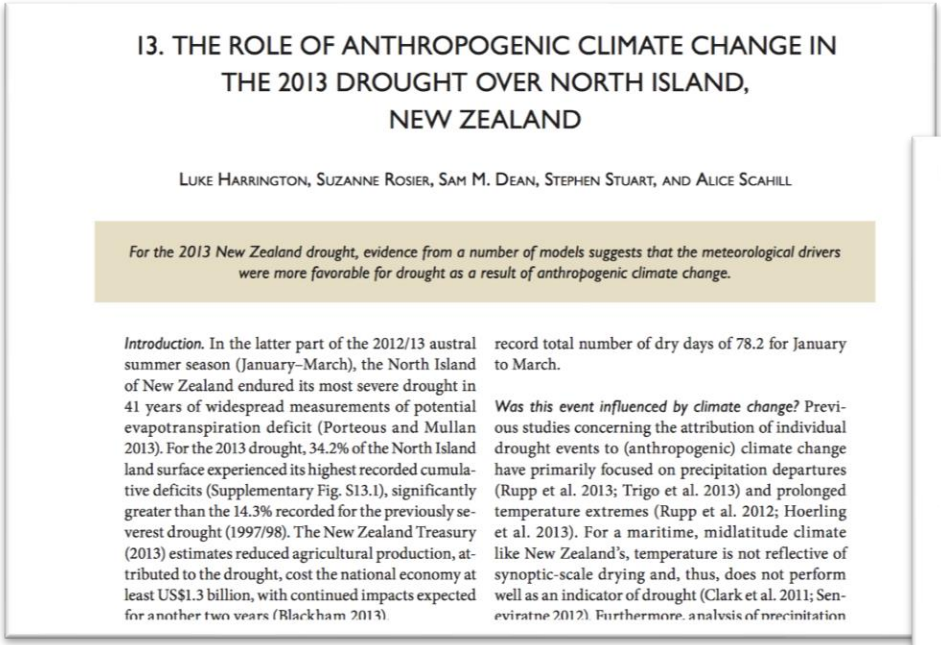
Manaaki Whenua
Landcare Research

MANAAKI WHENUA – LANDCARE RESEARCH

Applying adaptation pathways with primary industries in Hawke's Bay

Nick Cradock-Henry

11 September 2019
LINK Seminar
MPI, Wellington



13. THE ROLE OF ANTHROPOGENIC CLIMATE CHANGE IN THE 2013 DROUGHT OVER NORTH ISLAND, NEW ZEALAND

LUKE HARRINGTON, SUZANNE ROSIER, SAM M. DEAN, STEPHEN STUART, AND ALICE SCAHILL

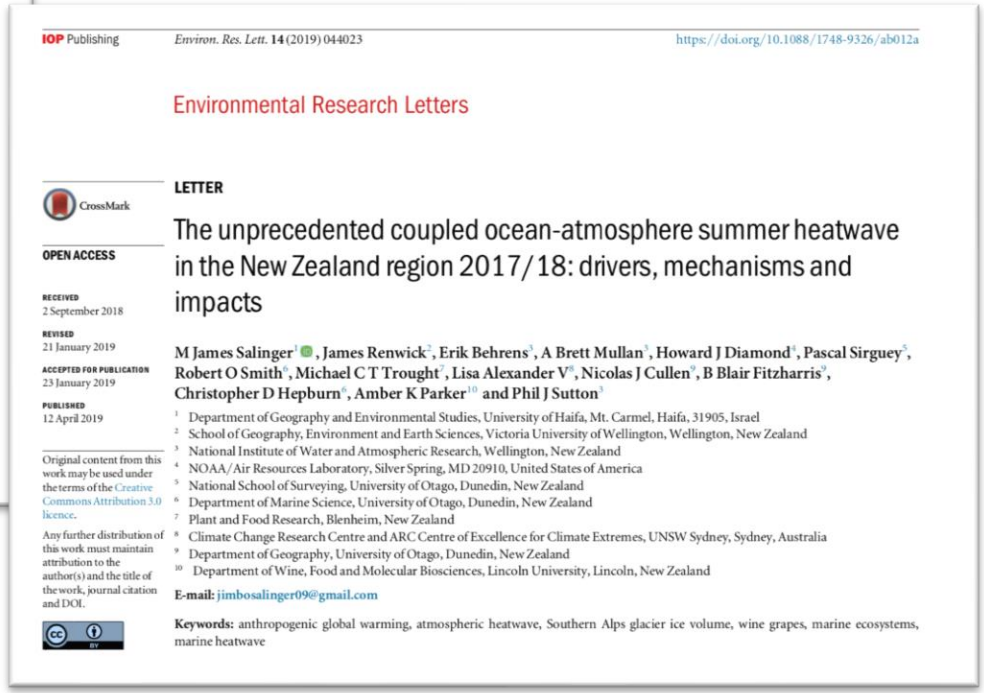
For the 2013 New Zealand drought, evidence from a number of models suggests that the meteorological drivers were more favorable for drought as a result of anthropogenic climate change.

Introduction. In the latter part of the 2012/13 austral summer season (January–March), the North Island of New Zealand endured its most severe drought in 41 years of widespread measurements of potential evapotranspiration deficit (Porteous and Mullan 2013). For the 2013 drought, 34.2% of the North Island land surface experienced its highest recorded cumulative deficits (Supplementary Fig. S13.1), significantly greater than the 14.3% recorded for the previously severest drought (1997/98). The New Zealand Treasury (2013) estimates reduced agricultural production, attributed to the drought, cost the national economy at least US$1.3 billion, with continued impacts expected for another two years (Blackham 2013).

record total number of dry days of 78.2 for January to March.

Was this event influenced by climate change? Previous studies concerning the attribution of individual drought events to (anthropogenic) climate change have primarily focused on precipitation departures (Rupp et al. 2013; Trigo et al. 2013) and prolonged temperature extremes (Rupp et al. 2012; Hoerling et al. 2013). For a maritime, midlatitude climate like New Zealand's, temperature is not reflective of synoptic-scale drying and, thus, does not perform well as an indicator of drought (Clark et al. 2011; Senevirat[illegible] 2012). Furthermore, analysis of precipitation

"…Climate change is making a difference to New Zealand now, affecting our droughts and our rainfall extremes…"
(Harrington *et al*. 2014)



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Environmental Research Letters

LETTER

The unprecedented coupled ocean-atmosphere summer heatwave in the New Zealand region 2017/18: drivers, mechanisms and impacts

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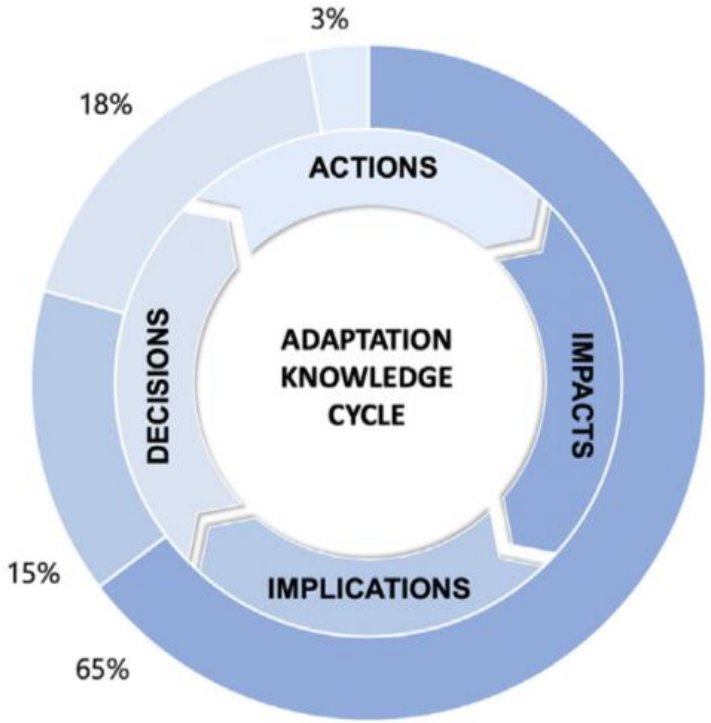
Keywords: anthropogenic global warming, atmospheric heatwave, Southern Alps glacier ice volume, wine grapes, marine ecosystems, marine heatwave

"The unprecedented heatwave provides a good analogue for possible mean conditions in the late 21st century."
(Salinger *et al*. 2019)

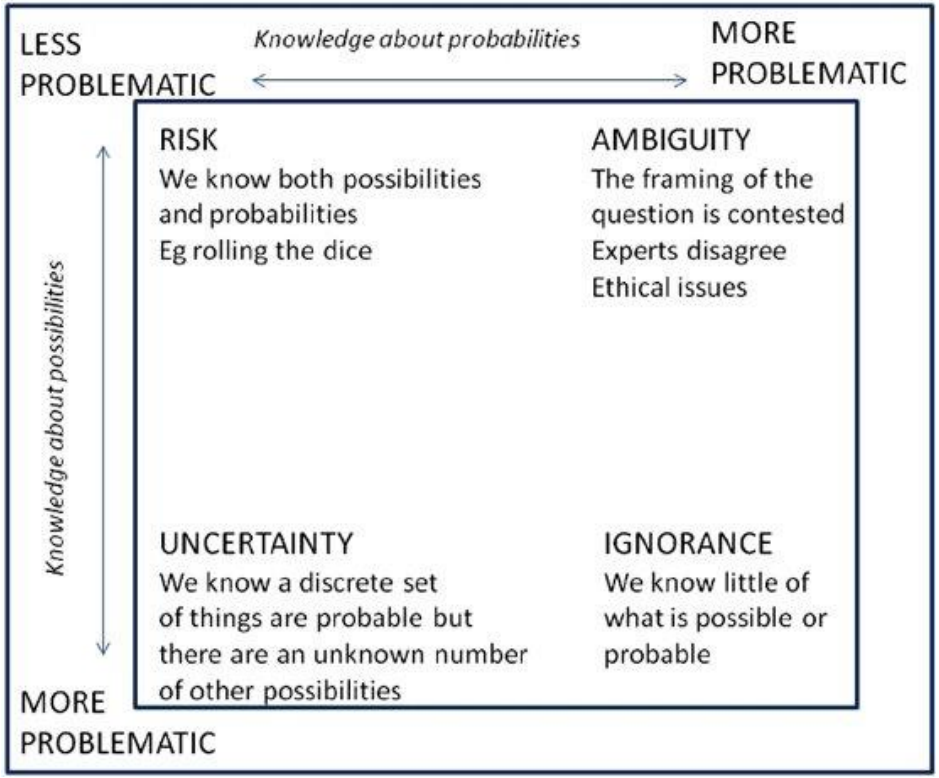
What do we know?

- Review of climate change research for NZ primary industries
- Focus on mitigation
  - 224 papers on mitigation
  - 22 papers on adaptation
- Emphasis on characterizing impacts and implications
- Decisions?
  - Can we do anything about it or its impacts?
  - How and when do we take action?
- Actions?
  - How do we know we're doing the right thing?



(Cradock-Henry *et al.* 2019a,b)

Adaptation: complex, messy and contested



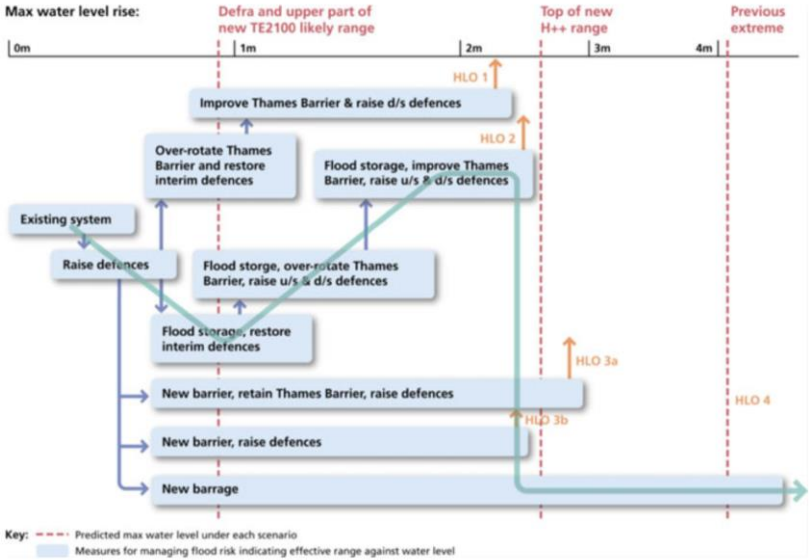
(Stirling 2010)

Look beyond risk to ambiguity, uncertainty and ignorance using quantitative and qualitative methods.

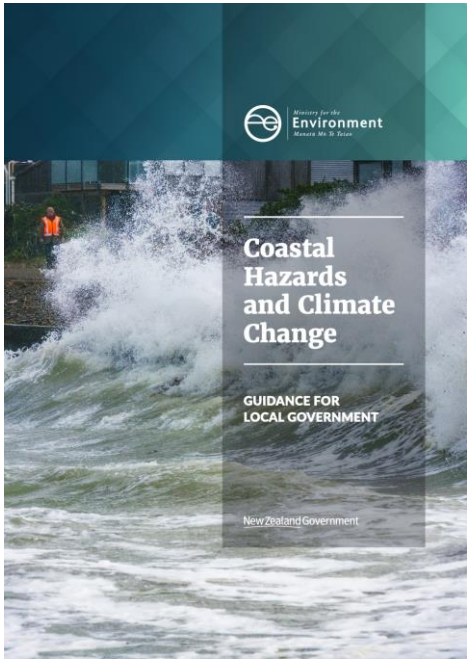
- Flexibility of commitments
- Adaptability, resilience
- Robustness, diversity

Dynamic Adaptive Policy Pathways (DAPP)

- Support decision making under conditions of 'deep uncertainty'
- Technical process, probabilistic modelling, linked to policy and management actions



Thames Barrier (Ranger et al. 2013, Bloemen et al. 2018)



(MfE 2017)

Adaptive management with a pathways focus

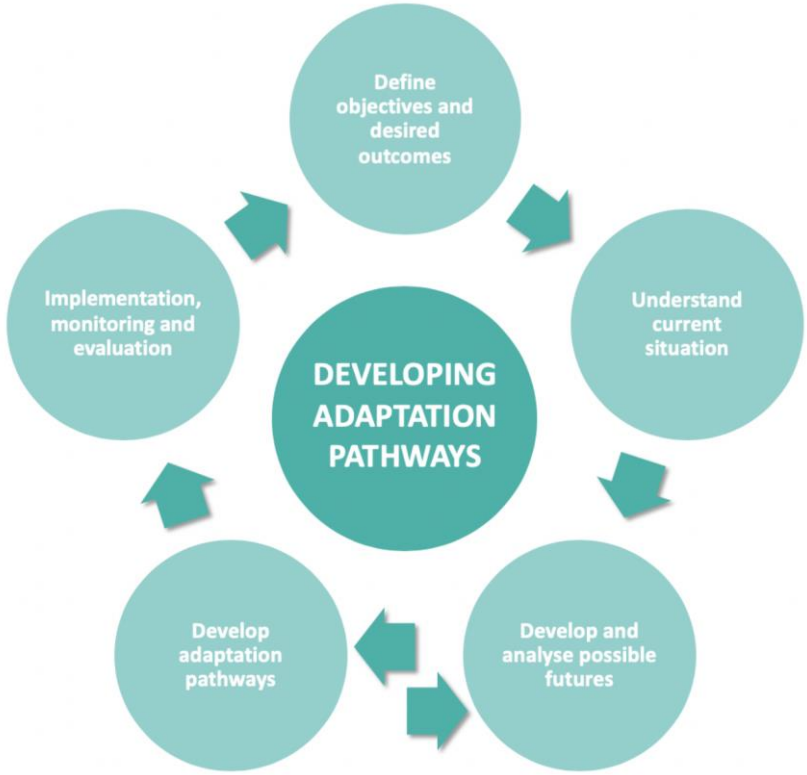
- Adaptation in the primary industries and rural regions
  - Multiple stressors (not all climate related)
  - Diverse stakeholders at multiple levels (individual land managers, sector bodies, local/regional gov't. and more)
  - "No one in charge"
  - Adaptation actions come with synergies and trade-offs
- Adaptive management
  - Step-by-step process of planning, doing, monitoring and reviewing
  - Rejects linear outcomes
  - Iterative, flexible process
  - Learning

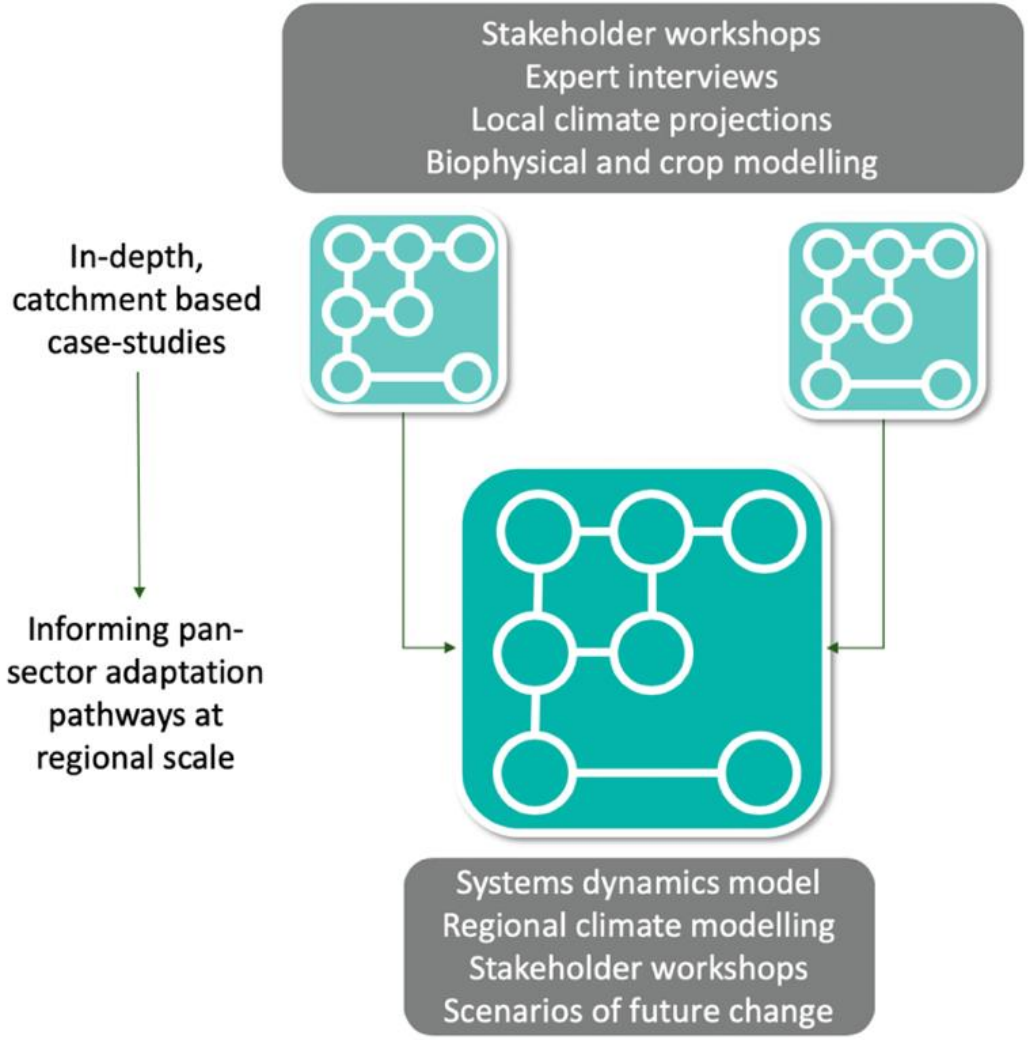
Applied adaptation pathways

- Adaptive strategies are available
  - prioritise actions
  - identify trade-offs in advance
  - comprehensive suite of actions

- Different responses depending on how climate (and non-climate parameters) change through time.

- Tools and processes to support adaptation planning and decision making in the face of uncertainty.





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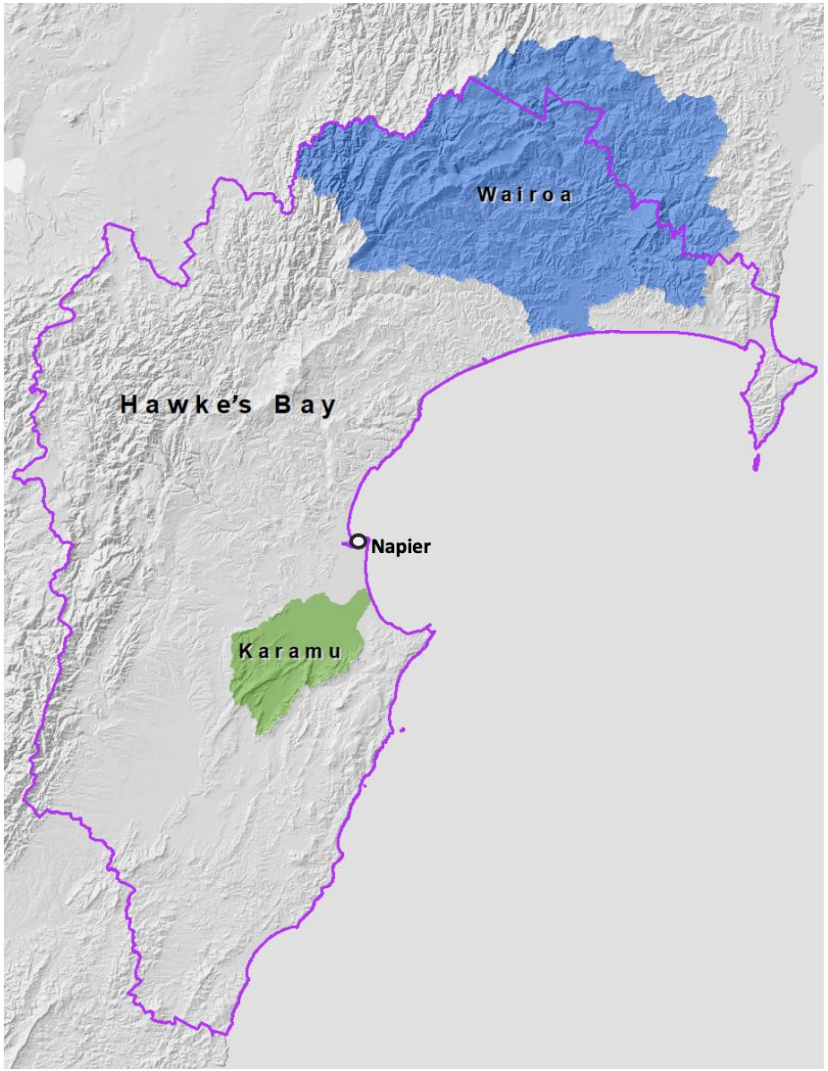
[1] Ministry for Primary Industries, Sustainable Land Management and Climate Change (SLMACC) Research Programme 2017 Request for Proposals.

[2] Hawke's Bay Regional Council (2016). Matariki: Hawke's Bay Regional Economic Development Strategy and Action Plan 2016. Hawkes Bay Regional Council, Napier.



Wairoa (265,000 ha)

- Northern Hawke's Bay
- Socio-economically deprived
- High proportion of Māori
- Steep uplands, erodible soils
- Forestry, sheep and beef

Karamu (52,000 ha)

- Central Hawke's Bay
- Highly productive, valuable land
- Home for 85% of HB population
- Viticulture, arable and cropping, horticulture, forestry.

Sheep + beef / beef / deer

Short rotation cropland

Dairy

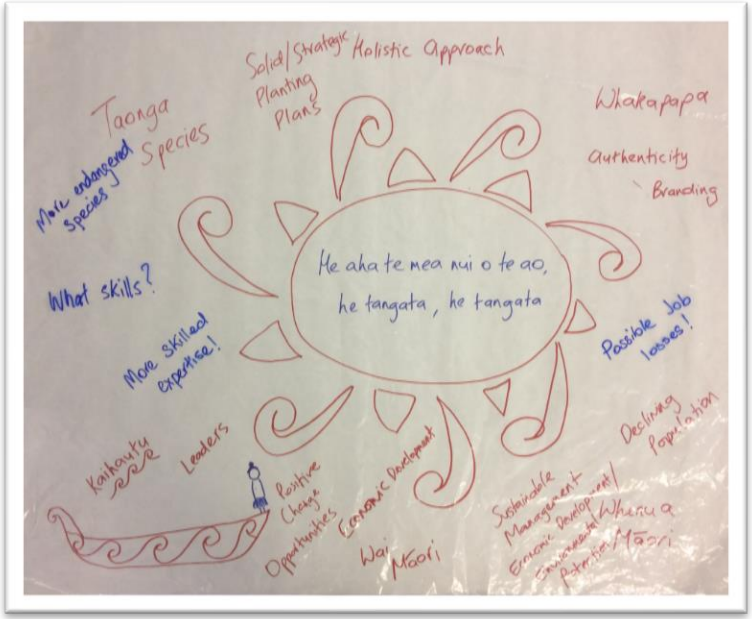
Other

Perennial

Forestry

Who has a stake?

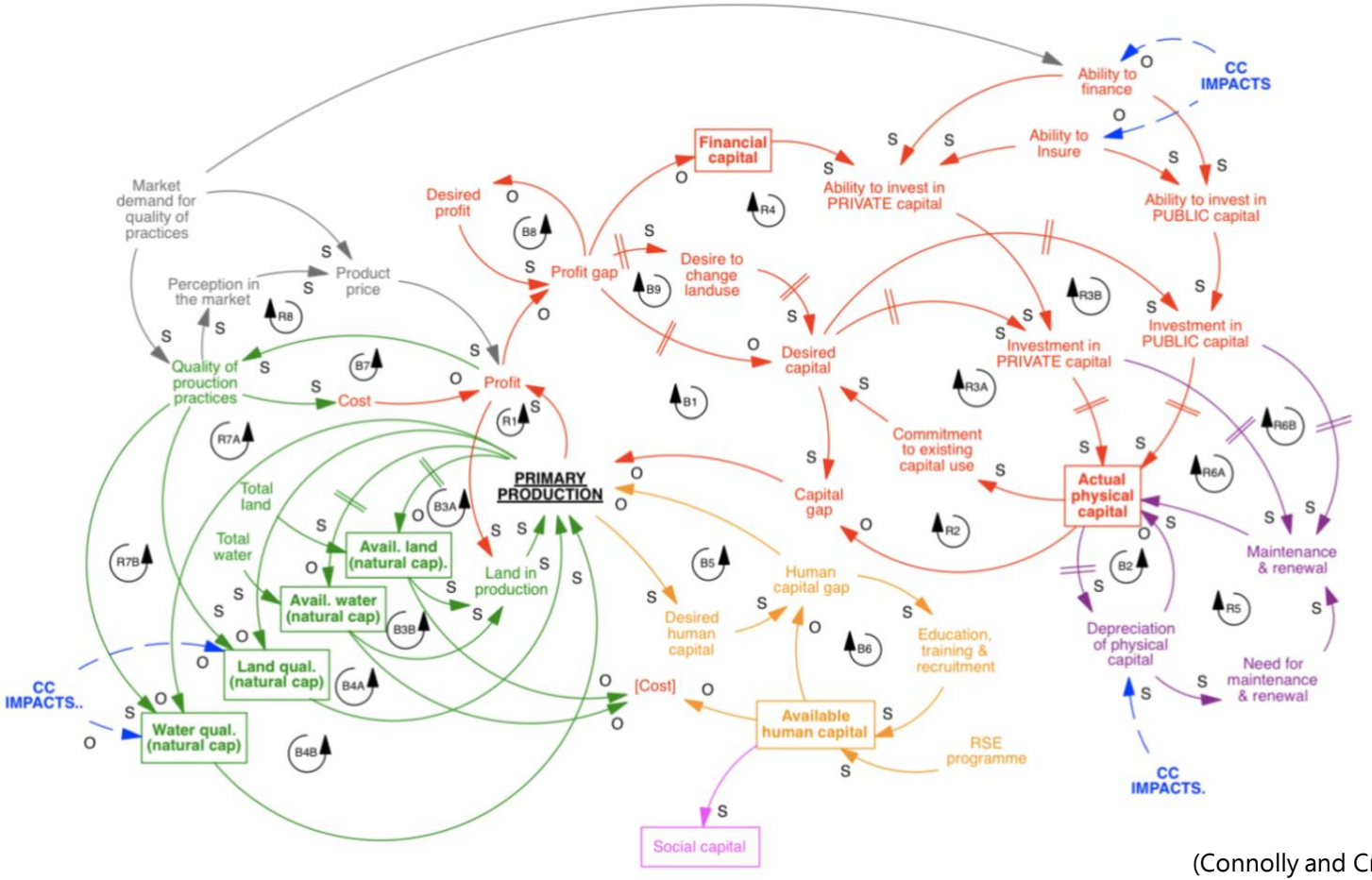
- Diverse interests and actors
- Problem framing and structure
  - differences weren't as important as the values that people had in common across the catchments, and at the regional level.
- Professional identity, place attachment, social well-being, community, sense of place.



What is at stake?

		AGRICULTURE HORTICULTURE, VITICULTURE, ARABLE AND LIVESTOCK	
	WATER SUSTAINABILITY AND SECURITY OF SUPPLY		Natural capital maintained (or improved)
INFRASTRUCTURE PRODUCTION AND PROCESSING		Connections to regional and national systems/assets	Protected healthy freshwater systems (rivers, lakes and aquifers)
COMMUNITY RESILIENCE AND WELL-BEING	Sustainable, engaged community, with diverse population	Local employment/ entrepreneurial opportunities	Vibrant regional economy

What is the current situation?

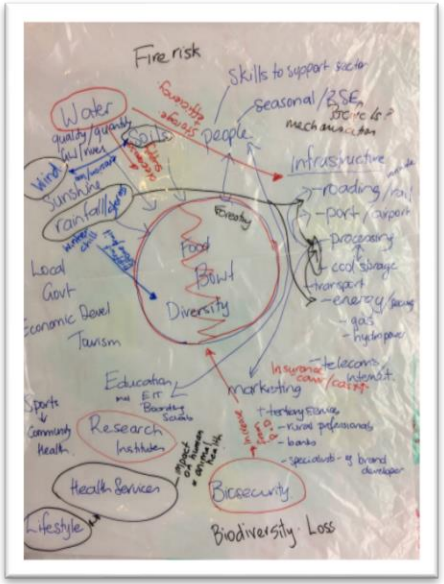


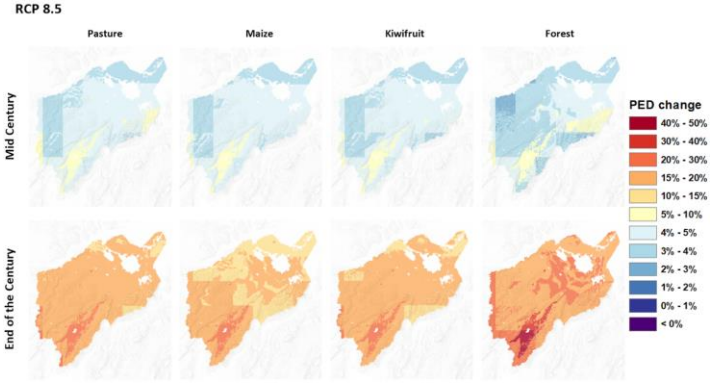
(Connolly and Cradock-Henry 2019)

What is the future(s) like?

Case study	Climate scenarios: Moderate	Climate scenarios: Extreme
Karamu	• **0.75°C** warmer, mostly in **summer/autumn** • **15** additional 'hot days' per year • **5** fewer 'cold nights' per year (i.e. frosts) • **5%** less rainfall annually, mostly in **spring** • **5%** more extreme rainfall • **120 mm** increase in PED deficit **(drought proneness)** • + increase in extreme winds and storms is **uncertain**	• **2.5°C** warmer, mostly in **autumn** • **60** additional 'hot days' per year • **10** fewer 'cold nights' per year (i.e. frosts) • **10%** less rainfall annually, mostly in **spring** • **10%** more extreme rainfall • **160 mm** increase in PED deficit **(drought proneness)** • ++ increase in extreme winds and storms is **uncertain**
Wairoa	• **0.75°C** warmer, mostly in **summer/autumn** • **30** additional 'hot days' per year • **5** fewer 'cold nights' per year (i.e. frosts) • **5%** less rainfall annually, mostly in **spring** • **5%** more extreme rainfall • **100 mm** increase in PED deficit **(drought proneness)** • + increase in extreme winds and storms is **uncertain**	• **2.75°C** warmer, mostly in **autumn** • **60** additional 'hot days' per year • **5** fewer 'cold nights' per year (i.e. frosts) • **5%** less rainfall annually, mostly in **spring** • **15%** more extreme rainfall • **140 mm** increase in PED deficit **(drought proneness)** • ++ increase in extreme winds and storms is **uncertain**

Definitions: **hot days:** the number of days per year with maximum temperature >25°C; **cold nights/frosts:** the number of nights per year with minimum temperature <0°C; **extreme rainfall:** 1% top highest rainfall events; **Potential Evapotranspiration Deficit (PED):** the cumulative difference between potential evapotranspiration (PET) and rainfall from 1 July of a calendar year to 30 June of the next year, for days of soil moisture under half of available water capacity (AWC), using an AWC of 150 mm for silty-loamy soils; **+, ++:** (very) positive change





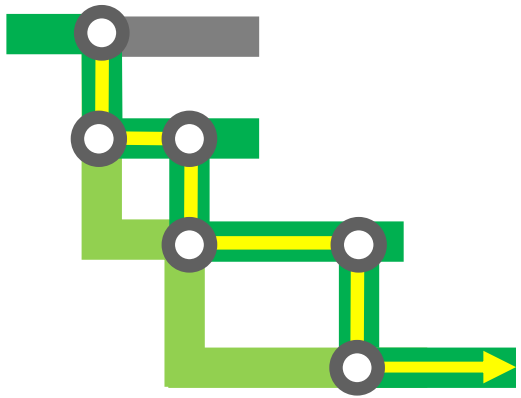
Applied adaptation pathway

Current practice

Irrigation efficiencies

Change species base of grass farming (lucerne)

Land-use change;
new modes of production;
breeding for heat tolerance
and productive performance

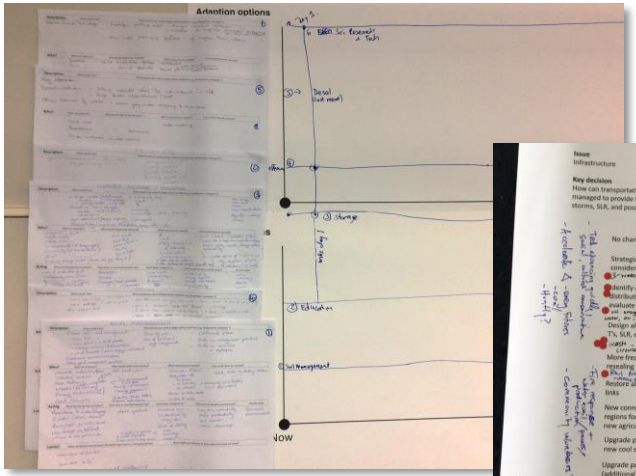


0 20 100 years

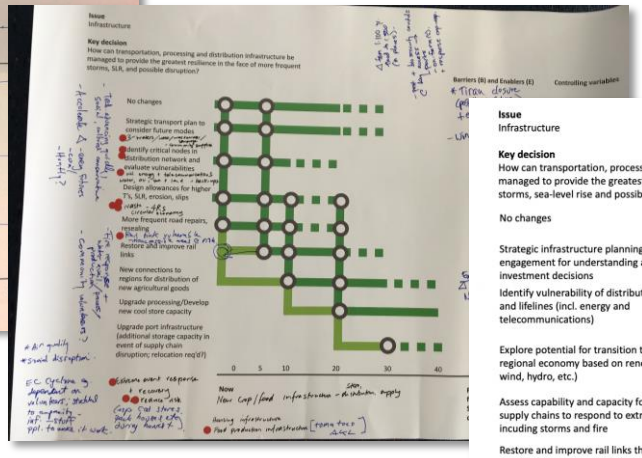
Now

Future – reduced rainfall, higher temperatures, more frequent extremes and variability

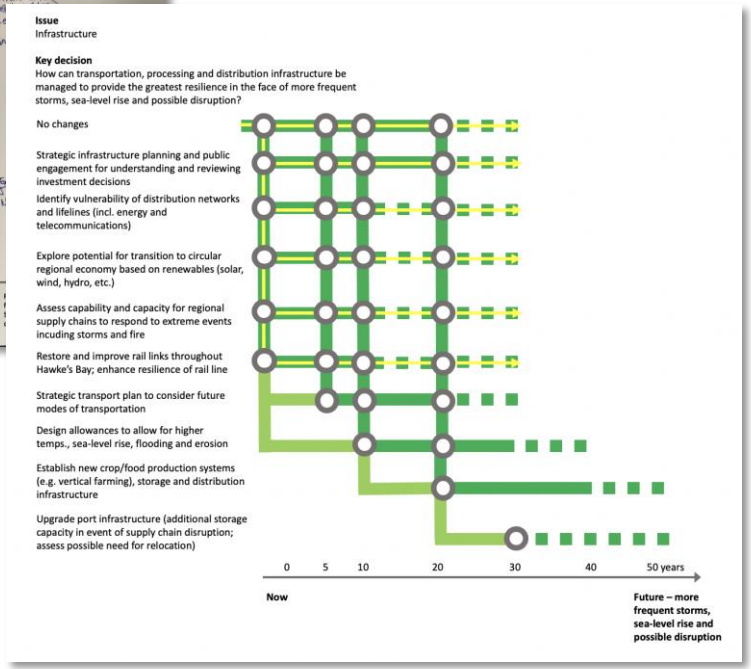
How do we realise desired outcomes?



Identify options and lifetime



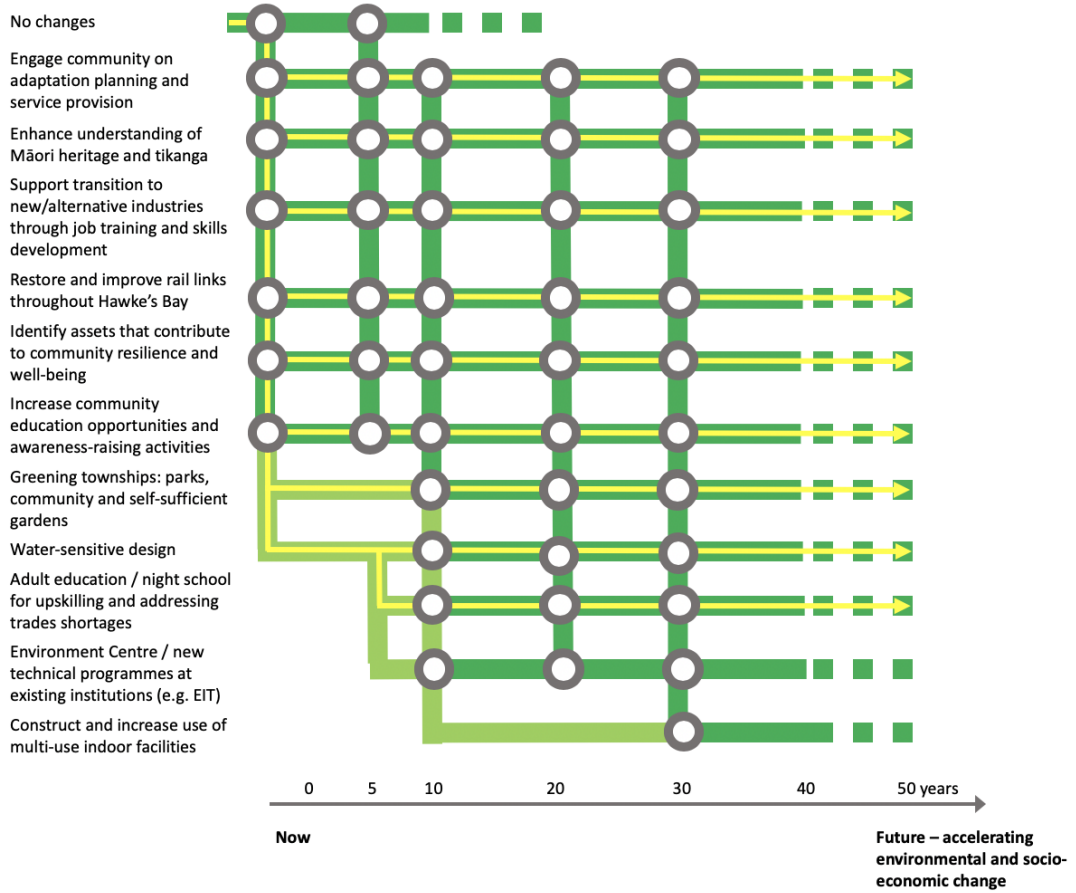
Iterate and preferred pathway



Community resilience and well-being

Issue
Community resilience and well-being

Key decision
How can community resilience and well-being be enhanced or maintained in the face of growing environmental change, socio-economic inequality and urbanisation?



Infrastructure

Issue
Infrastructure

Key decision
How can transportation, processing and distribution infrastructure be managed to provide the greatest resilience in the face of more frequent storms, sea-level rise and possible disruption?

No changes

Strategic infrastructure planning and public engagement for understanding and reviewing investment decisions

Identify vulnerability of distribution networks and lifelines (incl. energy and telecommunications)

Explore potential for transition to circular regional economy based on renewables (solar, wind, hydro, etc.)

Assess capability and capacity for regional supply chains to respond to extreme events incuding storms and fire

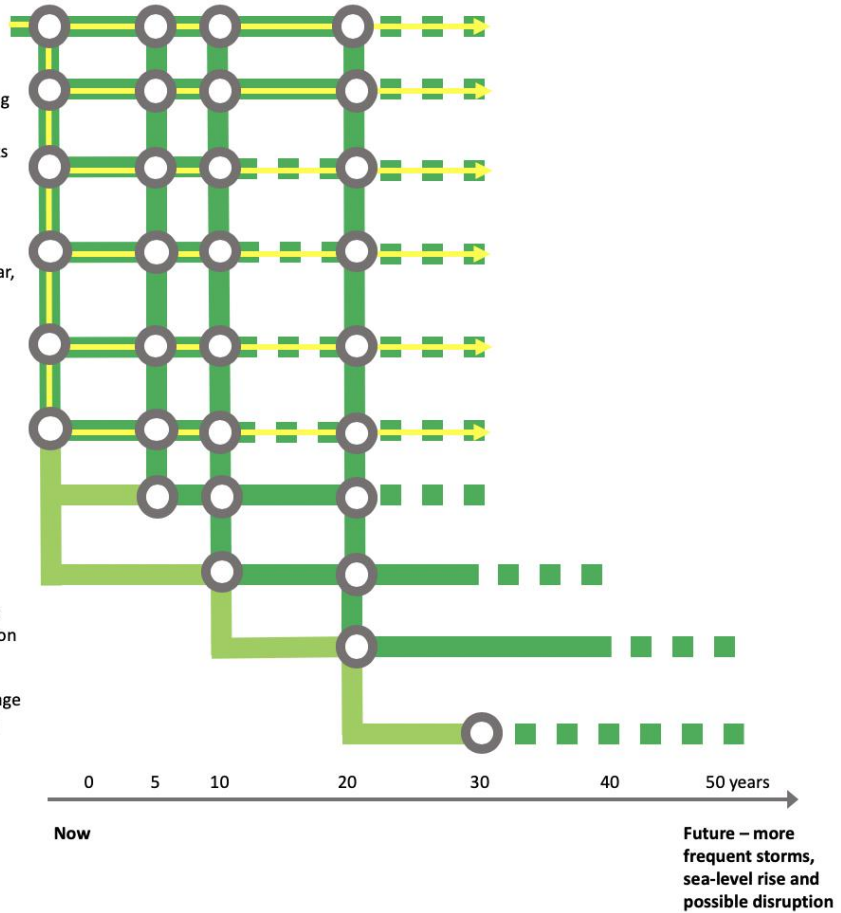
Restore and improve rail links throughout Hawke's Bay; enhance resilience of rail line

Strategic transport plan to consider future modes of transportation

Design allowances to allow for higher temps., sea-level rise, flooding and erosion

Establish new crop/food production systems (e.g. vertical farming), storage and distribution infrastructure

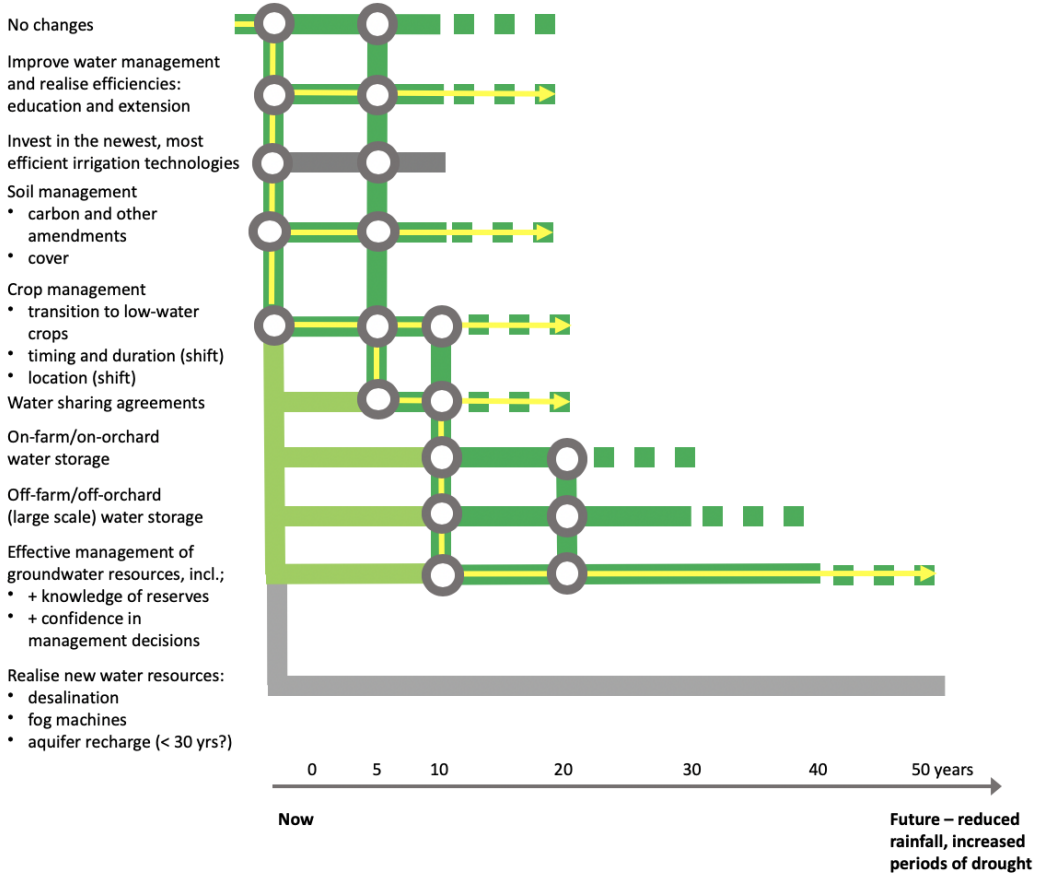
Upgrade port infrastructure (additional storage capacity in event of supply chain disruption; assess possible need for relocation)



Water

Issue
Water

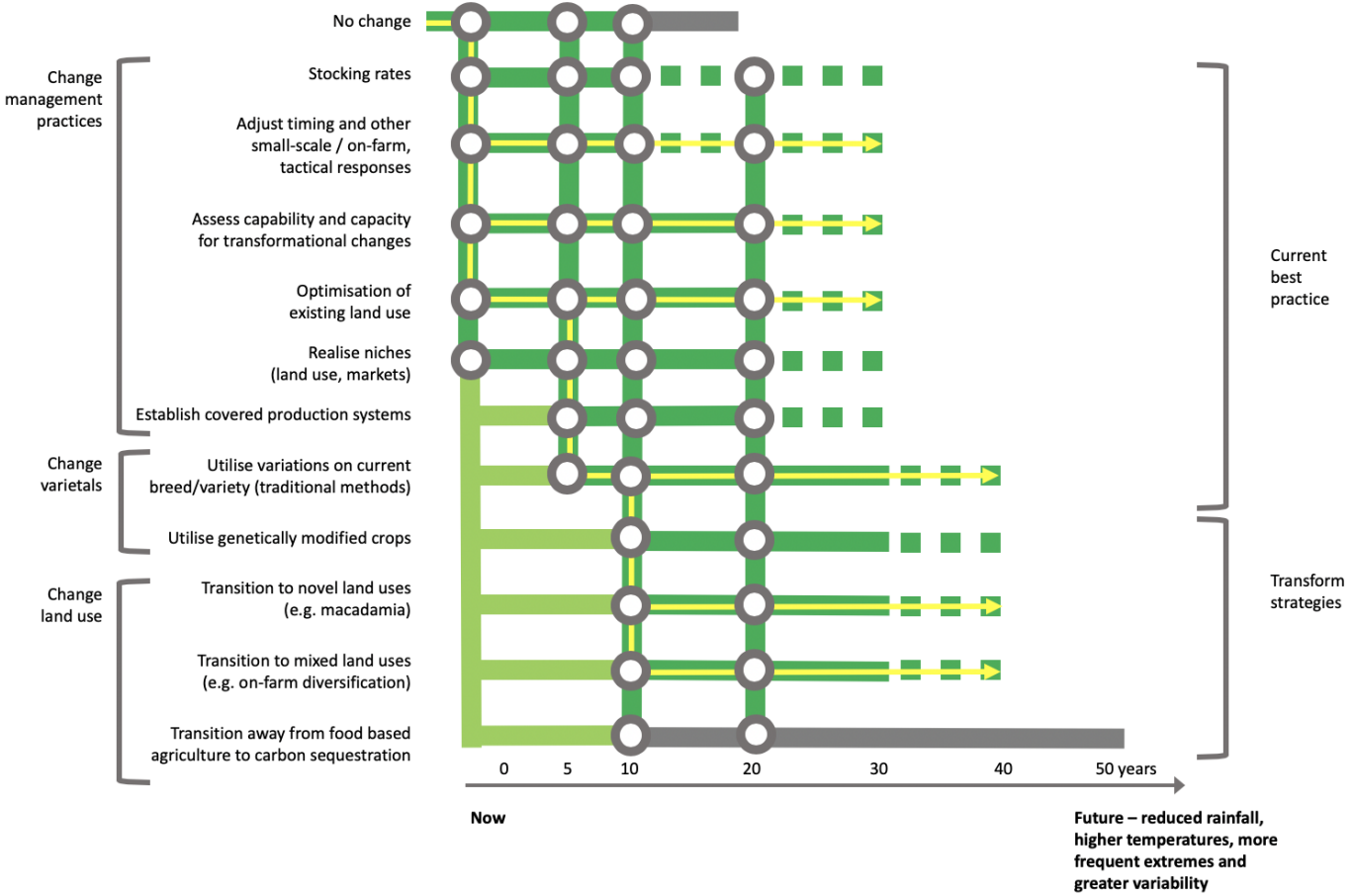
Key decision
How does Hawke's Bay maintain security of supply for agriculture given future possible reduction in supply, either as a consequence of climate change induced rainfall decline or reduced availability from groundwater?



Issue
Primary industries

Key decision
How and when can primary industries transition to more viable agricultural practices (incl. land use) in the face of warmer and drier conditions?

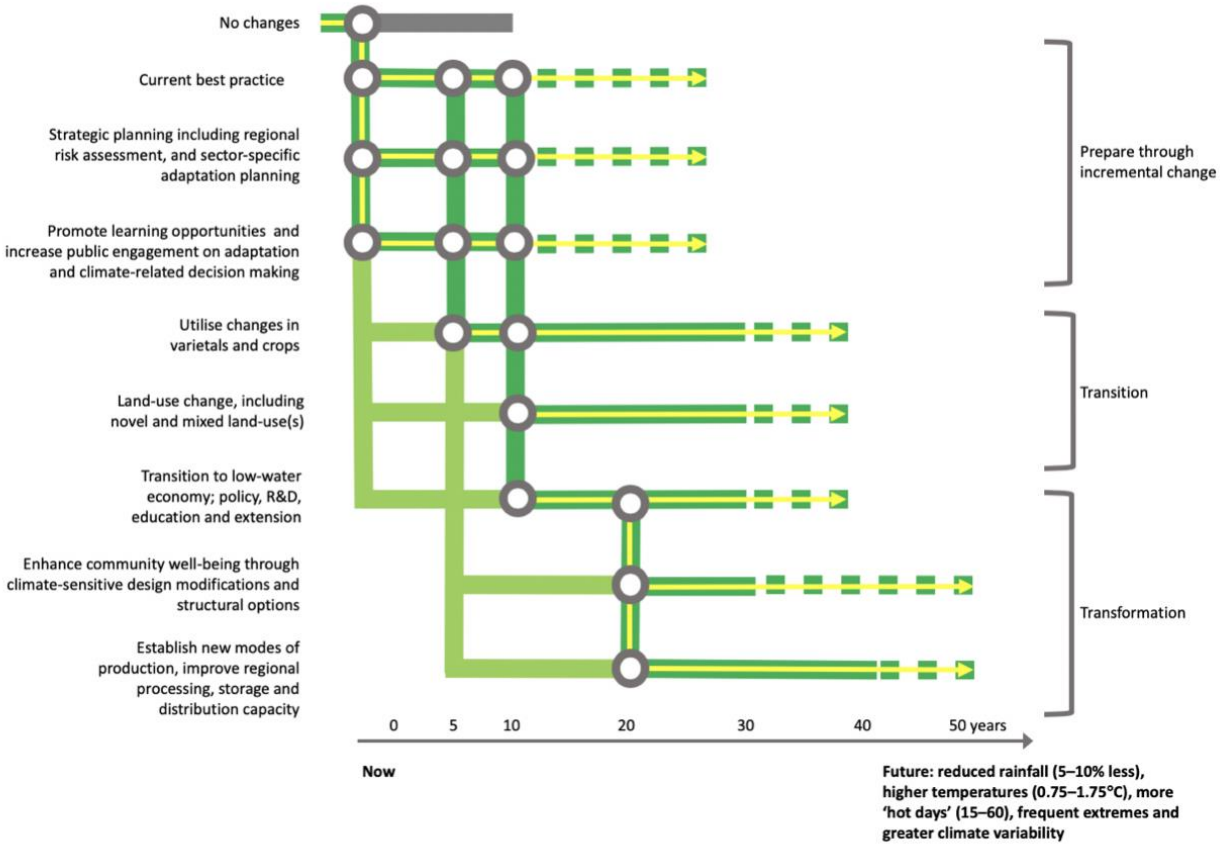
Primary industries



Regional Pathway

Issue
Regional scale

Key decision
How do primary industries in Hawke's Bay adapt to hotter, drier conditions and more frequent disruptive events in the face of continuing social and economic change?



The problem is wicked, the solutions messy and clumsy

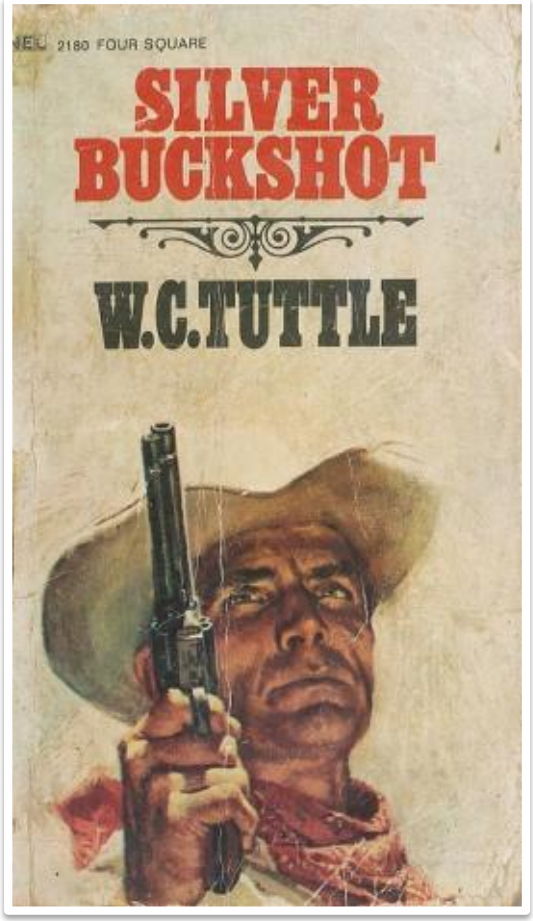
"… climate change is a double-edged sword for our sector in HB - on the one hand warming could make it easier to grow grapes in Central Hawke's Bay and to ripen warmer climate varieties more reliably on the Heretaunga Plains but on the other hand it may quite quickly make the Plains unsuitable for growing cool climate varieties and an increase in late season humidity & extreme weather events could be detrimental to quality.

Of course there is also the issue of increase in summer drought & increase in evapotranspiration leading to higher irrigation requirements, against a backdrop of increasing community concern around water allocation."

Winemaker, Central Hawke's Bay

Adaptation can begin now: despite uncertainty.

- Impacts will be felt across multiple domains, requiring a linked-up and coordinated approach to adaptation.
- Best practice contributes to incremental adaptation, but alone may be insufficient.
- Tools and processes to support adaptation decision-making and action are needed.
- Applied adaptation pathways provide a useful framework for strategic planning for primary industries, but it is not without its limitations.
- Monitoring and evaluating adaptation can provide an empirical basis for understanding and tracking progress towards outcomes, improve the ability to design effective policy interventions and demonstrate the impact of adaptation science, supporting the transition towards climate-resilient primary industries.



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Thank you

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