bodies and researchers, and enabled by Māori governance entities. We acknowledge the shortcomings of our one-day symposium for mana whenua farmers and growers.

1. GROWING KAI UNDER INCREASING DRY

The purpose of the Growing Kai Under Increasing Dry rolling symposium was to kickstart a research-based conversation about climate change adaptation in a way that contributes to the drought-policy conversation in Aotearoa New Zealand. The themes and key findings in this report are based on presentations and discussions across four related events.

This report is intended to be a learning resource for a variety of users, including the three organising National Science Challenges, and the primary sector community of farmers and growers, mana whenua, industry bodies, and local and central government.

The Four Events

Three short background webinars brought together the latest in climate projections, drought resilience research and land-use science, which provided the basis for a subsequent all-day event where evidence-based conversations around future drought policy were generated.

- *Webinar One (11 May 2021):* Drought and the changing climate: What does the future look like for farmers and growers?
[Watch video](#)
- *Webinar Two (18 May 2021):* Drought and the changing climate: Farm profits and community resilience.
[Watch video](#)
- *Webinar Three (25 May 2021):* Drought and the changing climate: What to grow and where?
[Watch video](#)
- *Symposium (31 May 2021):* [Growing Kai Under Increasing Dry](#)

Data Gathering

Data collection for this report has been achieved through:

- Recordings of presentations, panels and discussion.
- Event attendance.
- Post-event surveys.
- SLIDO question management during the Symposium.
- Card-based Q&A responses, collected during one-day Symposium .
- Post-Symposium interviews with speaker.

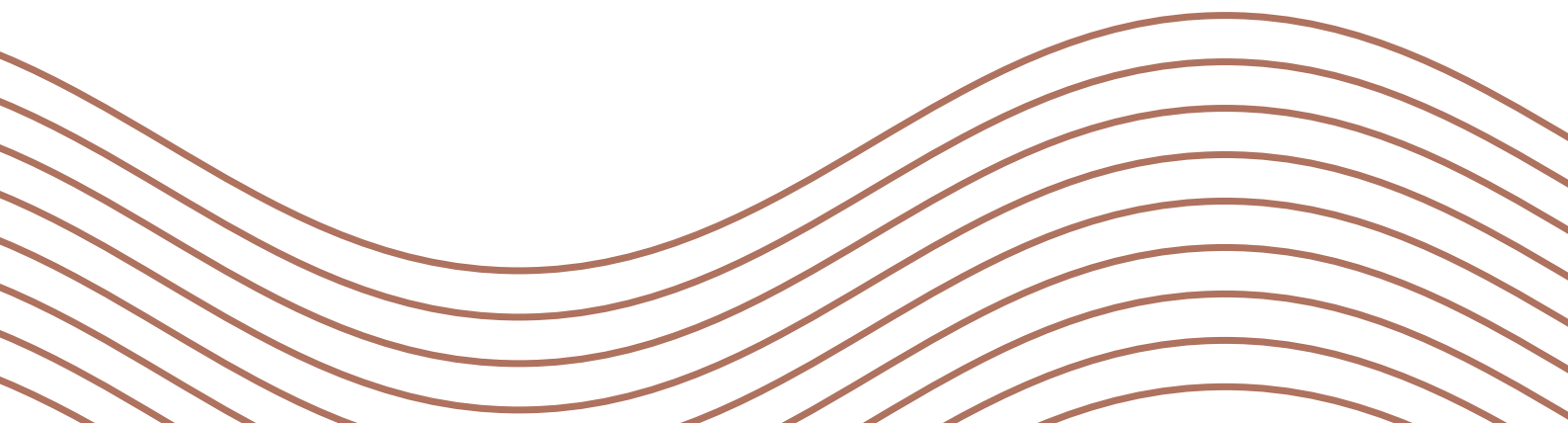
In a post-Symposium survey, attendees were asked about the value they had gained from the events, and comments indicate it was useful for a variety of reasons. For example:

“I work in a role directly with farmers and growers, so having this background and the outcomes of discussions to share with farmers/growers is very valuable.”

“Everyone is talking about the same things – finding the same issues important.”

“Networking opportunities between the public sector and industry.”

“Great to be face-to-face with colleagues over this topic and to sense collective support for continuing to work together.”



2. INSIGHTS: CLIMATE CHANGE AND ADAPTATION IN THE PRIMARY SECTOR

This report is not offered as a final guidance document on responding to drought, but rather, an exploration of the themes discussed by those who presented at and attended the Growing Kai Under Increasing Dry webinars and symposium. The organisers note that the event was not designed in a way that encouraged or enabled some groups to attend, including mana whenua and young people.

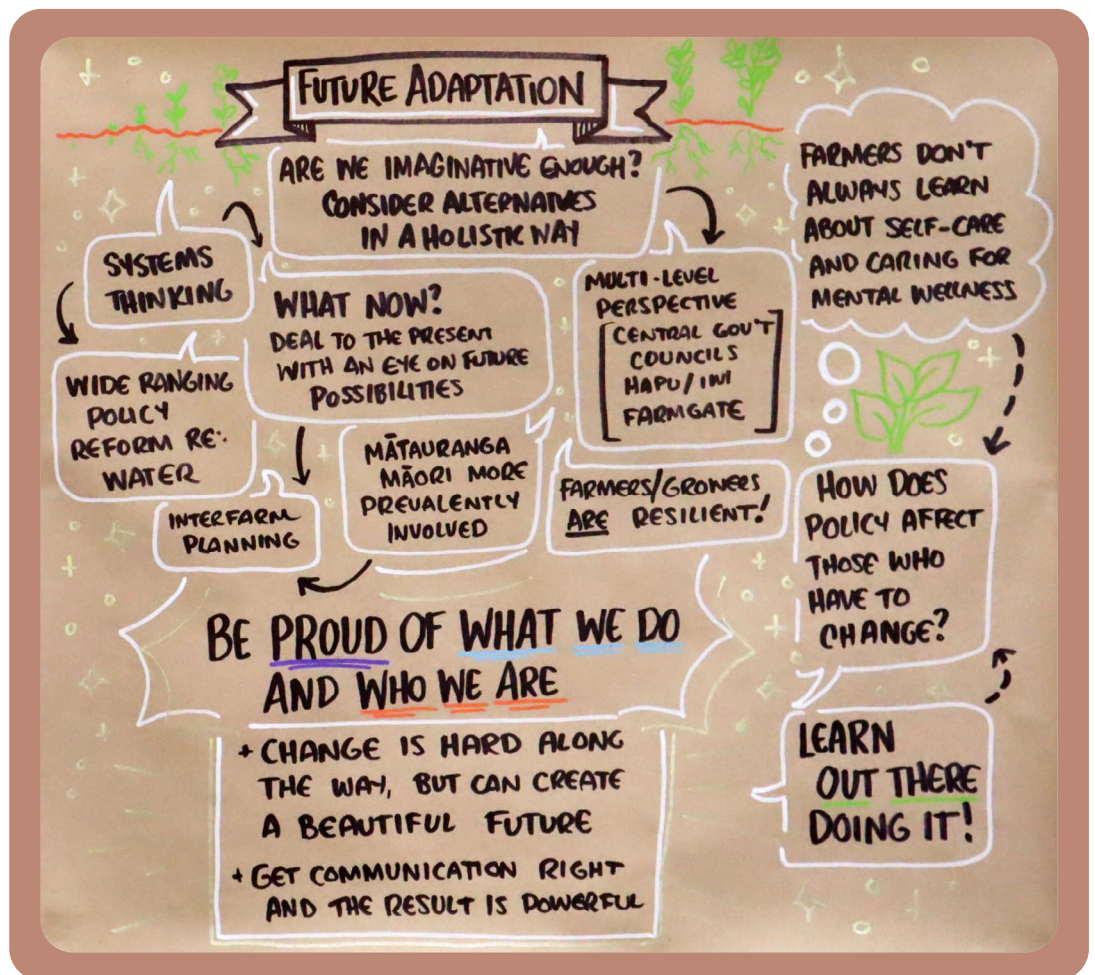


Figure 2: Insights into Future Adaptation. Credit: Pepper Raccoon Design.

Four broad insights provide context for subsequent discussion around how different groups within Aotearoa New Zealand can contribute to primary sector climate change adaptation. These are:

2.1 Adaptation will not be easy, but the benefits are unquestionable

“The time horizons are intergenerational, decisions made now will have consequences for the future.”

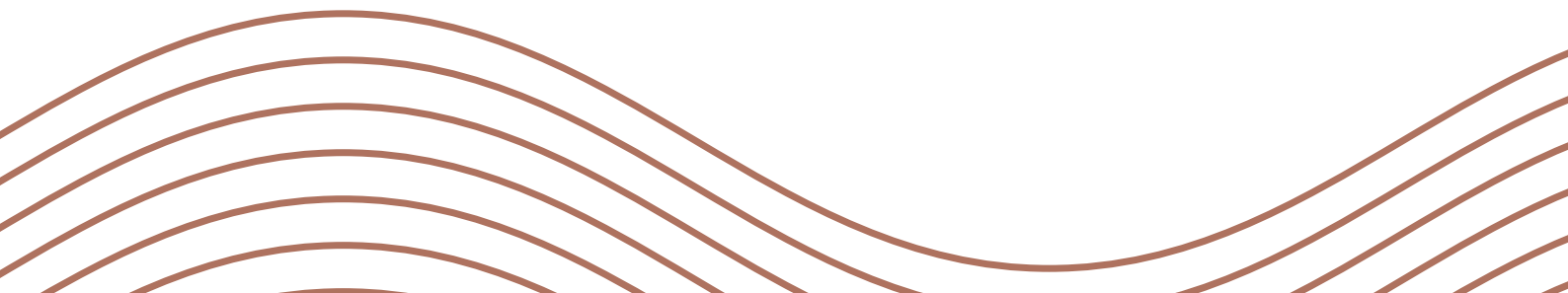
- In the face of inexorable and impactful climate change, commercial farming and growing operations, which currently contribute \$48 billion annually to Aotearoa New Zealand’s export economy, must be protected as a priority to ensure they remain productive and profitable.
- Climatic volatility is already becoming a strain on the mental health of farmers and growers, is impacting financial stability, and is tipped to be an even greater impediment to profitability in the future. Supporting those working on the land to best adapt to increasing weather-related upheaval is considered a useful approach to minimising these negative impacts.
- While climatic changes will impact farm productivity negatively, there are also financial risks and implications for farm businesses investing in climate change adaptation actions. Smoothing the ups and downs of farming revenue that result from environmental volatility would support planning for on-farm adaptation costs.
- There are likely to be environmental benefits from applying adaptation tools and practices including: less strain on water resources, better soil health, and lower pollution levels.

- Globally, there is a large market for premium food that is environmentally friendly. This is a growing trend that should influence (and motivate) Aotearoa New Zealand’s climate change adaptation strategy, which would in turn support a relevant and compelling food story.

2.2 Climate change is already happening, and its effects will be increasingly substantial

‘This is the new normal’ ... and yet ... ‘it is a rapidly evolving issue.’

- Climate change and drought are inevitable. Impacts will likely increase over time, but these impacts will be experienced differently around the country and may necessitate land-use change in some areas.
- Temperatures and evapotranspiration will both increase. Rain will be concentrated during shorter episodes, increasing the incidence of both drought and flooding.
- Heat stress will affect livestock more intensely in the future, and this in turn will reduce productivity.
- Adaptation initiatives are already happening, albeit ad hoc, disjointed, and often reactive.
- Diversification is becoming more common among farmers and growers as a strategy for spreading risk, and this has likely contributed to the perception that the primary sector is now less siloed than it once was. On-farm diversity, while lowering environmental risks, can increase other risks if farmers lack the requisite business knowledge to successfully implement new practices.



2.3 Adaptation is about people, families and legacy

“The climate change discussion seems to take place with an absence of people, but policy needs to attend to the human element.”

- Climate change responses must not omit the human element. Farmer mental health and resilience were issues discussed repeatedly throughout the Symposium.
- We have a national responsibility to support farmers and growers in their adaptation efforts, and much depends on us getting this right. Supporting farmers and growers rather than punishing them is the safest and most motivating approach.
- Resilience is multi-leveled and in addition to the land, also includes the people, communities, and future generations. Different rural communities draw resilience from different places, and effective support will factor in existing strengths and weaknesses.
- Less adaptable farmers are experiencing more stress: some can be stuck in a crisis-response cycle which leads to just-in-time decision-making.
- The primary sector is already highly regulated with more constraints on business-as-usual coming. This can cause a feeling of overload for farmers, and new strategies and policies would do well to account for this.

2.4 Working together is essential

“Unless we work together, we are going to lock ourselves into the status quo.”

- Creating an effective climate change adaptation strategy for Aotearoa, both nationally and regionally, will require active collaboration, bringing people together from all parts of the agri-food and fibre systems to make decisions.

- Collaborations must include people representing a range of important knowledge bases, including:
 - Farming philosophies and practices.
 - Mātauranga Māori.
 - Western science and research.
 - A national view of Aotearoa New Zealand (e.g. central government, industry bodies).
 - A regional, local, rohe-specific view (e.g. mana whenua, farmers, local/regional government).
 - Intergenerational (particularly youth) contributors .
 - Commercial expertise in market preferences.
 - International perspectives.
- Collaboration must work towards long-term horizons. While some events require quick responses, reducing the ongoing harm from climate change requires longer-term strategic planning based on multiple perspectives.
- Only some climate change issues are national (e.g. food security). Regional collaborations will be necessary because some regions will be hit harder than others, and some localised industries will be impacted differently. Input from local communities and mana whenua will improve planning rigour and increase engagement.
- To build trust and ensure useful information flows between farmers, mana whenua, researchers and policy-makers, we need to translate knowledge and domain-specific language between groups. Values and aspirations should be considered alongside data when making decisions and planning for adaptation.

3. ACTION: SPRINGBOARDS FOR ACCELERATING ADAPTATION

Climate change adaptation covers wider terrain than just drought. Armed with information from Growing Kai Under Increasing Dry, we offer a number of ideas for how Aotearoa New Zealand can move forward together to enable the primary sector’s adaptation to climate change with urgency. This is a journey that begins now, and yet it is unrealistic to think we will achieve the perfect adaptation scenario in the very near term. Rather, the work should be seen as an ongoing transition or journey.

‘We can be either proactive or reactive, but climate change impacts are inevitable.’

Springboards for Accelerating Primary Sector Climate Change Adaptation

Six specific themes rose to the top during Growing Kai Under Increasing Dry, which we believe could underpin a national climate change adaptation strategy for the primary sector. Each constitutes one component action of a total response, and while none would be singularly effective, missing any of these actions would make any adaptation approach insufficient. We note that other considerations might still be usefully added.

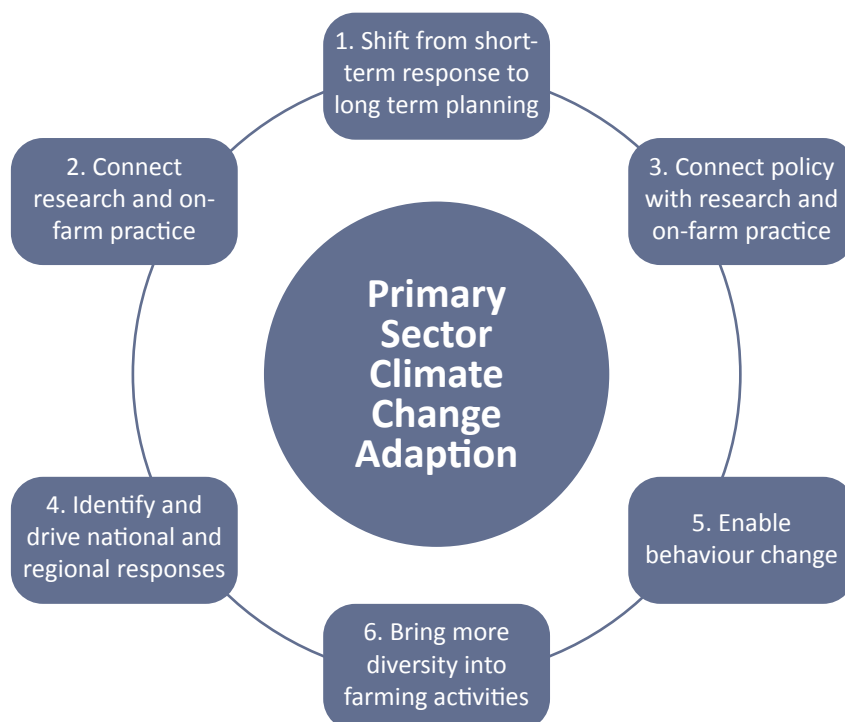


Figure 3: Springboards for Accelerating Primary Sector Climate Change Adaptation, as identified in Growing Kai Under Increasing Dry



3.1 Shift from short-term event response to long-term planning

Taking a long-term strategic approach, rather than maintaining a short-term alleviation focus, requires collaboration between all those connected with the primary sector, including farmers and growers, tangata whenua, researchers, central and local government, industry bodies, and support organisations. This level of partnership will enable greater investment in adaptation activities and ensure the current high level of risk and responsibility is shared across Aotearoa New Zealand.

3.2 Connect research and on-farm practice

Discovering and applying science-based solutions on-farm is already happening, but not at the pace required to pre-empt serious impacts that will increasingly result from climatic volatility. Potential actions that can achieve greater connection in this area include: creating trustful relationships, ensuring the concerns of farmers and grower influence research questions, inviting holders of mātauranga Māori to co-contribute with primary sector biophysical scientists, learning from the international community, translating language between parties, and adjusting the processes currently used inside Aotearoa New Zealand's research, science and innovation system to enable scientist-farmer collaborations.

3.3 Connect policy with research and on-farm practice

Symposium discussions suggested that a gap between research and policy does exist and is hampering development of effective policy that would increase the willingness and ability of farmers and growers to adapt to climate change. A similar gap is observed between policy and the farming community. Closer relationships will begin to bridge this gap.

3.4 Identify and drive national and regional responses

Decision-makers should recognise that there are specific adaptation needs at national, regional, and local levels. At the national level, the government can contribute to understanding international consumer preferences and providing financial support for adaptation investment, while a more localised approach is needed in terms of identifying land use opportunities, for example.

3.5 Enable behaviour change

The task ahead of us will not be achieved easily – it is complex, involves many individuals and organisations, and the pathway is uncertain. Importantly, farmers and growers are not all starting from the same place. The government has a significant role to play through enabling innovation, investment and flexibility, and in not punishing farmers and growers. Similarly, industry organisations are in a good position to serve as knowledge brokers for farmers, and to advocate for their needs with both researchers and government.

3.6 Bring more diversity into farming activities

Diversity is already being embraced by farmers and growers around the country, and is considered to be an important principle in climate change adaptation. It is not without risks, however, and more research, education and financial support from a range of quarters is needed to support this trend.

SPECIFIC ADAPTION ACTIONS

Growing Kai Under Increasing Dry offers many specific actions that can be taken to support climate change adaptation. These can be classified as:

1. Incremental Adaptation – actions farmers and growers can take on-farm, such as changing seed sowing dates.
2. Systems Adaptation – actions that need to be led primarily by government, industry bodies and the science and innovation system, in partnership with farmers and tangata whenua, such as improved drought modelling, and establishing new infrastructure or species.
3. Transformational Adaptation – actions that can be informed by the National Science Challenges, such as identifying novel land use opportunities.

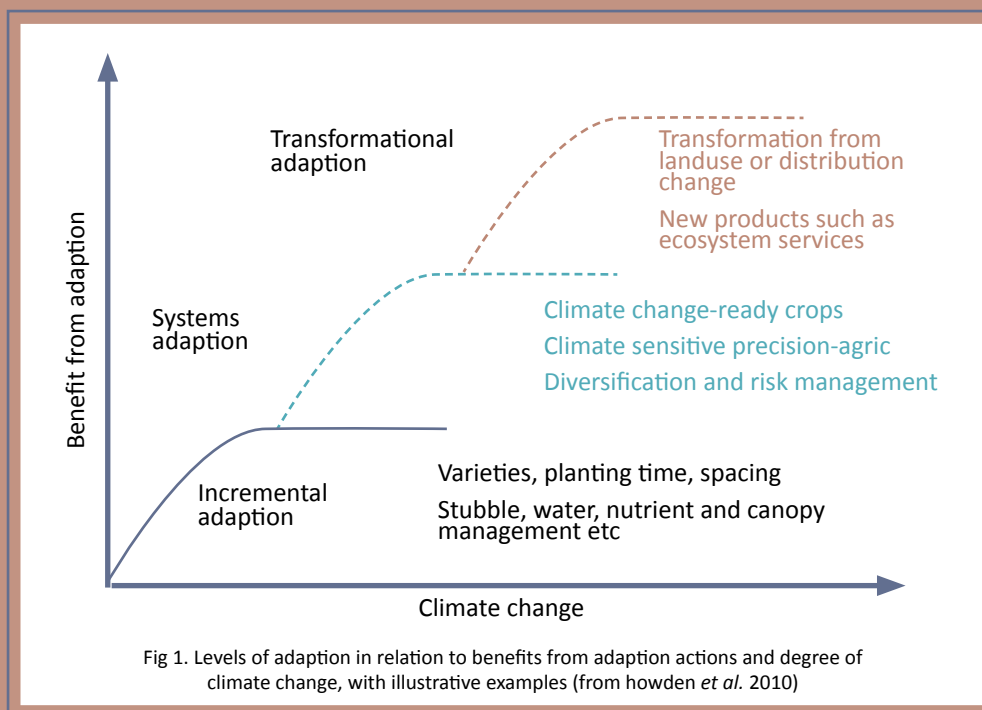


Figure 4: *Levels of Climate Change Adaptation*. Source: Rickards, L., Howden, S.M., 2012. *Transformational adaptation: agriculture and climate change*. *Crop Pasture Sci.* 63, 240.

Incremental Adaptation action examples:

- Move to autumn calving.
- Focus on soil biology and health, for example by improving water holding capacity, through moving to minimum tillage, seed drills, and planting crops that improve soil structure.
- Look to traditional farming practices including regenerative techniques, increasing organic matter, and using old deep-rooting cultivars.
- Seek traditional knowledge such as mātauranga Māori to understand what has worked in the past.
- Plant more trees.
- Plant new varieties that are drought tolerant.
- On-farm water capture and storage.
- Frugal and targeted irrigation.
- Use water meters.
- Diversify farm activities to spread risk.
- Undertake on-farm value-add activities to increase control.
- Purchase additional land with different environmental profiles to spread risk.
- Move from fossil fuel to renewable energy.
- Include on-farm adaptation activities in Farm Environment Plans.
- Support other farmers during adverse events to reduce negative outcomes.
- Plan for extreme weather rather than normal conditions to reduce uncertainty.

Systems Adaptation actions:

- Better water storage techniques, harvesting high flows.
- Refine how water is applied on-farm, for example through improving efficiency and precision of irrigation.
- Recycle wastewater.
- Invest in ageing water infrastructure to reduce water loss.
- Introduce climate hardy cultivars through breeding and species development.
- Explore alternative protein sources.
- Scale climate change adaptation tools, models and forecasts to catchment level.
- Improve drought forecasts and make them easily accessible.
- Invest in multi-hazard assessments across landscapes.
- Write flexible pro-adaptation policy that de-risks change and promotes innovation and creativity.
- Craft policy that encourages desired behaviour change through using appropriate incentives.
- Redefine Aotearoa New Zealand's food narrative and food story.
- Support on-farm testing and commercialisation pathways for pro-adaptation discoveries.
- Invest in science and supporting researchers to collaborate with farmers/growers and policy-makers (at national and local levels).
- Translate science to end-users more effectively through better communication.
- Better communication about climate change using a variety of channels from mainstream media to one-on-one conversations.
- Develop a National Climate Change Adaptation Strategy, outlining a national primary sector direction for adaptation.
- Boost extension investment and activities.
- Ensure strategic planning protects future generations of farmers.

Transformational Adaptation actions:

- Map different types of farmland, conditions, and suitable land uses.
- Explore alternative land use opportunities.
- Create a land-use strategic plan.

4. AGENTS: ROLES AND RESPONSIBILITIES FOR PRIMARY SECTOR ADAPTATION

There are already many adaptation ideas and techniques being applied on-farm, with researchers helping to bring new discoveries to the fore. While actions have the primary sector at their heart, they necessarily involve industry, government, the science sector, tangata whenua, and farmers and growers at the coalface; each group has existing resources and constraints, as well as specific roles to play.

“Neither a top-down nor bottom-up approach alone will do.”

4.1 Farmers and Growers

Decision-makers on the ground

Status Quo (current strengths/ weaknesses, current state of adaptation response)

- Farmers hold important knowledge about their land and practices.
- Farmers tend to plan for the normal, but less so for the unexpected.
- There are variable responses to adaptation across sectors and regions.
- Some communities are better able to adapt than others.
- Diversification and reaching across silos is becoming more common in the face of climate change.
- Mental health is a key issue.

Future Focus (informed by Growing Kai Under Increasing Dry)

Farmers will be the ones to implement land-based adaptation strategies, both in the shorter and longer terms. They should be supported to change, not punished.

Farmers and growers are best to focus on carrying out incremental adaptations, while also providing advice on systems and transformational adaptations that require higher level input.



Figure 5: Summary of Farmer Panel Discussion.
Credit: Pepper Raccoon Design.

Adaptation is about shifting and changing systems now to reduce disruption later. As noted by Julia Jones, the Symposium’s keynote speaker, farmers and growers should be planning for various scenarios to reduce potential risk.

Mana Whenua

In this section, we include Māori farmers, growers, and agribusiness, operating using a mix of farming methods informed by biophysical science and mātauranga Māori. We recognise that mana whenua hold critical local and historical knowledge, and will need to implement adaptation strategies. However, Māori were not well represented within Growing Kai Under Increasing Dry, and there was not sufficient time, diversity or in-depth knowledge among those exploring this issue to tackle it in any great depth. The organisers accept responsibility for this significant and meaningful gap.

Areas for future consideration include:

- What can mātauranga Māori contribute to climate change adaptation?
- Policy-makers and researchers must work much harder to engage with and develop meaningful relationships with Māori farmers and agribusinesses.
- Non-Māori partners should not rely on the idea of a homogenous Māori view when thinking about land management, but rather, be informed by the practices and expectations of hapū.
- The importance of oral histories about land, water and wetlands of the past, which can serve as guidance for future practices.

Farmers should focus on what they can control

Ultimately, farmers must focus on what they can control, and this includes on-farm planning and tactics, and their decisions about future investment. Building successful systems to deal with drought and other challenges is the way to improve control, and science can help achieve this, as can well-informed and effective policy, relationships, good communication, and good mental health. Reliable data needs to be the foundation for planning and making choices about what levers to pull and actions to take.

Diversification is one approach to managing risk and volatility. It is becoming more common across sectors, but perhaps especially among dairy farmers. These farmers are bringing additional activities onto their land, including beef, sheep, goats and crops.

Land purchase and lease is another way to minimise risk, particularly through working parcels of property with different pressures, so that stock and annual crops can be moved around as needed.

A variety of **land management practices** were reported, for example, planting trees for flood and wind protection, precision irrigation and rain capture, and these can be applied according to local weather and climate. Some growers have learned how to bank rain through reduced cultivation and using different crops to improve soil structure, or have planted new cultivars such as winter crops that are more efficient in capturing rainwater throughout the year and give improved resilience heading into the summer.

A farming operation may become more involved in the value chain through investing in value-add processing of their produce, for example.

“Decisions around adaptation need to be owned and implemented by local people.”

Relationships and collaboration are key

People and communication were considered key enablers of collaboration. Sharing ideas through mainstream media would be helpful, but so too are one-on-one conversations at barbecues and other social events, as people learn and teach differently. Sharing ideas will always be beneficial, and this applies to learning relevant science and exploring a range of on-farm activities.

The importance of good mental health

Established Rural Support Trusts support people during adverse weather events. A key strategy is to bring farmers together as a form of mutual support because farmers are good at sharing knowledge and learning from each other. People who farm in

Aotearoa New Zealand tend to be resourceful and adaptable, and will adopt tools and technology that they can see are useful.

Why is this important? Because people need to be in the right frame of mind before they can make good decisions. What has become clear from supporting people who are not coping is that they tend to be less adaptable, and they may be new to the industry and/or without financial backing.

Ensuring farmer wisdom is shared with researchers and policy-makers

While the biggest impact farmers and growers can make is on-farm, they also need to advise researchers and decision-makers to ensure adaptation tools are fit for purpose.

4.2 Industry bodies

Conduits for adaptation

Status Quo (current strengths/weaknesses, current state of adaptation response)

- Industry bodies take an umbrella view of their own sector.
- These organisations are often involved in research, either directly or guiding research directions by external researchers.
- Highly active in the primary sector, industry bodies are often the primary source of information and support for farmers. In the past, they have not always proactively supported their members to recognise and respond to environmental issues such as climate change.

Future Focus (informed by Growing Kai Under Increasing Dry)

In the journey towards adaptation, industry bodies are well placed to support the three levels of adaptation:

- Incremental adaptation – through farmer education and bringing scientific discoveries to the farm gate.
- Systems adaptation – through serving as a conduit between farmers/growers and researchers, and between farmers/growers and policy-makers.
- Transformational adaptation – through large scale collaboration.

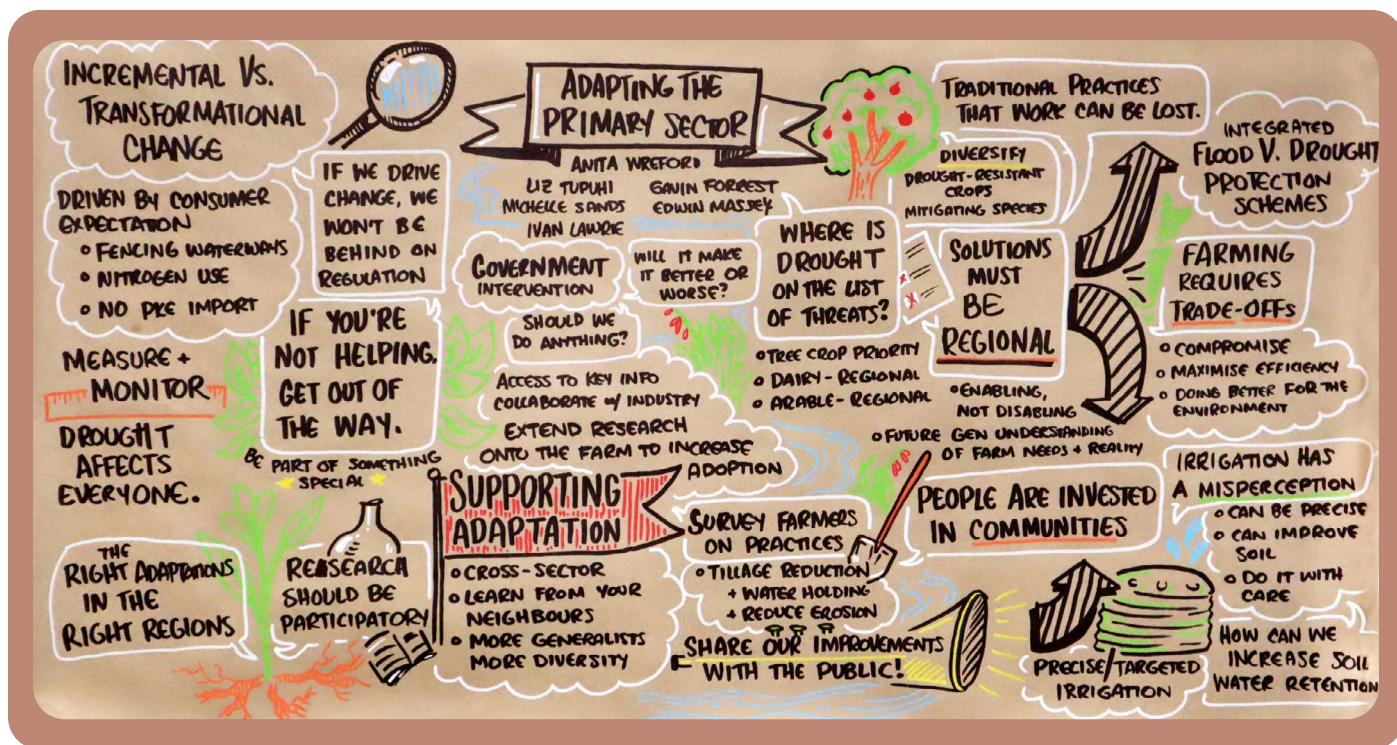


Figure 6: Summary of Industry Organisation Panel Discussion.
Credit: Pepper Raccoon Design.

Five key roles

There are five key roles that industry bodies should perform that essentially involve coordination and communication:

1. Short-term crisis response – including regional and local coordination and supporting farmer mental health.
2. Longer-term collaboration and strategy across the industry and beyond.
3. Advocate for the knowledge required by farmers and growers to adapt.
 - a. Insert industry needs into research questions.
 - b. Provide farmers with access to important and useful information, including research findings related to climate change adaptation, and sharing innovation around diversification ‘how to’.
 - c. The need for more research extension, whereby people in research and industry organisations directly support farmers and growers to apply research findings and adopt new practices, was called for by multiple parties.
4. Collaborate with government, researchers and other industry organisations on common themes – including land-use opportunities, water allocation, and development of new cultivars.
5. Advocate for farmers of the future – ensuring they are prepared for new legislation, supporting future-focused water management, and pushing for the long-term best interests of the farmers of today (e.g. encourage adoption of greenhouse gas mitigation measures). Financial volatility is a significant moderator of how farmers and growers can invest in adaptation and incorporate this into their financial planning. There is an opportunity for large agribusinesses to alleviate this constraint by building some resilience and predictability into farm incomes. This would require considerable advocacy by farmer organisations.

Bringing people on the journey

We must accept that the adaptation conversation will be confronting for some, not everyone will be moving from the same place at the same pace, and there are many different views about what needs to happen. There is arguably a lack of climate change adaptation leadership across industry bodies and central and local government, but farmers and growers need a plan for change, including preferred industry direction and clarity around the steps for achieving it.

Potentially, a primary sector national adaptation strategy would be a good place to start. Such an approach would give everyone a common vision to start working towards.

One specific task mentioned several times during the Symposium was creating a compelling food story that integrates with Aotearoa New Zealand’s adaptation strategy to connect consumers with our primary sector. While this is not necessarily the sole responsibility of industry organisations, they have the opportunity to lead this in collaboration with farmers, mana whenua, government and researchers.

Productive advocacy in action

Drought is a significant risk in sectors that use trees and other perennial crops because they are longer-term, static crops with a 10-15 year investment period. Because change is not a quick thing in this situation, advocating to regional councils for a rootstock-survival water allocation to keep rootstock alive during dry periods has been a priority for one industry body. If droughts become more frequent and trees are not saved, then orcharding becomes too risky. A policy that is mindful of protecting the resilience of trees is important.

4.3 Researchers

Creating new possibilities

Status Quo (current strengths/weaknesses, current state of adaptation response)

Scientific research is recognised as essential for developing new adaptation tools, and providing data-based insights into best pathways for minimising the negative impacts of climate change.

However, Aotearoa New Zealand's research, science and innovation system fails to effectively support on-farm application of science at the current time. This has a number of implications, including:

- Researchers may not be aware of the biggest challenges facing farmers and growers from their perspectives.
- The most potentially significant discoveries may not be explored and/or validated on-farm.
- Data is vital, but translating it into insight is not resourced enough.
- Researchers do not always succeed in communicating effectively with farmers and growers.
- There is a lack of data on the impacts of the primary sector maintaining the status quo.
- National projections are not useful at regional and local level, and science has a challenge to communicate local-scale information.

Future Focus (informed by Growing Kai Under Increasing Dry)

Researchers have a role in developing tools that can lead to both incremental and systemic adaptation, and should contribute data and insights into transformational planning and decision-making.

Specific factors to consider moving forward:

- Adjust funding processes so that researchers can work in partnership with farmers on the land.
- What does a farmer-centric approach to science look like? Remove the complexity to engage farmers.
- Provide localised data, modelling and forecasting.
- Explore and communicate the implications of maintaining the status quo.

Suggestions for this group centred on improving communication, connection and administration to ensure that new tools and processes can be used for impact in the real world.

Better links with farmers and growers

Research is an essential part of adaptation, but only if it is collaborative and participatory. Researchers need feedback from farmers on the ground if they are to respond to their needs, and the role of research in adaptation is only strengthened through good communication that translates science into application on-farm. One of the Symposium's messages was clear: Farmers have a long history of adapting to changing circumstances and they will use good alternative tools and practices if available.

The challenge is to make new discoveries available on-farm as a matter of urgency. Attempts are being made to transfer science to end-users to help create impact on the ground (through the National Science Challenges, for example), but despite these efforts, it remains a challenge without an easy answer.

Better links with industry bodies

Organisations such as DairyNZ, LIC and Fonterra are working with researchers to ensure the right questions are being explored, for example:

- What is the impact of heat and heat stress on animals?
- What are the impacts of animals on the environment?
- What is the right forage base in the right place?
- How do we ensure we have the right animals in the right place?
- How do we store more water within soil?
- How do we responsibly use water from rivers?

Investment in extension has been demonstrated to support on-farm research application, and industry bodies can assist with that, not least through explaining to people why practice change is essential. Expanding extension services would be an investment, but the cost of not doing anything is significant and risks a scenario where promising research is never transferred to farmers and growers.

Better links with regional planning and policing

The existing plethora of knowledge about how, where and why the climate is changing, as well as future impact models, is not being translated into regional planning processes to the extent it should. Similarly, more work is needed to get these insights through to farmers and growers so they can understand future changes in risk and consider alternative practices and options for future decision-making.

A good example of where better communication would be impactful is in the field of hydrology.

Current recommendations are often based on the past, but with climate change this becomes a less useful method. This new uncertainty needs to be better communicated to farmers so that they understand, for example, that consent applications based on previous data are not necessarily going to be accepted.

Communicating risk and uncertainty

One issue mentioned more than once during the Symposium is the language currently used to describe extreme events. We talk about one-in-100-year floods, for example, which implies we can be confident that such an event will not be repeated for decades post-flood. However, this is misleading because the reference point for these episodes is changing, that is, they appear to be happening more frequently as a result of climate change. Formally changing terms and references to adjust expectations would be useful.

Researchers as communicators

Not all researchers are well equipped to take new knowledge to the farm gate, and so should be encouraged and enabled to work with those who can. The research and science system itself constitutes a barrier to impact-focused research because extending research findings to end-users usually comes a distant second to more traditional measures of science value (such as publication in science journals). Creating impact also requires additional funding over and above resourcing research itself. Further, researchers may not be familiar enough with on-farm activities and priorities to ensure their outputs constitute practical land-based tools. There was strong support for employing more knowledge brokers to translate research findings into farm practice and/or policy.

Science adoption in action

Farmers are regularly surveyed by the Foundation for Arable Research about rotation and cultivation practices. A key finding from this research is that since 2011, there has been a significant decrease in tillage. This change is helping keep moisture in soil, reduce erosion, and decrease pore congestion caused by over cultivation. This shows change over time and suggests that science is impacting on-farm practice.

4.4 Central government

National level oversight and support

Status Quo (current strengths/weaknesses, current state of adaptation response)

- The slow pace of government was acknowledged as a barrier to adaptation. It takes time to enshrine climate change adaptation into legislation, and then it takes years more to insert it into local and regional government policy.
- Government is seen as taking an 'umbrella' national approach to issues that affect regions very differently, and this is problematic.
- Currently, the regulatory environment is seen as punishing farmers rather than enabling innovation.

Future Focus (informed by Growing Kai Under Increasing Dry)

The government has the power to support incremental and systemic adaptation through supporting a well-funded science system, and enabling the application of new discoveries and practices. It should also be involved in transformational adaptation through supporting knowledge creation and ensuring policy and physical infrastructure can support positive changes.

More specifically, the government should:

- Create a regulatory system that works – practical, flexible, motivating and enabling.
- Support a strong and outcomes-focused research and science system.
- Develop a longer-term climate change adaptation strategy that supports farmer resilience.
- Be a safety net for adverse events as needed.



Adapting the Primary Sector Panel Facilitator — Anita Wreford

Delegates thought the government has a duty to support Aotearoa New Zealand to effectively respond to increasing climate change impacts in a way that ensures the continuation of primary sector profitability, while also sharing risk with individual farmers and communities, and protecting the environment. This can be achieved through leading alignment across central government departments and with local government, businesses, iwi/hapū and communities, and by supporting stronger connections between science and policy to enable effective climate change adaptation action at all levels: national, regional and local.

WHAT IS CENTRAL GOVERNMENT ALREADY DOING?

National level programmes underway

- National Adaptation Plan.
- Three waters reform.
- Establishment of Taumata Arowai.
- Resource management reform.
- MPI adverse event support .
- Freshwater reform.
- Industry Transformation Plans.
- Fit for a Better World roadmap.

Short term drought response 2020/21

- Regional council survey to build awareness of the situation.
- Funding stocktake to assess central government support.
- Targeted support for Northland.
- Improving central government coordination.

Source: Symposium Presentations by Paul Barker (DIA) and Peter Ettema (MPI)

The National Adaptation Plan

Subsequent to last year's Climate Risk Assessment there is now a National Adaptation Plan being formed, which will outline how Aotearoa New Zealand will respond to climate change risk.

Given the importance to the primary sector, MPI is contributing across four of the Plan's five sections. While the Ministry takes a big picture approach, recognising wider issues and reforms, there are also points of specific interest to the primary sector, such as high value soils and combating erosion in heavy storm events, which must be encompassed by any national-level response.

Primary Sector Recovery Policy

This policy, administered by MPI, guides government decisions on recovery assistance following adverse climatic or natural hazard events and biosecurity incursions impacting on-farm. It operates via five key principles:

1. Individuals and communities have primary responsibility for managing their own risks.
2. The Crown is not insurer of first or last resort.
3. The focus is on families not businesses.
4. Support is focused at community level.
5. Classifications reflect the scale of need for recovery assistance.

Provide a good regulatory framework

The Government should also provide a good regulatory framework that works, is practical, and achieves intended outcomes with minimal disruption to farming activities.

- A theme that became apparent during the Symposium was the need for central, regional and local government policy to be flexible and innovation-enabling rather than restrictive and/or punishing.
- Policy must incorporate an understanding of how farmers are adapting and what pressures they are experiencing if they are to “set the boundaries and pave the road” to support positive change.

“Decision-makers must get onto farms to better understand what happens there.”

- One specific area that the government could usefully focus on is looking for opportunities to drive change around water use. How can we motivate sustainable water use through applying requirements such as measuring, planning and reporting water consumption?
- Several panellists felt the government was not currently meeting its regulatory obligations, with farmers themselves having to take on too much individual responsibility for adaptation planning and action.

Fit-for-purpose research and development infrastructure

- The government could take responsibility for ensuring the plethora of data that has already been collected over the years is collated, analysed, and utilised, particularly through contributing to models and extracting meaningful insights on how to adapt.
- Benefits would likely result from more integrated and strategic planning that considers the entire country while incorporating the flexibility to allow for individual catchment level initiatives so that farmers can better understand their range of options. Specifically, this would usefully include multi-hazard assessment and climate modelling.
- Supporting research into how soils can retain water, practices for slowing overland flow, and decreasing evapotranspiration would all have a huge impact as long as results were adopted on-farm.
- Similarly, a push for harvesting high flows and building water storage would also be useful.
- Work with researchers to change how climate-related language frames extreme events, for example, not using terms such as ‘one-in-30-year storm’ when similar events may now be occurring every two or three years.

Partnership in action

It is possible to learn from other initiatives such as the current partnership between MPI and a range of primary sectors, which aims to address biosecurity challenges. This initiative used a co-design process where everyone was included and consensus was gained on: shared principles and values, language, compromises, actions, timeframes, funding, evaluation measures, and what success would look like.

Support longer term resilience of farmers and farming communities

Just-in-time management has increased primary sector vulnerability; one small upset can destroy the whole chain. We need a longer-term view and action plans at individual, catchment and regional levels in order to increase resilience. Because climate change is progressing rapidly, a forward-looking framework is needed to support strategic planning rather than piecemeal responses.

What does a resilient community look like? It would have the space to think and plan for the long term, and be willing to self-manage and ask for help. Resilience encompasses many things, including social resilience, financial wellbeing, environmental infrastructure, and cultural and institutional factors. A community can be strong in one facet but poor in others, for example, have strong social resilience but poor economic resilience.

So what can support better planning? Farmers are accessing information to support decision-making, but currently this tends to have a current/short term focus that doesn't support longer term adaptation. Some considerations:

- There is a risk of merely modifying the current rather than collectively entering into the paradigm shift needed, so we are not suggesting small tweaks as a solution.
- One approach is to plan around the common and expected: adverse events, financial disruption and regulatory change. Seen through this lens, disruptors may in fact have some common solutions, and this awareness can feed into longer-term planning.
- Scenario modelling should be a key tool in planning, for example, agriculture pasture cover under different farm regimes, rainfall, and temperatures.
- Provide understanding of global market changes through agencies such as NZTE.

“We have to build up resilience rather than hold out for greater certainty.”

“Farmers are very good at planning for the normal – there is a high level of variability so contingency planning is baked into farm practice – but the unknown in climate change increases uncertainty, and planning can suffer as a result.”

Historical farmer resilience

Farmers already have an inherent resilience and have worked through large scale challenges in the past. The upheaval experienced by farmers in the 1980s was sudden and extensive. While many farmers adapted to their new political and economic reality, thousands of others left the industry over the space of three or four years.

What might we learn from this episode in our history? Potentially the government might consider how it can support a respectful and dignified exit from the industry by those farmers who are unwilling or unable to make the necessary changes. A related question is what level of assistance farmers might be offered to transition into different types of farming activity.

Fulfil a safety net function, particularly in response to dramatic events

Through ministries such as MPI, the government has provisions in place to support farmers and growers during and after extreme weather events. While some delegates thought more should be done, others did not hold this position.

4.5 Regional government

Sub-national level support

** It should be noted that local and regional government was not well represented within Growing Kai Under Increasing Dry, and so limited insight was generated from their point of view; these notes are based on the feedback from other groups.*

Status Quo (current strengths/weaknesses, current state of adaptation response)

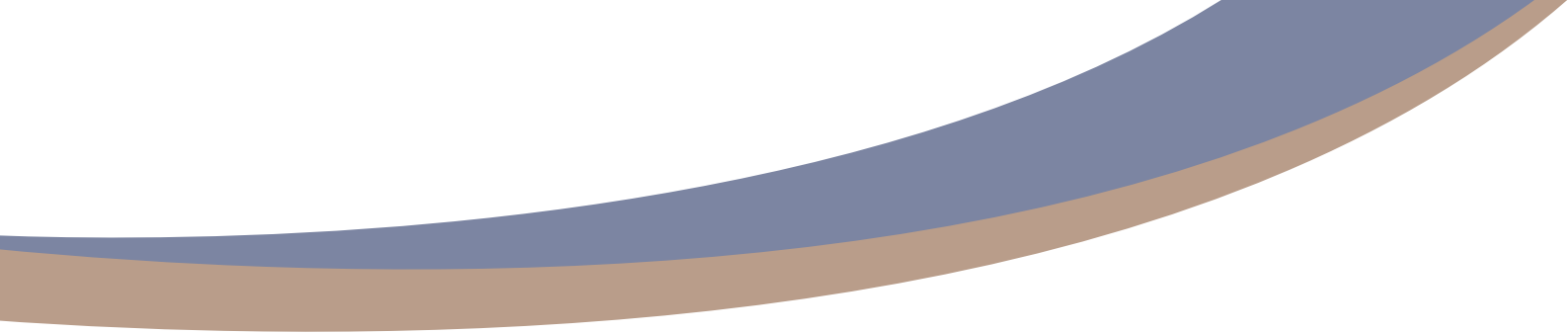
- Regional councils have been active in the environmental and climate change space, however, this has been primarily as a regulator and so trust is not necessarily high from farmers' perspectives.
- In contrast, district and city councils have been less focused on this, and their role moving forward is unclear.
- Some helpful initiatives are already in play, such as:
 - itstimecanterbury.co.nz
 - [Ashburton District Council's Resilient Business project](#)

Future Focus (informed by Growing Kai Under Increasing Dry)

Exactly how local government should contribute to climate change adaptation in the future was not clearly set out during Growing Kai Under Increasing Dry.

A first step would be to undertake public engagement, to build trust with farmers and growers and enable more effective consultation and collaboration. Collaborations must include people representing a range of important knowledge bases, including:

- Farming philosophies and practices.
- Mātauranga Māori.
- Western science and research.
- A national view of Aotearoa New Zealand (e.g. central government, industry bodies).
- A regional, local, rohe-specific view (e.g. mana whenua, farmers, local/regional government).
- Intergenerational (particularly youth) contributors .
- Commercial expertise in market preferences.
- International perspectives.



Panellists agreed that effective adaptation will only be achieved through a mix of national strategy and local decision-making and action, rather than an ‘either-or’ situation. This signals an important role for local government.

“National policy has to be enabling, especially for innovation, but it’s important to have regional and local input because from a national level you just don’t see what’s happening on the ground and so you can’t respond to it.”

Collaborative action can take many different forms. One example discussed was a Northland initiative, which has had a strong focus on alleviating ‘water poverty’. That response has been achieved collectively by multiple groups, including Northland Regional Council, district councils, local iwi and hapū, and central government. The parties have come together to look at areas of need and sources of funding, and are utilising science and information to develop solutions. This is the type of collaboration that needs to take root across the country to deal with this challenge.

Other points for consideration:

- Clear scenario planning at a sub-national scale and better communication around the implications of these scenarios for farmers and growers is needed.
- There is likely a role for regional and local councils to focus on community resilience and the mental wellbeing of farmers, through understanding who is most vulnerable and how they can be supported.

- To what extent might regional councils be involved in supporting some farmers to exit the industry with dignity?

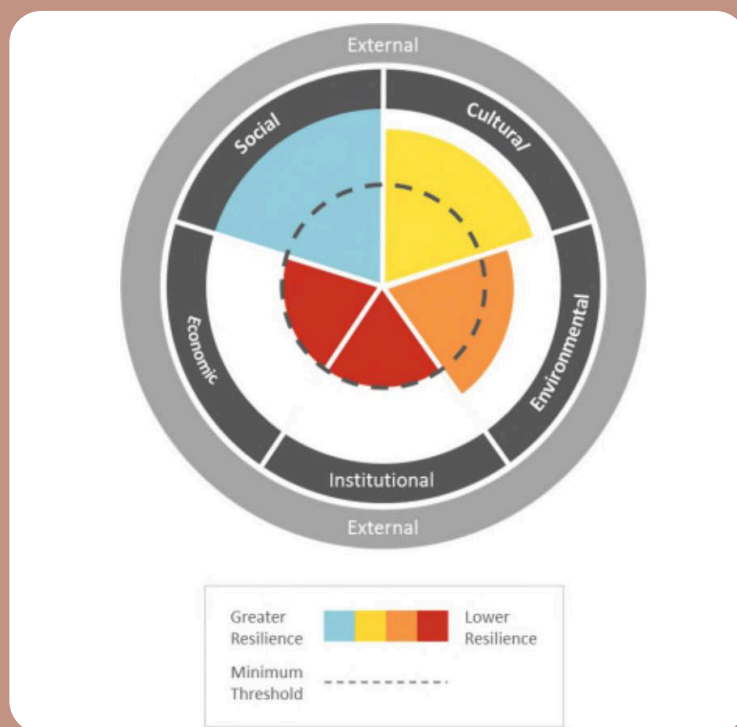
Central government recently established a Review into the Future for Local Government. This initiative will explore local government functions and make recommendations for change where Te Tiriti o Waitangi obligations, partnerships and community wellbeing may be elevated in importance, while a segment of existing infrastructure management responsibilities may be removed from councils’ purview. Three Waters in particular will be completely reorganised nationally over the coming years, and the RMA is also being reimagined.

This changing political environment will have a significant impact on local government functions, which in turn will inform how climate change adaptation is supported.

Measuring community resilience

Recent research indicates that community resilience can be measured, and this can provide useful information for supporting resilience in rural communities.

A Resilience Index tool was developed to identify community strengths that can be leveraged to respond to drought or other extreme weather events, and predict where the problems might lie. It measures five dimensions: social, cultural, environmental, economic and institutional/organisational resilience.



Different communities have different sources of resilience and this can inform targeted strategies for supporting those communities. For example:

- In *socially resilient communities* (good access to vehicles, telecommunications, internet) the use of formal organisations and communications processes as well as informal networks to connect with struggling farmers works well. Index examples: Central Hawke's Bay, Far North, Gore.
- In *culturally resilient communities*, working through Māori organisations and relationships is the most effective way to reach farmers. Index examples: Kawerau, Ōpōtiki.
- In *economically resourced communities*, reaching out and supporting through market channels is a useful approach, for example, through ensuring markets are working well, while social networks might not be so important. Index examples: Selwyn and south Wairarapa.
- In *mixed communities*, that is, communities without a singular significant source of resilience, support needs to reach out through multiple channels - through markets, and social channels both formal and informal. Index examples: Waikato and Waitomo.

Further reading:

- [Resilience Indicators](#), Our Land and Water NSC
- NZIER [Insight](#) classifying rural communities by resilience

5. NEXT STEPS

We note that this report is being released into a fast-changing regulatory and legislative environment. The government's National Adaptation Plan is in development.

The three National Science Challenges will continue to seek opportunities to bring people together to further discuss issues related to climate change adaptation and to share relevant research. These will be developed to prioritise engagement with people whose perspectives are missing from this report: youth; Māori farmers, growers and agribusiness; and regional councils.

We will share information about future events via email with those who attended the webinars or symposium. To join this mailing list, email ourlandandwater@agresearch.co.nz.

If you would like to share a suggestion or need (research, engagement or other) please also email this address.



APPENDIX 1.

THE SYMPOSIUM'S NATIONAL SCIENCE CHALLENGE PARTNERS

The National Science Challenges were established in 2014 with the aim of tackling the biggest science-based issues and opportunities facing Aotearoa New Zealand. The Challenges bring together some of the country's top researchers to work collaboratively across disciplines, institutions and borders to achieve their objectives.

The Challenges represent a new way of funding research, with five key principles making them unique within the science system: they are mission-led, focus on science quality, bring together best research teams for collaboration, invest strongly in stakeholder engagement and public participation, and prioritise Māori involvement and mātauranga.

Three Challenges partnered to deliver the Growing Kai Under Increasing Dry Rolling Symposium:

1. Our Land and Water *Toitū te Whenua, Toiora te Wai*

The Our Land and Water National Science Challenge aims to preserve the most fundamental treasures of our country – our land, water and associated ecosystems – while producing value from those same treasures.

Our Land and Water is targeting goals under three research themes, which it aims to achieve by 2024:

- **Future Landscapes:** Decisions on land use change and management practices are able to be made with confidence that they will lead to improvement in te Taiao.
- **Incentives for Change:** New approaches to incentives and value chains are motivating people and organisations to make better decisions for te Taiao.
- **Pathways to Transition:** New options and pathways to enhance te Taiao are being explored by land stewards and organisations in the agri-food and fibre system.

2. Resilience to Nature's Challenges *Kia manawaroa – Nga Ākina o Te Ao Tūroa*

Resilience to Nature's Challenges has a mission to accelerate Aotearoa New Zealand's resilience to natural hazards.


Resilience to Nature's Challenges features 10 research programmes focused around two major themes:

- **Understanding Risk:** comprises new research to advance our understanding of natural hazards, including earthquakes and tsunami, volcanoes, coastal hazards, high-impact weather, and wildfires.
- **Accelerating Resilience:** comprises mātauranga Māori, social science, and economic and engineering research to develop policies, tools and methods to ensure new resilience knowledge becomes part of daily decision making in Aotearoa New Zealand.

3. The Deep South *Te Kōmata o Te Tonga*

The Deep South's mission is to enable New Zealanders to adapt, manage risk and thrive in a changing climate.

The Deep South works through five Research Programmes:

- **Vision Mātauranga:** investigates climate change impacts and opportunities for iwi, hapū, whānau and Māori businesses. It represents the largest ever Māori-led research effort into the implications of changing climate conditions for Māori society.
 - **Impacts & Implications:** aims to involve New Zealanders as communities, end-users and stakeholders in considering key impacts of, and decisions around, climate change.
 - **Processes & Observations:** focuses on improving knowledge about poorly understood aspects of the ocean, sea ice and atmosphere in the deep south, to improve climate models and projections.
 - **Earth System Modelling & Prediction:** has established the first New Zealand Earth System Model (NZESM), which combines the physical processes of atmospheric and oceanic circulation with the chemical and biological processes to inform international climate assessments.
 - **Engagement:** explicitly identifies and responds to the needs and priorities of research users, including communities, Māori, industry sectors, and local and central government, and feeds into the scientific process to ensure our research is relevant and useful.
- 

APPENDIX 2.

ROLLING SYMPOSIUM WEBINARS

This section provides summary points from presentations in the three science-focused webinars and the subsequent symposium held at Te Papa in Wellington. Further details, including research references, can be found at ourlandandwater.nz/kaiunderdry.

Webinar One — Drought and the changing climate: What does the future look like for farmers and growers?

In this webinar, Andrew Tait and Sue Rosier (both from NIWA) and Luke Harrington (The New Zealand Climate Change Research Institute, Te Herenga Waka Victoria University of Wellington) talked about changing drought risk from today through to the end of the century, extreme weather modelling and impacts, and how science is progressing. Recent extreme weather events were also explored, as were the financial impacts of climate change. The webinar recording and a full summary can be found [here](#).

Key Points

- Climate change projections at all three Representative Concentration Pathways (RCPs) show that Aotearoa New Zealand will be warmer across the board over the coming decades. At a finer level, there will be: more precipitation in the west, and less in the north and east of the country; rain will be concentrated within shorter time frames, meaning more dry days are projected; droughts are expected to start earlier, last longer, and be more intense.
- Ozone depletion over Antarctica, together with greenhouse gases affecting storm tracks, mean high pressure systems are stationing themselves over Aotearoa New Zealand more often, making drought more likely. In fact, every degree of warming could double drought frequency, and increase extreme hot days five, 10 or 20-fold. This is important because the biggest impact of drought may be in animal heat stress, which in turn may cause a decline in milk yields.
- Large, complex models can be of limited use at a local level and are very expensive and computationally heavy to run. One useful alternative resource is weather@home, an Oxford-based tool containing a regionally specific Australia/New Zealand model. It provides grid information down to 50km², allowing researchers to have higher confidence in the distribution's tails for temperature and precipitation, for example, especially for rare climatic extremes. This model suggests a 1.5-2 degrees warming (based on the Paris agreement) compared with pre-industrial temperatures, and there is also a +3 degree future run as well.

Webinar Two — Drought and the changing climate: Farm profits and community resilience

Drawing on recent examples from both climate change adaptation and disaster risk management, Nick Craddock-Henry and Kenny Bell (both from Manaaki Whenua – Landcare Research) and Bill Kaye-Blake (NZIER) explored the resilience of our rural communities. Within the context of on-farm experiences of drought and climate change, resilience can be supported by identifying what enables farms, individuals and/or industries to cope, or not. The webinar recording and a full summary can be found [here](#).

- In Aotearoa New Zealand, agriculture accounts for around 7% of GDP, 6% of total employment and 60% of total exports, so there is no doubt of its importance to the economy. Nationally, between 2007 and 2017, drought-driven climate change cost New Zealanders around \$720 million in insured damages and economic losses, about six times the figure for flood damage. These impacts were felt variably across the regions.
- Land-based primary industries for the most part have adapted well to local long-term conditions, but continuing to operate based on historical expectations leaves farmers exposed and sensitive to climatic variability and/or changes in extremes. Research is looking to advance resilience-based approaches to dealing with adverse events, including incorporating resilience into policy and practice.
- Quantifying the impact of weather on economic and social outcomes enables future projections to be made, and can answer questions such as, ‘What are the financial or other benefits of adaptation vs. taking no action?’ Using available modelling, we can be confident that moderate reductions in dairy farm profit are likely from day one, and that severe losses in sheep/beef farm profits of up to 54% are expected by 2100. However, it is also evident that global climate action would reduce losses significantly in both areas and potentially pay dividends to Aotearoa New Zealand’s farmers.
- Resilience is both the idea of bouncing back and bouncing forward. Bouncing back to an identity or status of ‘normality’, while bouncing forward is about adapting to change.
- Resilience can be measured using a newly developed Resilience Index Tool, which focuses on five dimensions: social, cultural, environmental, economic and institutional/organisational resilience.
- Communities have different sources of resilience and this should inform targeted strategies for supporting those communities. Using the Resilience Index Tool can help identify where problems might lie for specific communities, as well what strengths can be leveraged to respond to droughts or other events.

Webinar Three — Drought and the changing climate: What to grow and where

In this webinar, Anne-Gaelle Aussiel and Shaun Awatere (both from Manaaki Whenua – Landcare Research) and Anita Wreford (Lincoln University) explored climate change-related questions, including: What are the implications of future drought? What will it mean for farmers and growers? What are the limitations and opportunities that may present themselves with this changing climate? How do we prepare and make decisions when the future is uncertain? How could planning, policy, data and decision-making be informed by Mātauranga Māori? The webinar recording and a full summary can be found [here](#).

- There are three types of adaptation: tactical (such as changing seed sowing dates), strategic (such as establishing new infrastructure and species), and transformational (such as land use change). Each of these can be considered in Aotearoa New Zealand’s approach to meeting future challenges.
- A number of on-farm impacts are expected over the coming years as a direct result of climate change, and these will differ significantly by region. Specific changes include: higher risk of animal heat stress, especially in the central North Island; an increase in pasture yield in winter and spring but less in summer; some crop yields could change; and timing for grape development may shift, with flowering being up to four weeks earlier in some regions.
- The more local our climate modelling and the further ahead we look, the greater the uncertainty. Despite the lack of confident predictions, farmers can start to incorporate adaptation into near-term decision-making in ways that allow for future flexibility and don’t preclude subsequent adaptation-oriented changes. For example, considering long-term land use suitability before making new purchases.
- For about 600 years, Māori values ensured harmony with te taiao (the natural world), and informed the creation of cultivation mosaics tightly matched to microclimates in the landscape. By contrast, since the 1980s, government schemes and incentives have actively encouraged pastoral farming in unsuitable areas, with negative outcomes for natural systems, biodiversity, water quality and a profound impact on Māori cultural values.
- Māori land-use decisions involve large numbers of people across generations. To support culturally aligned decision-making about the whenua, a values framework has been developed, which draws from core values of kaitiakitanga, manaakitanga and whakatipu rawa.

APPENDIX 3.

ONE-DAY SYMPOSIUM SESSION SUMMARIES

The Symposium was opened by facilitator Josh Te Kani, with acknowledgement of those who have passed, a reminder to delegates of the significance of Matariki, and a warm welcome to farmers and growers, researchers, industry groups, and those from government, both in person and online.

An opening address set the scene for the day ahead, followed by presentations from two central government representatives, which added a government perspective to the scientific context already provided during the earlier webinars. Later in the morning, two expert panels provided primary sector insights, first from farmers and growers, and then from industry body representatives. There was an opportunity for delegates to explore some key issues within small groups in the afternoon, before final thoughts were offered to close the session.

Opening Address by Julia Jones Head of Insights, NZX

Julia set the scene for the Symposium by sharing observations to consider in terms of how Aotearoa New Zealand can adapt to climate change.

1. Working together will lead to solutions – no one is more valuable than anyone else.

In her opening address, Julia advocated for a realistic and collaborative approach to climate change based on two key factors. First, change is already happening, so taking a leadership position is preferable. Second, there is no singular solution, but rather, solutions will come from many places.

It will be important to work together across domains and generations, and most importantly, we need to stop punishing farmers.

2. Our economy is more agile and adaptable than we think – in fact it can progress hand-in-hand with adaptation.

The primary sector exports \$48 billion of food and fibre annually, so it needs to be protected. In particular, risk needs to be managed and communities protected.

Despite this seemingly large export figure, Aotearoa New Zealand supplies just 2% of the global food system, and this means we have agility and can easily evolve and adapt. There are several factors that growers might usefully consider, including: supply chain security, shifting consumer preferences and behaviour, and Covid-19.

Aotearoa New Zealand is good at selling physical produce, but we forget to demonstrate ‘how’ we produce things and highlight the value attached to that. The key for Aotearoa New Zealand moving forward is to create a food story that starts at the farm gate and is integrated with our adaptation strategy.



“Adaptation is about surviving and thriving in the face of change.”

3. We no longer have a choice about whether to change or stick with the status quo – changes are already happening.

Climate change-related extreme weather will become more common and so we simply have to adapt. As Julia describes it, “We don’t always get to choose change; it just comes at us.”

Financial disclosure laws now require organisations of all types to anticipate future risks and signal mitigation plans. The same approach is needed on farms. Farmers and growers should plan for various scenarios to reduce potential risk, says Julia. “Adaptation is scenario planning and working together to reduce risk.” It is about shifting and changing systems now to avoid panic later.

4. Bigger picture solutions – strategically planning together.

Sector level innovation will be important, and this should sit within a less siloed, more diversified ecosystem. Bringing together different sub sectors will assist, as well as better connecting policy-makers and central government processes with on-farm realities.

Julia observes a lack of climate change adaptation leadership throughout the sector, including within industry bodies, and central and local government. No one is talking about a transition plan, instead, people appear to be aiming straight for utopia, she says. Now is the time to accept that everyone will not be moving from the same place at the same pace, and there are many different views about what needs to happen. Focus on the willing and help them to know where to start and what to do.

“The key for Aotearoa New Zealand moving forward is to create a food story that starts at the farm gate and is integrated with our adaptation strategy.”

Current Policy Settings

To add another perspective to the discussion, two speakers presented on central government’s current and future climate change response.

Wai Water

Paul Barker, Partnerships Director, Department of Internal Affairs Te Tari Taiwhenua (DIA)

Paul discussed water security and the complex interplay of issues such as climate change and drought that create negative impacts for communities. He provided an outline of government planning and activities in this area.

Water security

Water security and drought are deeply connected. DIA has been looking at water security through a multifaceted ‘multi hazard risk lens’, which makes sense because climate change is an exacerbator of natural hazards and is interconnected with additional issues, none of which can be viewed alone. A systems perspective is needed that accounts for all relationships between water security, climate change, and extreme weather events.

Key issues

At the National Security System level, central government works through a variety of agencies which are the risk owners for a range of natural hazard risks. Several key issues are relevant to managing water security, including:

- competing priorities and objectives for water.
- multiple agencies having interests in water security, however, there is no single agency tasked with its oversight, and self-suppliers (rainwater tank and bore supply) are on their own.
- drought and water shortages changing the way New Zealanders value and use water.
- the need to better translate science on water issues into policy.

What is central government doing?

There is a great deal of reform and change underway, including the Three Waters Reform, and a National Adaptation Plan is now being developed. This critical piece of work will outline how Aotearoa New Zealand will respond to climate change risk, and it must be published by the close of 2022.

Despite the work already taking place within government, Paul acknowledged that more action is required, including better coordination and alignment within central government, and with local government, businesses, iwi/hapū and communities, and stronger connections between science and policy to enable effective action at all levels: national, regional and local.

Building resilience of the primary sector to a changing climate

Peter Ettema, Principal Advisor, Ministry for Primary Industries Manatū Ahu Matua (MPI)

Peter focused his presentation on how dealing with climate change and drought requires joined-up thinking and action, and yet this is a critical conversation we don't have often enough.

Policy

The Ministry for Primary Industries (MPI) works across government to support and enable the primary sector, and highlight and encourage understanding of the sector's specific concerns, including water security; an issue that is becoming ever more important in the face of climate change. Three focus areas guide MPI's activities with respect to water: water for the supply chain; drinking water for rural communities; and stock water. More broadly there is a focus on:

- Building resilience and reducing risks ahead of drought.
- Ensuring policies are rural-proofed.
- Supporting collaboration across government to plan for drought.

Adverse event response

Recent drought events have affected large tracts of Aotearoa New Zealand, and highlight the importance of ensuring communities are better prepared for more frequent future droughts, and can recover more robustly.

“One key issue the Ministry acknowledges is that families and communities are responsible for risk, and with climate change, there is more and more risk to manage. They are looking to alleviate this through on-farm practice.”

The Ministry supports the government's response to adverse climatic and natural hazard events that impact on-farm. Multiple initiatives are in play to support farmers and growers, and MPI works with other ministries to provide more holistic support for response and recovery.

MPI works with a wide range of organisations to provide support for farmers and growers, including: Rural Support Trusts and complementary service providers who can target hard to reach communities; recovery coordinators MPI can appoint following an adverse event; national bodies, such as MPI's National Adverse Events Committee (NAEC); the National Emergency Management Agency (NEMA), and Civil Defence Emergency Management (CDEM); sector-specific groups, such as DairyNZ, Beef+Lamb NZ and Federated Farmers; and government departments such as the Ministry of Social Development (MSD) and Inland Revenue (IRD).

Moving from response to resilience

A new high-level strategy, Fit for a Better World (FFBW), is helping the government move from a model based on response to one with a stronger emphasis on resilience and adaptation. FFBW provides a roadmap for achieving significant gains over the coming decade through:

- Accelerating the productivity, sustainability and inclusiveness of the primary sector to deliver more value for all New Zealanders.
- Bringing together key areas such as climate change, freshwater, animal welfare, biosecurity, and people management.
- Increasing opportunities to build our presence in markets and to provide more products to discerning consumers

PANELS

The Symposium involved two panels, the first featuring farmers and growers, and the second made up of representatives from industry bodies. A Q&A format was used, and the insights shared have been incorporated into the earlier sections of this report. While there was a high level of agreement among panel members, the ideas and experiences discussed did not necessarily constitute a consensus. A list of panellists is included in Appendix 4. Detailed discussions can be found at ourlandandwater.nz/kaiunderdry.

Panel 1: Views from Dry Land

In this panel, farmers and growers from around Aotearoa New Zealand shared their lived experiences of the changing climate. They were asked how these experiences have influenced their own experiences, and how they intended to adapt to the future climate. Panellists also commented on how other agents such as government and researchers could best support their on-farm adaptation.

“Every farmer is different and every farm is different.”

Panel 2: Adapting the Primary Sector

In this panel, representatives from a range of institutions working in the primary sector were asked how their respective organisations were adapting to the changing climate, and in the context of future drought projects, what future policy needs to deliver to effectively support adaptation.

“One of the key benefits of [researchers] working in partnership with industry and government is that you can get the expertise out there on-farm and influence people to show them the behaviour change needed to generate different results.”

Collective Conversations: Views, Issues and Reaching Outcomes

In this facilitated session, attendees were invited to explore key issues and challenges facing the sector, and generate ideas for resolving these. They were encouraged to use a future-focused lens to imagine a future where Aotearoa New Zealand has fully adapted to a changing climate and then work backwards to understand how this goal could be reached as a nation. The ideas shared have been incorporated into earlier sections of this report. Detailed discussions can be found here, but should be considered as food for thought rather than the result of in-depth consideration and expertise relevant to each question.

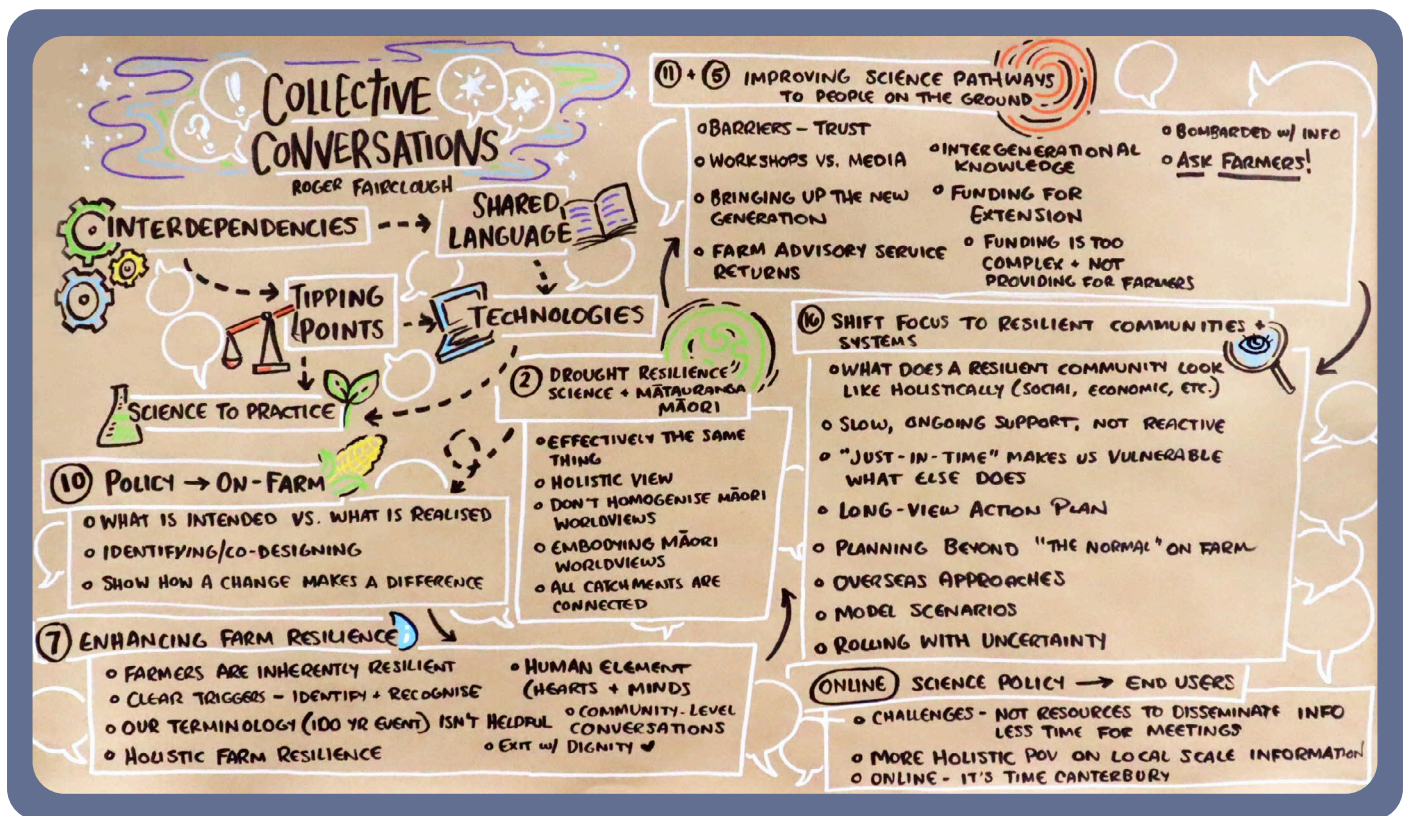


Figure 7: Summary of Collective Conversations.
Credit: Pepper Raccoon Design.

This session was facilitated by Roger Fairclough, who began by summarising some of the key discussion points of the morning, including:

- Frequent mention of the interplay between the private sector and government, now and into the future.
- Claims that siloes are no longer so prominent within the primary industry.
- Interdependencies, in that drought comes up for every sector.
- The importance of infrastructure in the adaptation conversation, including water storage, irrigation, and hydroelectric generation.
- Soil security.
- One group of words related to 'how we get to where we want to go' is being used commonly: adaptations, transitions, journeys, and pathways.
- Another group of words used often relates to working together towards a common goal, and this is reassuring: collaborative, collective, joined up, and participatory.

There were other issues that Roger thought had been only lightly touched on but warranted further exploration:

Technology – is there more opportunity here?

Tipping points – Aotearoa New Zealand is proving that we are more adaptive than most economists would anticipate – Kaikōura, Canterbury and Covid-19 have all proved it – BUT if we hit certain climate-related tipping points, will that change?

Thinking about *alternative land values* such as the value of native bush – is there an interface with productive land use versus other values that exist in the natural environment?

Related to the repeated need to *converse across sectors*, let's not treat the group brought together for this Symposium as its own silo either – how can we be more comfortable working across groupings, systems and processes?

In terms of the contribution that science can make to practice – how do we improve this relationship to ensure research is *useful, usable and used*?

APPENDIX 4. FACILITATORS, SPEAKERS AND PANELISTS

Webinars

Dr Andrew Tait (NIWA)

Andrew is NIWA's Chief Scientist for Climate, Atmosphere and Hazards, and specialises in applications of climate data and products, and climate change impacts and adaptation research. Andrew is a lead author of the Australasia chapter of the IPCC Fifth Assessment WGII Report, a member of the WMO Commission for Climatology (CCI) executive, and co-chair of the WMO CCI Focus Area on 'Climate Services for Societal Benefits'.

Dr Luke Harrington (Te Herenga Waka Victoria University of Wellington)

Luke is a Senior Research Fellow at the New Zealand Climate Change Research Institute, and is researching better ways to understand and quantify changes in both extreme heat stress and drought over the coming decades. Luke's research in 2016 culminated in the first comprehensive attribution study of a New Zealand drought.

Dr Suzanne Rosier (NIWA)

Suzanne is a climate scientist at NIWA in Wellington. She played a key part in helping launch weather@home Australia/New Zealand to the public, and has subsequently analysed its large New Zealand datasets with a particular focus on extreme rainfall. Her new weather@home experiments are looking into how weather and climate extremes might be different a few decades from now.

Dr Nick Cradock-Henry (Manaaki Whenua – Landcare Research)

Nick is a senior scientist with Manaaki Whenua – Landcare Research, where he leads work on climate change impacts and implications, adaptation and resilience to natural hazards. Nick co-leads the Resilience, Policy and Governance programme in the Resilience to Nature's Challenges National Science Challenge.

Dr Kenny Bell (Manaaki Whenua – Landcare Research)

Kenny is an economist at Manaaki Whenua – Landcare Research who specialises in using statistical methods to understand how weather affects society. His current research topics include valuing environmental outcomes in the far future, valuing natural capital using statistical methods, and understanding measurement error.

Dr Bill Kaye-Blake (NZIER)

Bill advises government and commercial entities by providing an independent, analytical perspective. Much of his work is in the agri-food sector, including innovation and natural resource impacts. He uses a variety of quantitative and discursive approaches from the applied behavioural sciences.

Dr Anne-Gaelle Aussiel (Manaaki Whenua – Landcare Research)

Anne is an environmental scientist focussing on land-use and climate change impacts on biodiversity and ecosystem services. Her research interests include: integrated and multidisciplinary approaches for coupling biophysical and economic models; environmental management decision making; spatial information; climate change; landscape change dynamics; and biodiversity conservation.

Assoc Prof Anita Wreford (Lincoln University)

Anita is an economist and leader of the Deep South Challenge's Impacts and Implications programme. Her research includes: economic evaluations of adaptation and applying robust methods to deal with climate uncertainty; identifying and evaluating the effectiveness of adaptation options; mitigation options and costs in agriculture; community resilience to extreme weather events; and adaptation decision-making among stakeholders.

Dr Shaun Awatere (Manaaki Whenua – Landcare Research)

Shaun is a senior kairangahau and a theme leader with Ngā Pae o te Māramatanga, New Zealand's Māori Centre of Research Excellence. Shaun's work involves improving the incorporation of Māori values into economic decision-making for collective assets that will enable Māori organisations to make decisions more aligned with kaupapa Māori. He is currently engaged in research and policy to help prepare iwi/hapū Māori for climate change mitigation and adaptation planning.

SYMPOSIUM

Facilitator — Josh Te Kani

Vision Mātauranga Knowledge Broker, Resilience to Nature's Challenges

A specialist in Māori communications, Josh has a background in iwi broadcasting and Iwi-Crown engagement. As the Vision Mātauranga Knowledge Broker for the Resilience Challenge, Josh works to increase understanding of mātauranga Māori and enhance research to give enduring results for communities.

Opening Address — Julia Jones

Head of Insights, NZX

Julia is the Head of Insight with NZX where she provides insight and foresight to support business, communities and ultimately the whole of the country to keep progressing. Her previous time with KPMG fuelled a passion for understanding global trends and their impact on Aotearoa New Zealand's economy. Julia's career highlights include completing the Harvard Agri Seminar in China, winning MPI's Emerging Leader Scholarship to attend the Te Hono Boot Camp at Stanford University, graduating from the AWDT Escalator Program, a short stint working in Russia, and being appointed to the Primary Sector Council.

Current Policy Settings

Paul Barker, Partnerships Director

Department of Internal Affairs Te Tari Whenua (DIA)

Paul leads work on community resilience working with government agencies and local government on natural hazards and climate change adaptation. Paul has an extensive public policy background and has worked in New Zealand and for international agencies including the OECD.

Peter Ettema, Principal Advisor

Ministry for Primary Industries - Manatū Ahu Matua (MPI)

Peter has spent his career working across the primary sector, both in New Zealand and overseas. He supports work to build resilient and sustainable primary sector-based businesses and rural communities. He has a Masters of Environmental Management as well as qualifications in the measurement and management of agricultural greenhouse gases and farm environmental planning.

Panel 1: Views from Dry Land, facilitated by Nick Cradock-Henry

Brenton O'Riley Viticulturist – Te Mata Estate

Brought up on a Manawatu dairy farm, Brenton always had a passion for agriculture and horticulture. This led to studying towards a Bachelor of Oenology and a Bachelor of Viticulture. Brenton has worked for some of the NZ's largest wineries, with a particular focus in technical viticulture, grower relations and supply and demand. Brenton is now based in the Hawke's Bay at Te Mata Estate, where he is the company viticulturist. Brenton is hugely passionate in sustainability, organics, precision agriculture and the pursuit of quality wine.

Bruce Wills Hawke's Bay Sheep & Beef Farmer

Sheep & cattle farmer from Hawkes Bay. Off farm holds Governance roles with Ravensdown, Our Land and Water and Resilience to Nature's Challenges (National Science Challenges). Chair of Apiculture NZ, MPI's Deer PGP, Motu Economic & Public Policy Research, QEII National Trust and PITO. Previous National President of Federated Farmers 2011 to 2014.

Cathy Tait-Jamieson, BioFarm organic dairy farmer, Manawatu

Cathy (Ngai Tukorehe) farms 250ha on the banks of the Manawatu River in Palmerston North, which is prone to drought and flood. Certified organic, the farm produces BioFarm yoghurt from an on-farm microprocessing plant. Cathy is the Chair of her Iwi incorporation dairy farm in Kuku, Horowhenua and a trustee on Te Waka Kai Ora, the Māori Organic verification agency.

Fraser Avery, Marlborough sheep and beef farmer

Fraser Avery is a 4th generation sheep and beef farmer at Grassmere, Marlborough. He was Marlborough Farmer of the year in 2019, and is Chair of Northern South Island Farmer Council for Beef and Lamb.

Neil Bateup Rural Support Network, Waikato

A North Waikato dairy farmer with 670 Jersey cows on 240 hectares in a drought-prone area, Neil is a founding member and long-time Chair of the Waikato Hauraki/Coromandel Rural Support Trust, and is Chair of the National Council of RSTs. Neil has been an LIC Shareholder Councillor and served on the Fonterra Shareholders Council.

Richard Cookson Waikato Dairy Farmer

After achieving a PhD in soil biology and a 10-year university research career, Richard returned to his family's Fonterra and Tatura dairy farms 14 years ago. His business goal has been to implement a people-focused, low cost/risk, resilient, environmentally sustainable farming system across both cow and goat investments.

Panel 2: Adapting the Primary Sector, facilitated by Anita Wreford

Edwin Massey, General Manager Sustainability — NZ Winegrowers

Ed is responsible for the implementation of the wine industry's Environment Strategy to protect and enhance the industry's reputation as a world leader in sustainable production. Prior to joining NZ Winegrowers, he worked for central government in fisheries management before moving into biosecurity response.

Gavin Forrest, Policy Manager — Federated Farmers

Gavin has around 30 years policy and advocacy experience across local, regional and national issues affecting the primary sector. He has worked for MAF/MPI and the Office of the Ministers of Agriculture, Forestry and Primary Industry.

Ivan Lawrie, general manager of business operations — Foundation for Arable Research (FAR)

Ivan has extensive experience in arable research having worked in the area for close to 20 years. FAR is actively collaborating with HortNZ, MPI and MfE, as well as other cropping related organisations across New Zealand and internationally to support the sustainability and resilience of arable cropping.

Liz Tupuhi, scientist lead — DairyNZ

Liz has an environmental science background with much of her career spent working for regional councils and a stint working as a volunteer in Kiribati. Originally from a dairy farm in Wales, Liz came to Aotearoa in 1973.

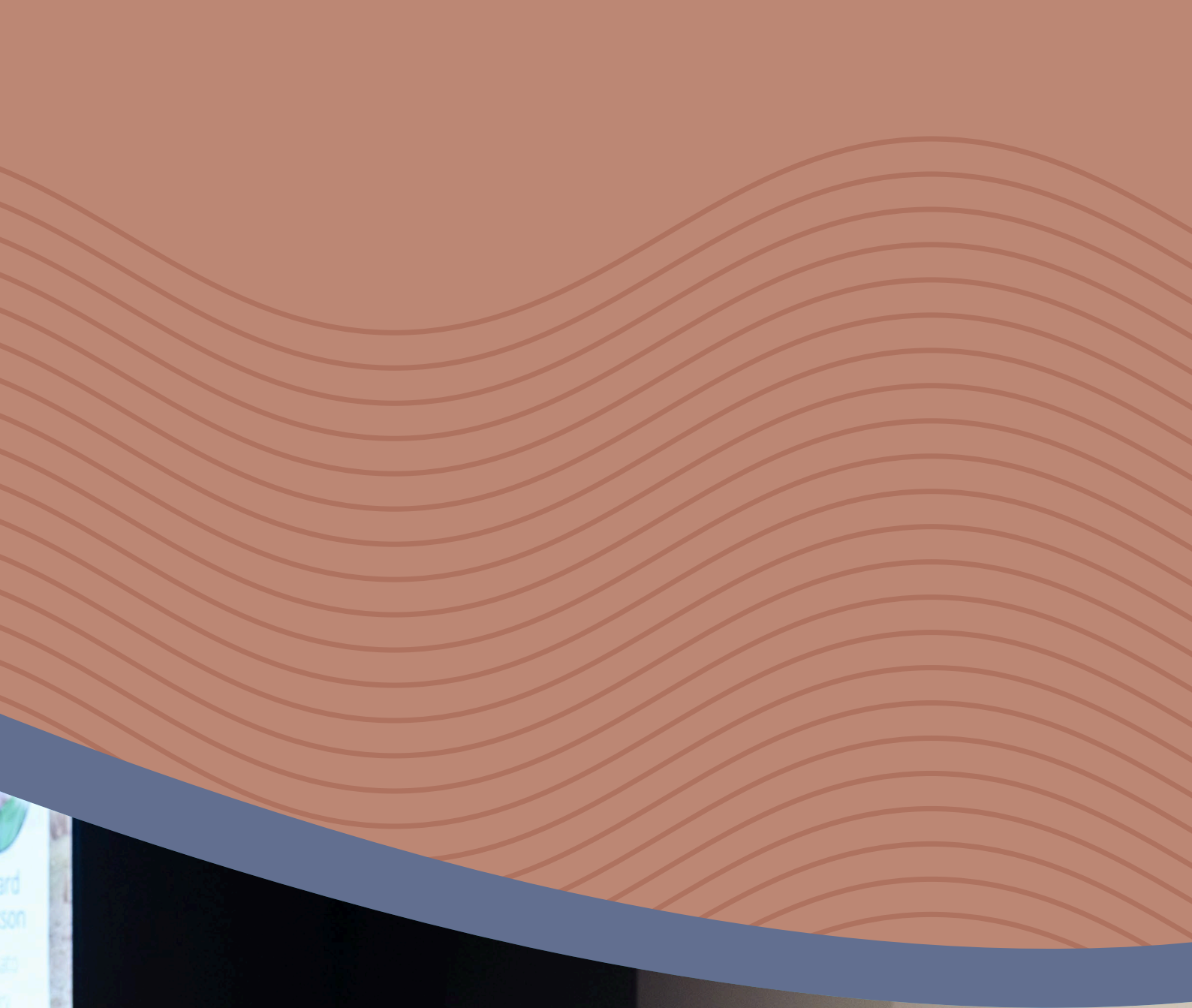
Michelle Sands, environment policy team lead — Horticulture NZ

Michelle has over 20 years of post-graduate experience in environmental management, water resource management, climate change adaptation, and more recently, climate change mitigation. With an interest in the roles of both science and values in informing decision-making at a range of scales, Michelle has worked with growers across New Zealand to better understand their horticultural operations and how resource management issues impact them.

Collective Conversations

Roger Fairclough – Session Facilitator

Roger is a Civil Engineer and Fellow of Engineering New Zealand and has worked extensively in the private and government sectors. Related to climate adaptation, Roger contributed to development of the ETS, co-leads the Climate Adaptation Platform and was a member of the Expert Panel to develop "Arotakenga Huringa Āhuarangi: A Framework for the National Climate Change Risk Assessment for Aotearoa New Zealand".



Views from Dry Land Panel