



# Applying adaptation pathways with Hawke's Bay primary industries

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## KEY MESSAGES

- Eastern regions of New Zealand, including Hawke's Bay, are expected to become hotter and drier with climate change. This has implications for primary industries in the area, including high-value horticulture and viticulture, dairying, livestock and arable farming, as well as forestry.
- An adaptation pathways approach is being trialled to support Hawke's Bay primary industries to adapt to climate change.
- Adaptation pathways provide a sequence of adaptation options and help decision makers to understand how and when to change their management practices in order to minimise risks and realise opportunities.
- Pathways visually display the order of adaptation options – from those that can be taken now, to ones that may be taken later – and provide a useful output for stakeholders' planning.
- The process of developing adaptation pathways highlights the complexity of adaptation planning for resource management at the regional scale. Including stakeholders in the process builds adaptive capacity, and can help avoid maladaptation by considering synergies and possible trade-offs among adaptation options.
- Pathways planning is being used in New Zealand for coastal hazards and sea-level rise, but it has potential for further application to primary industries to develop sector-specific strategies to better understand how individual farmers, regions and industries can adapt to climate-change-related challenges and opportunities.

## INTRODUCTION

Primary industries are an important part of New Zealand's economy and support livelihoods in rural regions throughout the country. Climate change is expected to affect primary industries, compounding existing

vulnerabilities, creating new ones and confounding decision-making.<sup>1,2</sup> Although our understanding of potential impacts has improved, the capacity for identifying, evaluating and comparing adaptation options remains limited by poor integration of social and economic studies with biophysical impact assessments, and an emphasis on individuals' adaptive strategies.<sup>3</sup> Working with land managers, local government and other stakeholders, we developed and applied a pathways approach to support adaptation planning for primary industries. Using Hawke's Bay as a case study, it combines regional climate change modelling with participatory research with stakeholders.



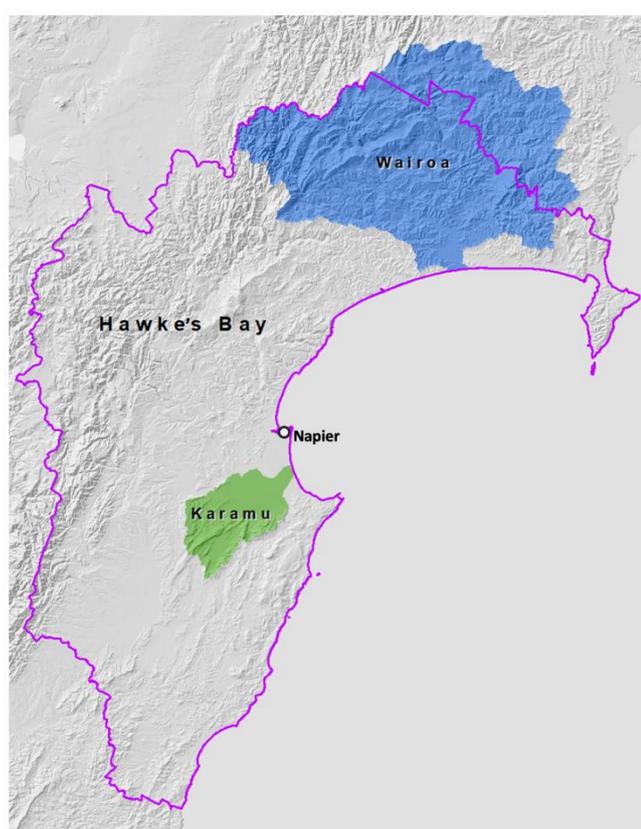
## HAWKE'S BAY BACKGROUND AND CONTEXT

Hawke's Bay is located on the east coast of the North Island of New Zealand, covering 14,200 km<sup>2</sup>. The region includes mountain ranges to the north and west, 350 km of coastline, productive plains, and hill country and native forest.

Hawke's Bay has a mild, Mediterranean-type climate (dry and warm). Summer is generally sunnier and hotter than New Zealand averages, with temperatures higher in the eastern lowland plains and cooler in the western hill country and mountain ranges. While winters are usually mild, frosts and occasional snow do happen. The region tends to experience long, dry periods and regular droughts, with relatively low mean annual rainfall (~1000 mm) and one of the lowest number of rain days in the North Island.

Approximately 151,000 people live in the region, and the local economy has long relied on primary production, including pastoral farming (sheep and beef) and horticulture. It is also the second-largest wine-growing area in New Zealand after Marlborough.

Two catchments were selected for our assessment: Wairoa and Karamu (Figure 1). The catchments are contrasting and exhibit diversity in terms of primary industries and land management. Both catchments face a number of inter-related challenges, including climate change adaptation, soil erosion, water availability and drought, and social and economic vulnerability. Wairoa is a remote, hilly, and erosion-prone region; Karamu is flat, with diverse land uses focused on high-value horticultural and viticultural production.



**Figure 1.** Hawke's Bay and case-study catchments.

Climate change is expected to result in warmer and drier conditions for much of eastern New Zealand, including Hawke's Bay.<sup>4</sup> The impacts of climate change will have implications for land management, and the primary industries in the catchments will need to adapt to reduce climate risks and realise opportunities.

### Adaptation to climate change

Adaptation involves taking action to avoid, withstand or benefit from current and projected climate changes and their impacts.<sup>5</sup> To support adaptation planning, therefore, it is necessary to understand what future conditions are likely to be and consider the range of actions or steps to be taken in response to those changes.<sup>6</sup>

Using downscaled climate and crop modelling for Hawke's Bay, together with interviews and workshops, local stakeholders identified the ways in which climate change would affect places, activities and features they valued. Adaptation options – from short-term changes in farm management practices, such as lowering stocking rates or improving water use efficiencies, to long-term, more transformational changes, such as changing crop varieties or land use – were discussed, and the suitability of each option was explored in facilitated conversations with other stakeholders.

An adaptation pathways approach was used to further explore which options would be feasible 'now', which ones would require some lead time and could be implemented 'later', and which ones required significant investment or further consideration – these options would be taken 'much later'. The pathways approach – a version of which is being used elsewhere in New Zealand for coastal hazards and sea-level rise – is useful for considering a range of possible futures and potential adaptation options.<sup>7,8</sup> The aim is to have a robust plan that is flexible enough to deliver desired outcomes regardless of how the future unfolds.<sup>9</sup>

### CLIMATE CHANGE AND HAWKE'S BAY

Climate projections were used to help understand the ways in which Hawke's Bay may change in the future. Two scenarios were developed, consistent with the international literature, and reflecting global emissions trends (Table 1).

**Table 1.** Climate change projections for Hawke’s Bay<sup>4</sup>

Case study	Climate scenarios	
	Moderate	Extreme
<b>Karamu</b>	<ul style="list-style-type: none"> <li>• <b>0.75°C</b> warmer, mostly in <b>summer/autumn</b></li> <li>• <b>15</b> additional ‘hot days’ per year, temperatures exceed 25°C</li> <li>• <b>5</b> fewer ‘cold nights’ per year (i.e. frosts)</li> <li>• <b>5%</b> less rainfall annually, mostly in <b>spring</b></li> <li>• <b>5%</b> more extreme rainfall</li> <li>• <b>120 mm</b> increase in PED deficit (<b>drought proneness</b>)</li> <li>• + increase in extreme winds and storms is <b>uncertain</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>2.5°C</b> warmer, mostly in <b>autumn</b></li> <li>• <b>60</b> additional ‘hot days’ per year</li> <li>• <b>10</b> fewer ‘cold nights’ per year (i.e. frosts)</li> <li>• <b>10%</b> less rainfall annually, mostly in <b>spring</b></li> <li>• <b>10%</b> more extreme rainfall</li> <li>• <b>160 mm</b> increase in PED deficit (<b>drought proneness</b>)</li> <li>• ++ increase in extreme winds and storms is <b>uncertain</b></li> </ul>
<b>Wairoa</b>	<ul style="list-style-type: none"> <li>• <b>0.75°C</b> warmer, mostly in <b>summer/autumn</b></li> <li>• <b>30</b> additional ‘hot days’ per year</li> <li>• <b>5</b> fewer ‘cold nights’ per year (i.e. frosts)</li> <li>• <b>5%</b> less rainfall annually, mostly in <b>spring</b></li> <li>• <b>5%</b> more extreme rainfall</li> <li>• <b>100 mm</b> increase in PED deficit (<b>drought proneness</b>)</li> <li>• + increase in extreme winds and storms is <b>uncertain</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>2.75°C</b> warmer, mostly in <b>autumn</b></li> <li>• <b>60</b> additional ‘hot days’ per year</li> <li>• <b>5</b> fewer ‘cold nights’ per year (i.e. frosts)</li> <li>• <b>5%</b> less rainfall annually, mostly in <b>spring</b></li> <li>• <b>15%</b> more extreme rainfall</li> <li>• <b>140 mm</b> increase in PED deficit (<b>drought proneness</b>)</li> <li>• ++ increase in extreme winds and storms is <b>uncertain</b></li> </ul>

## IMPACTS AND IMPLICATIONS FOR HAWKE’S BAY PRIMARY INDUSTRIES

Changes in temperature and precipitation will have impacts and implications for primary industries in Hawke’s Bay and elsewhere. Working with stakeholders representing a number of different sectors, we discussed what climate change might mean for the region. Potential impacts include:

- lower yields as a result of more frequent extreme events such as drought and/or floods
- disruption to supply chains as a result of damage to critical infrastructure
- losses due to increases in pests and disease
- increased risk of forest fires
- higher production costs and declining access to water resources
- potential loss of social licence to operate as a result of negative environmental impacts from intensive agriculture
- compounding environmental stresses and market or price shocks making it more difficult to maintain profitably.

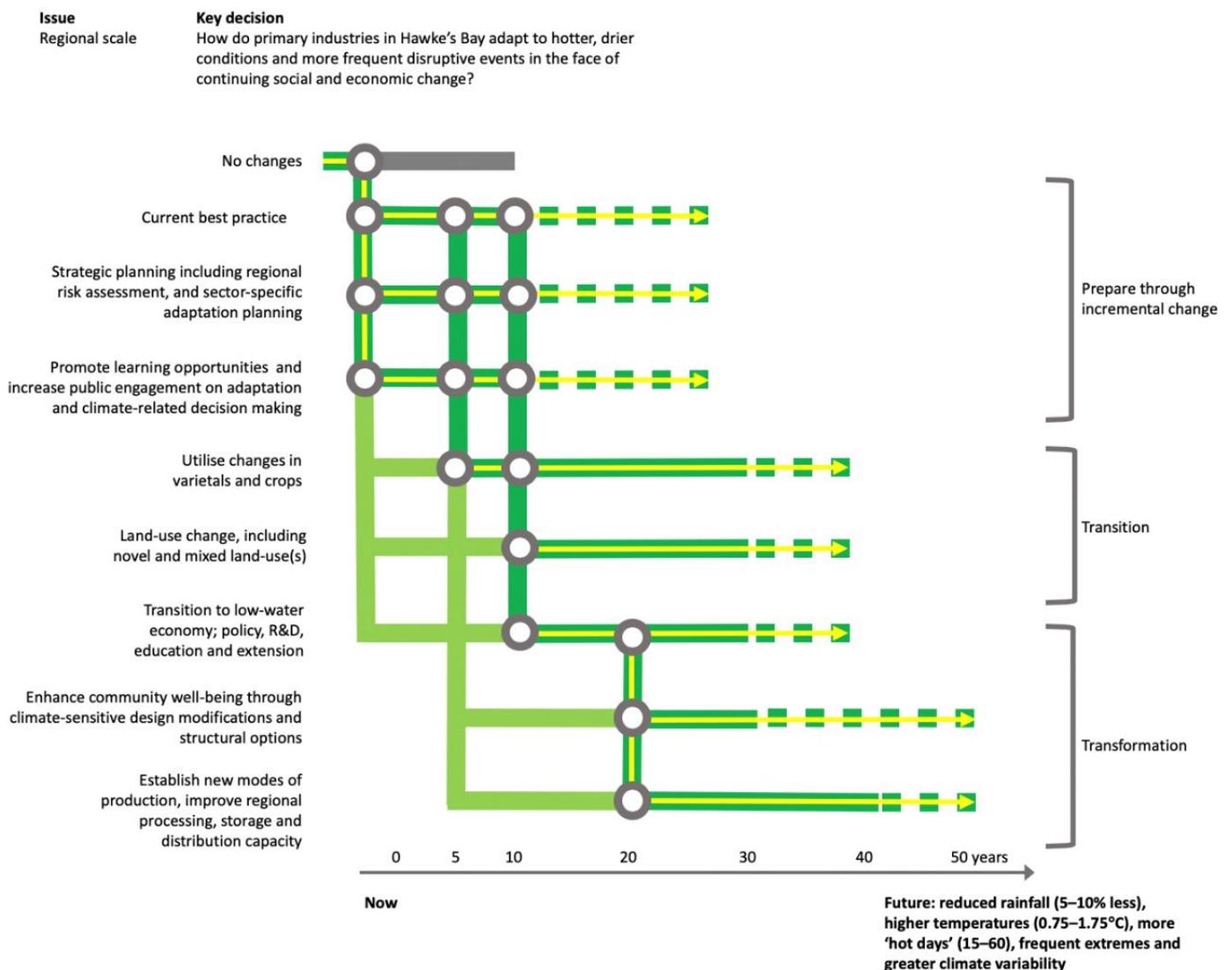
## Key areas for decision making

To support adaptation planning, stakeholders identified four priorities for decision-making to ensure the long-term sustainability of the primary sector in Hawke’s Bay – community resilience and well-being, infrastructure, water resources, and primary industries. Adaptation options were developed for each priority. By involving stakeholders in the planning process, new ideas were generated, links between options were explored, and the ways in which actions might be implemented were discussed.

For each of the four priorities a pathways diagram was produced, and the suite of preferred options were documented. The pathways diagrams are an easily accessible way of representing the range of adaptation options over time. Some decisions can be made now and will help primary industries adjust to changes in the short term; other decisions with long lead times may require additional investment or more research before implementing.

## Regional adaptation planning

Figure 2 shows the emerging regional adaptation pathway for Hawke’s Bay primary industries. It is based on key areas for decision-making identified by stakeholders and illustrates the decisions and actions that could be used to support adaptation across sectors. Implementing the pathway will require greater coordination between local and regional councils, iwi, communities, and the primary industries.



**Figure 2.** Regional adaptation pathway for Hawke's Bay primary industries

The horizontal axis of the pathway shows both a timescale and expected changes. The range of adaptation options considered are listed on the left-hand side of the pathway.

Against each option is a combination of dots and lines. 'Decision points' are indicated by a circle, showing the point in time at which a decision needs to be made between different options relative to the x-axis. This is based on the premise that as climate changes some options will become less suitable as adaptation measures and so new ones may be required.

In Figure 2, dark green lines show the time period over which an option can usefully address the priority in question, while the light green lines indicate options for which some preparation may be required. The yellow line shows the preferred adaptation pathway identified by stakeholders in

workshops. Additional information on interpreting the pathways diagram is provided in the full report.<sup>10</sup>

The pathways diagram shows the range of adaptation options considered and the preferred adaptation pathway based on the preferred options. The timing for each option and the relationship with other preferred options is also shown.

The horizontal axis of the pathway shows both a timescale and expected changes. The range of adaptation options considered are listed on the left-hand side of the pathway.

Although adaptation is local and potentially a sector-specific endeavour, it will require industry (e.g. sector bodies) and institutional support (e.g. local and central government) at different scales to be efficient and effective. Regional (and sometimes national) adaptation strategies must be

developed in concert with other industries to avoid maladaptation, realise synergies, and optimise cross-sectoral adaptive capacity. Narrowly focused actions may not create an adaptive sector if they do not account for opportunities, challenges, and preferred adaptations elsewhere.

For example, water use adaptation at the farm scale will be underpinned by sound regional policy and strategies, which in turn is enabled by national guidance and policy. Without this coordination across governance scales and over time, individuals, industries and regions could compete for scarce resources in a detrimental way.

In the short term many of the adaptation actions identified are likely to correspond with current best practices that help prepare for climate change through incremental change. Such actions could include risk assessment across regional value chains; promoting awareness of climate change adaptation, risks and opportunities; support for research on the potential for transformational changes; and selective breeding for agriculture.

The two highest-priority planning actions that could assist with cross-sectoral adaptation are the development of sector-specific adaptation plans, and investment in education, outreach and extension to enhance learning opportunities.

## RESULTS AND FUTURE DIRECTIONS

In summary, the development and application of pathways planning with and for primary industries in Hawke's Bay:

- provides a useful and versatile framework for engaging with diverse stakeholders on adaptation issues – the process is scalable and can be applied to individual land managers, across local and regional scales, or to generate sector-specific insights
- generates additional insight into the complexities of adaptation planning for primary industries
- demonstrates the growing interest in adaptation knowledge, which advances practical application and moves beyond continued debates and discussions regarding impacts and implications to more closely consider decisions and actions
- helps to facilitate cross-sector collaboration and knowledge sharing.

The results provide a novel application of pathways planning methods to the primary industries, and can serve as a template for further applications by local and regional authorities, and for sector-specific pathways development.

Adaptation to climate change is emerging as a priority scientific need in the primary industries and across New Zealand society more generally. Further application and development of pathways processes and research to support adaptation planning more widely with primary industries is needed to connect and empower stakeholders

to make decisions and implement actions towards climate adaptation.

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