Manaaki Whenua
Landcare Research

Mind the gaps: Climate change adaptation and the primary industries

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MANAAKI WHENUA – LANDCARE RESEARCH

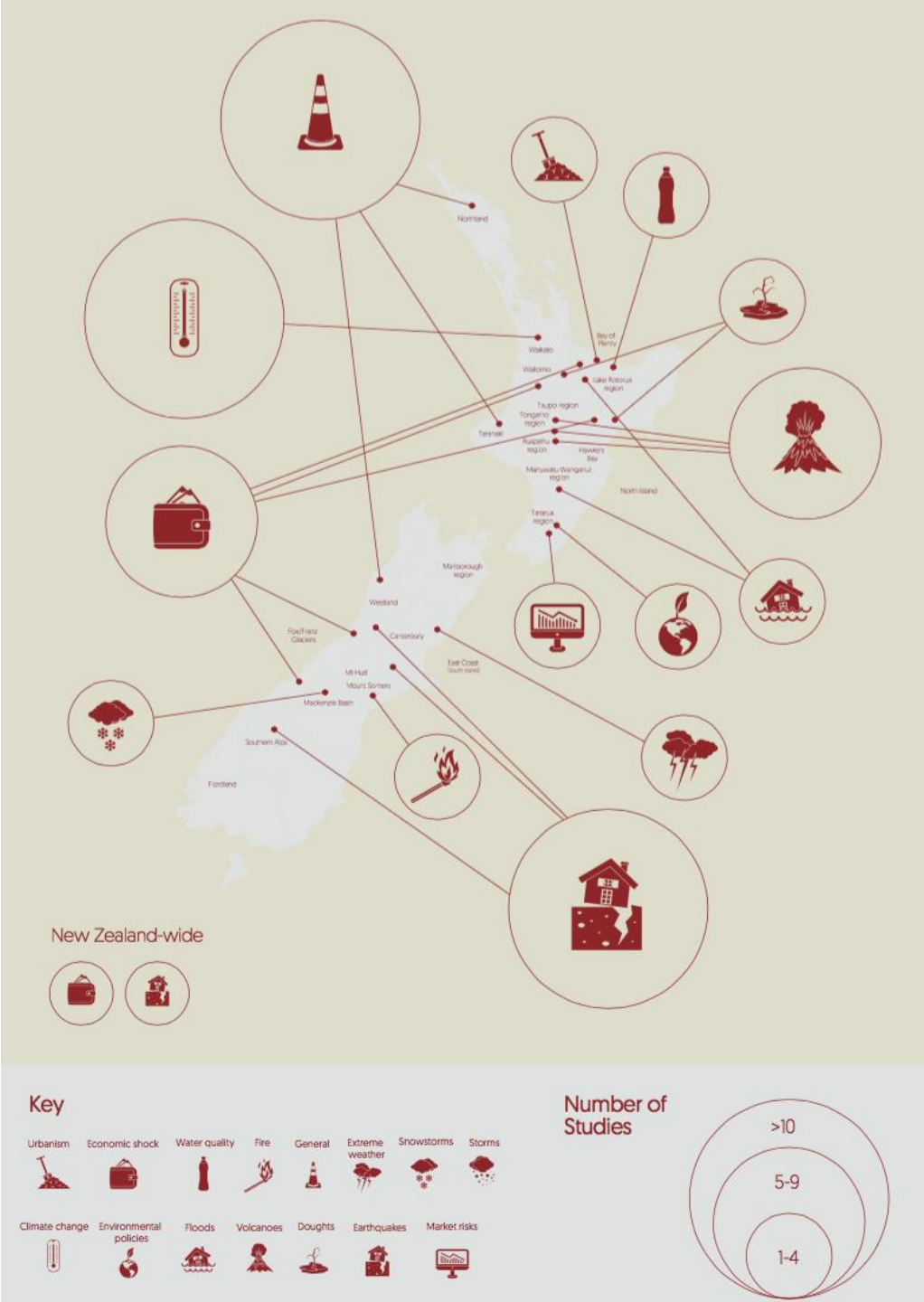
Outline of presentation

- Background and context
- Approach to review and synthesis
- Adaptation knowledge
- Research gaps
- Needs and priorities
- Questions and comments

Primary industries backbone of the rural economy.

Exposed to range of stressors

- Low frequency, high impact events; slow onset hazards; and unanticipated and interacting shocks.
  - Hurunui District



Spector, S., Cradock-Henry, N.A., Beaven, S., Orchiston, C., 2018. Characterising rural resilience in Aotearoa-New Zealand: a systematic review. Reg Environ Change. https://doi.org/10.1007/s10113-018-1418-3

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

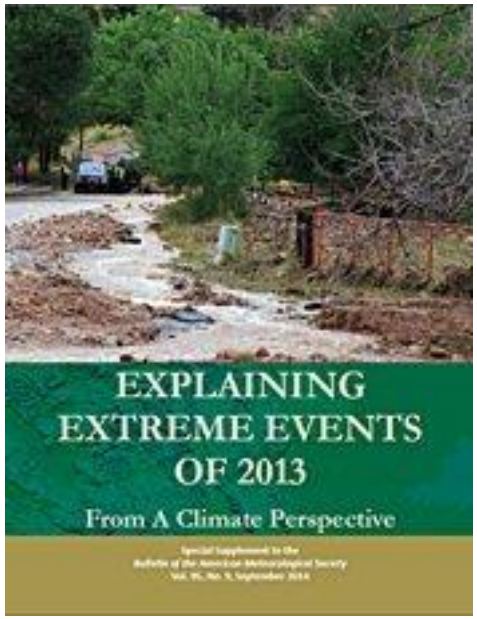
LUKE HARRINGTON, SUZANNE ROSIER, SAM M. DEAN, STEPHEN STUART, AND ALICE SCAHILL

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; Seneviratne 2012). Furthermore, analysis of precipitation



Harrington, L.J. et al. 2014. B Am Met Soc 95, S45–S48.

"…Climate change is making a difference to New Zealand now, affecting our droughts and our rainfall extremes…"


I hope this Drought
Shout becomes
a regular event.
Yeah right.
Tui

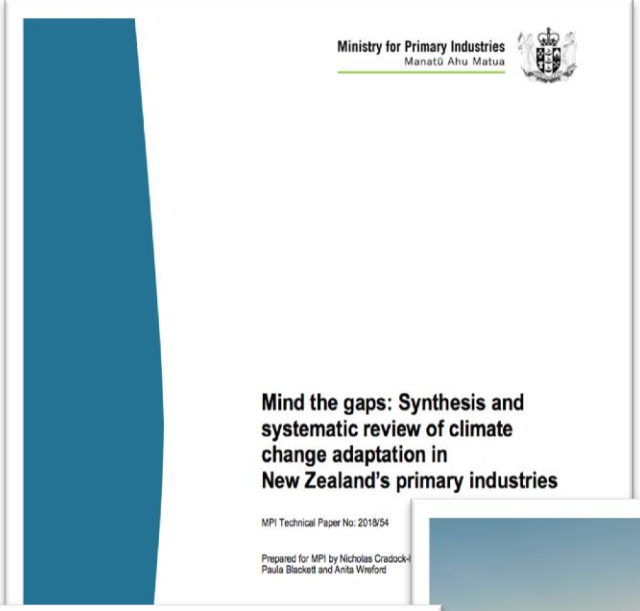
The future of New Zealand primary industries will depend in part on their ability to adapt to climate change.

Adaptation is the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC 2014).

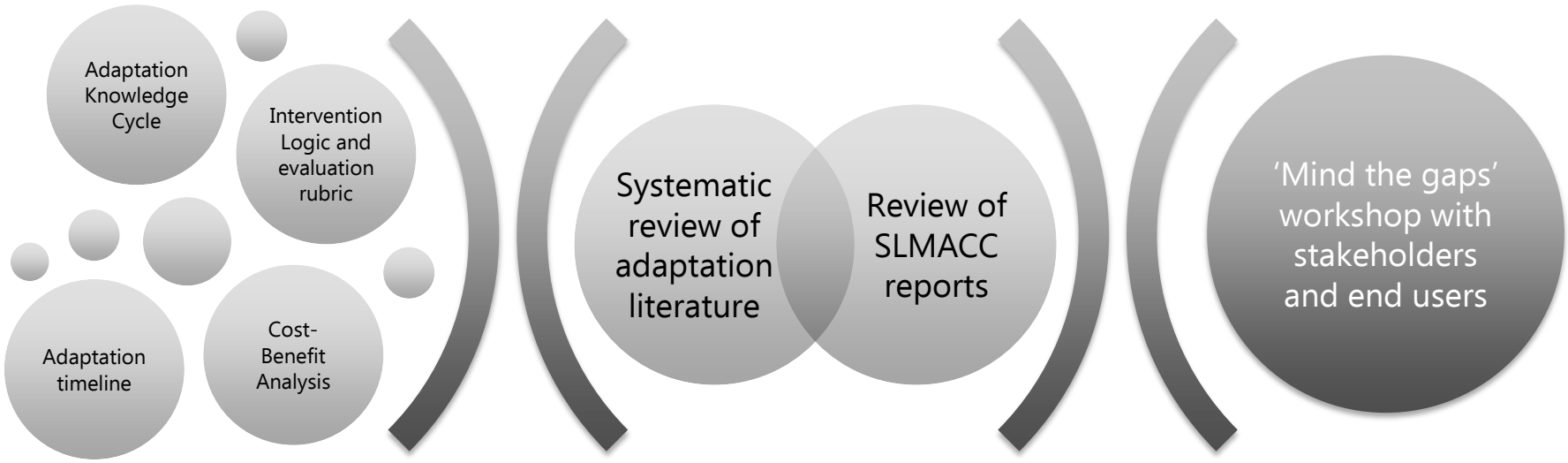
Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change (UNFCCC 2012).

Sustainable Land Management and Climate Change (SLMACC)

- Forestry and carbon markets
- GHG Mitigation
- Impacts and adaptation
- Technology transfer



What do we know, not know and need to know about climate change adaptation?



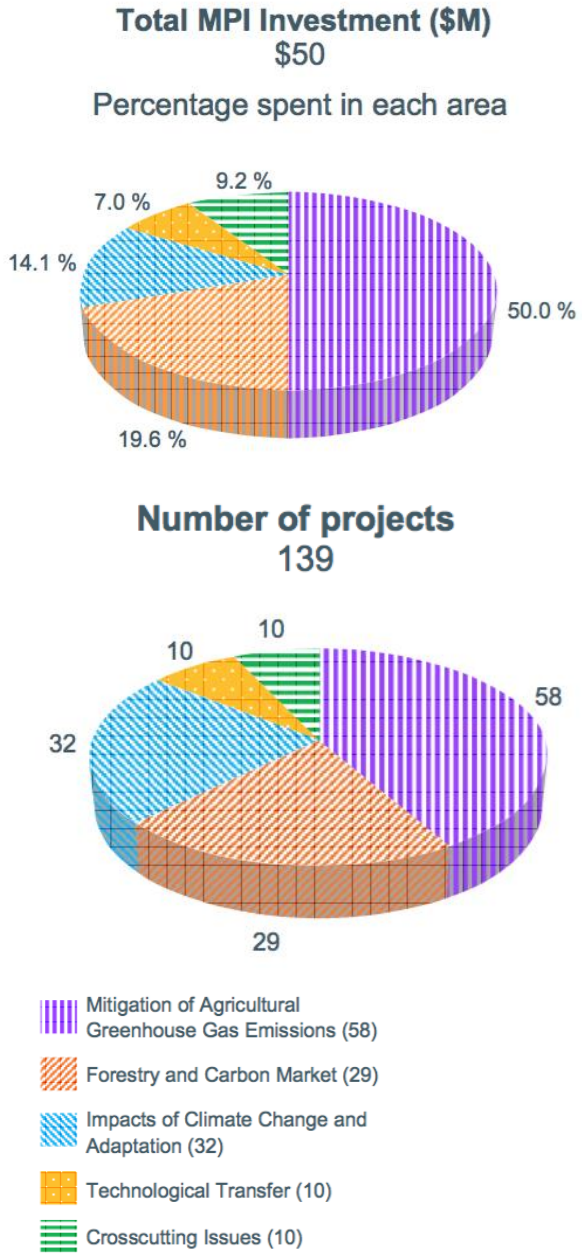
What do we know?

What do we not know?

What do we need to know?

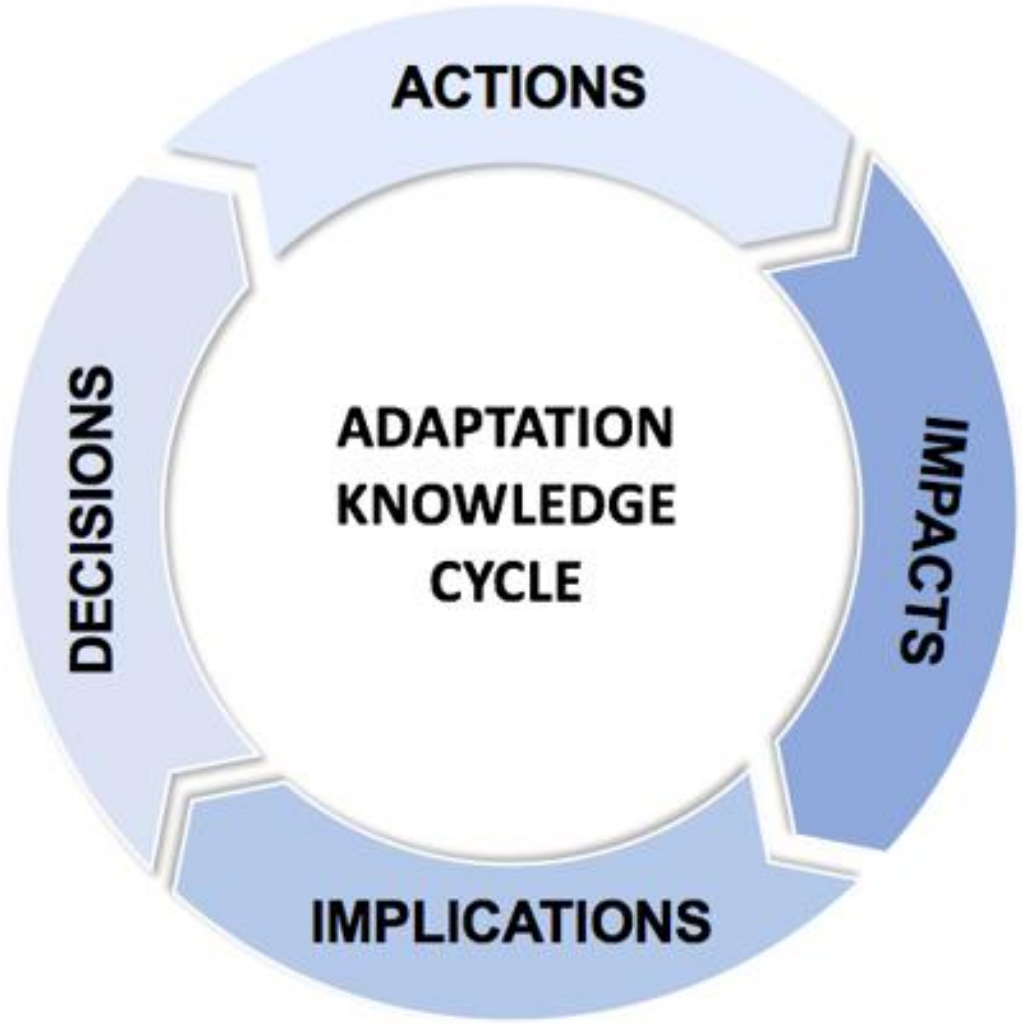
SLMACC Review

- $7M invested in adaptation-oriented research (14.1% of total science investment)
  - 32 projects (139 projects)
  - Clark & Nottage, 2012 ($1.5M) pan-sector
  - Three more projects worth >$500,000
  - Balance distributed among smaller, short-term (1-2 yrs.) projects of ca. $150-200K
- One of the only sources of funding for climate change research.
  - CCII (2012-2016, MBIE)



Systematic Review

- Synthesise and critically appraise published literature according to rigorous protocol
- Published literature (2007-2017)
- Adaptation knowledge base remains small.
  - 224 papers focused on GHG mitigation
  - 22 papers focused on adaptation
- Negative effects: north and eastern N Island
- Adaptation options assessed in literature include drought tolerant species and cultivars, changing stocking policies.
- Some regions face increased drought and flooding risk
- Biosecurity implications



IMPACTS	IMPLICATIONS	DECISIONS	ACTIONS
Evidence for direct and indirect impacts of climate change for primary industries.	Evidence for the implications of climate change on different components of primary industries.	Evidence that research supports decision-making at different scales to enable adaptation.	Evidence that research delivers knowledge and information to support changes in behaviour.

What do we know?

- **New knowledge and enhanced understanding of effects of climate change on primary industries.**

- **Effects**
  - Drought
  - Biosecurity
  - Climate variability and extremes
- **Sector-specific knowledge**
  - Pastoral farming
  - Cropping and arable
  - Horticulture and viticulture
  - Cross-sector science

Drought

SLMACC

IIDA	Lead author	Year	Sector	Location
Impacts	Tozer	2011	Pastoral	National
Implications	Clark	2008	Cross-sector	National
Decisions	Burton	2008	Cross-sector	Regional; North Otago, South Canterbury
	Cradock-Henry	2013	Dairy	Regional; Bay of Plenty
	McCusker	2015	Pastoral	National
Actions	-	-	-	-

LITERATURE

IIDA	Lead author	Year	Sector	Scale/Location
Impacts	Sylvester-Bradley	2008	Horticulture	National
	Zhang	2007	Pastoral	National
Implications	Lee	2013	Dairy	National
Decisions	Cradock-Henry	2008	Dairy	Regional; Bay of Plenty
	Gray	2011	Dairy	Regional; Hawke's Bay
	Hopkins	2015	Cross-sector	National
Actions	-	-	-	-

Biosecurity

- **Climate change will create significant biosecurity challenges**
  - **New pests, weeds and diseases**
  - **Subtropical pests and establishment of current seasonal immigrants and high risk taxa**
- **Import pathways, border management, host suitability**

SLMACC

IIDA	Lead author	Year	Sector	Scale/location
Impacts	Kean	2014	-	National
Implications	-	-	-	-
Decisions	-	-	-	-
Actions	-	-	-	-

SLMACC

LITERATURE

Pastroal farming

IIDA	Lead author	Year	Sector	Scale/location
Impacts	Newton	2011	Pastoral	Regional; Canterbury
	Tozer	2011	Pastoral	National
	Dodd	2011	Pastoral	National
	Lieffering	2008	Pastoral	National
	Fowler	2008	Pastoral	Regional; Canterbury, Hawke's Bay
	Guo	2008	Pastoral	National
	Crush	2014	Pastoral, Arable	National
	Zhang	2007	Pastoral	National
	Keller	2014	Pastoral	National
	Fowler	2013	Pastoral	Regional; Hawke's Bay
Implications	Renwick	2013	Cross-sector	National
	Lieffering	2016	Pastoral, drystock	Regional; Hawke's Bay, Southland
	Lee	2013	Dairy	National
Decisions	Rosin	2015	Pastoral	National
	Cradock-Henry	2015	Pastoral	National
	Gray	2011	Dairy	Regional; Hawke's Bay
Actions	-	-	-	-

IIDA	Lead author	Year	Sector	Scale/location
Impacts	Fowler	2013	Pastoral	Regional; Hawke's Bay
	Keller	2014	Pastoral	National
	Lieffering	2016	Pastoral; drystock	Regional; Hawke's Bay, Southland
	Zhang	2007	Pastoral	National
Implications	Lee	2013	Dairy	National
Decisions	Gray	2011	Dairy	Regional; Hawke's Bay
Actions	-	-	-	-

Horticulture and viticulture

SLMACC

IIDA	Lead author	Year	Sector	Scale/location
Impacts	Beresford	2012	Horticulture	National
	Sturman	2015	Viticulture	Regional; Marlborough
Implications	Clark	2012	Cross sector	National
	Kenny	2008	Horticulture	Regional; Bay of Plenty, Hawke's Bay
Decisions	-	-	-	-
Actions	-	-	-	-

LITERATURE

IIDA	Lead author	Year	Sector	Scale/location
Impacts	Sturman	2013	Viticulture	National
Implications	-	-	-	-
Decisions	Cradock-Henry	2016	Horticulture	Regional; Bay of Plenty
Actions	-	-	-	-

What do we not know?

- Adaptation research has been geographically and sectorally delimited.
- Critical knowledge gaps: biosecurity, wine and grape growing, arable farming and high-value horticulture.
- Limited research on climate change adaptation and decision-making.
- Empirical gaps, and methodological gaps

Empirical gaps

- Climatic and topographic diversity, regional variation in climate and soil.
- Regions and industries affected due to biological, socio-cultural, economic characteristics.
- Dairy: eastern regions, hotter and drier, manage water limits and pasture composition; heavier rainfall events in the west, soil erosion, runoff, and flooding.
- Industry-specific, regionally based options and pathways.

Adaptation is local.

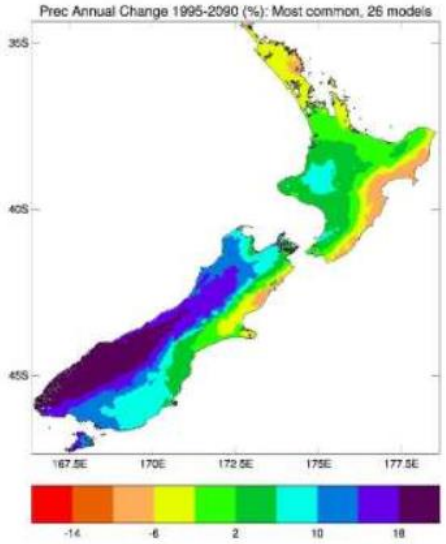
Scale/Region		Impacts	Implications	Decisions	Actions
National	National	15	4	2	1
North Island	Northland	1			
	Auckland				
	Waikato	1			
	Bay of Plenty			2	
	Gisborne	1			
	Hawke's Bay	1		1	
	Taranaki				
	Manawatu				
	Wellington				
South Island	Marlborough	1			
	Tasman				
	Canterbury	3	1	1	
	West Coast				
	Otago				
	Southland				

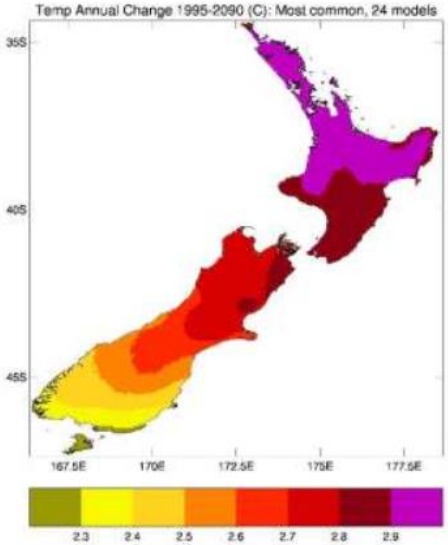
Methodological gaps

- **Research has either been top-down or bottom-up.**
- **Need to identify robust adaptation options.**
- **Systems thinking and resilience science can provide conceptual and methodological tools.**

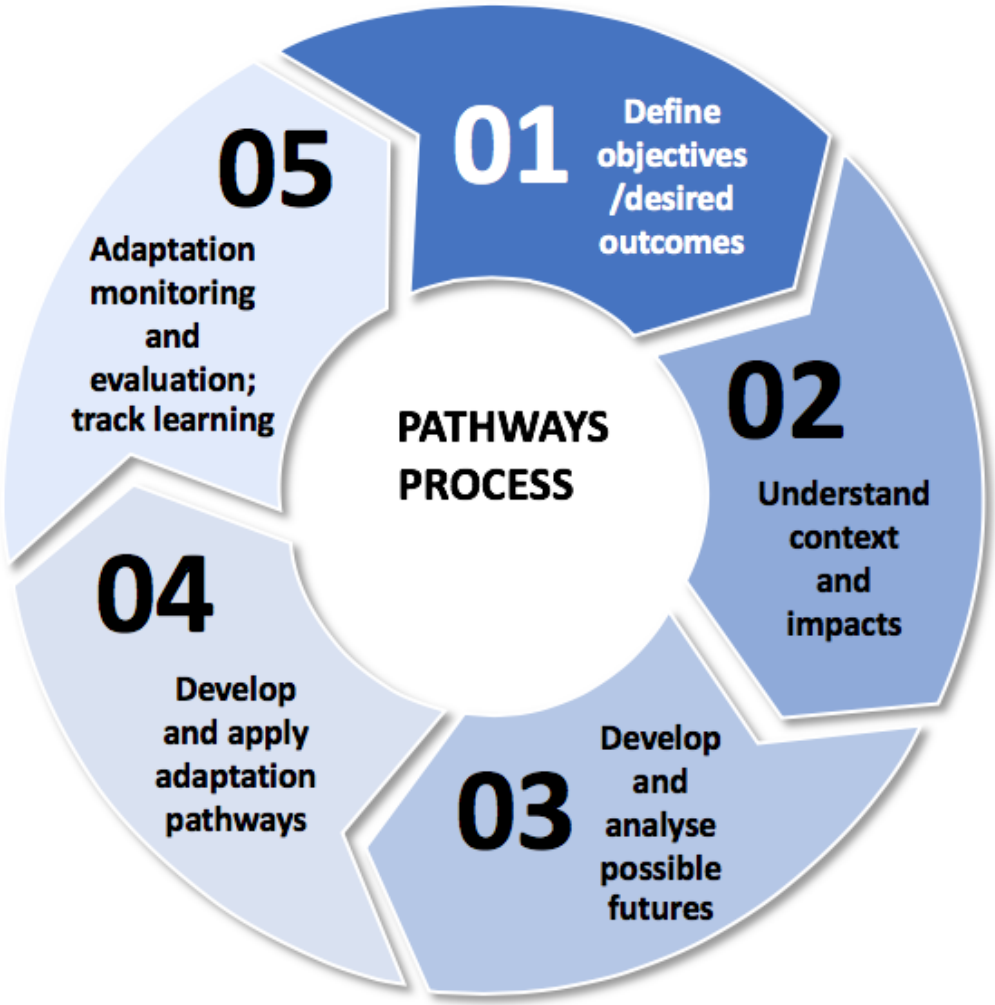
"Adaptation strategies and behaviours are still skinny. We need better regionally-based adaptation strategy development."

- Industry workshop participant





Adaptation pathways planning



Cradock-Henry et al. 2018

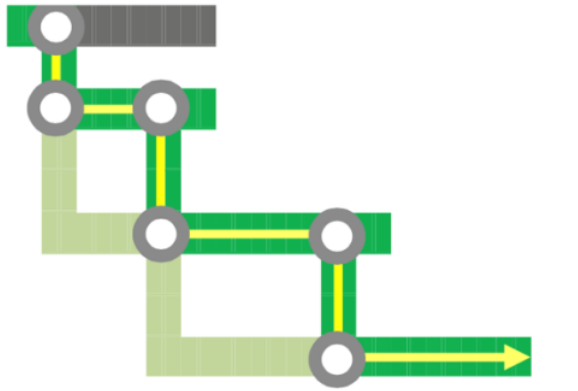
Applied adaptation pathway

Current practice
(Key area of decision making)

Invest in netting, or on-orchard water reticulation

Change varietal or mode(s) of production

Relocate productive land use(s) and related processing infrastructure (e.g. kiwifruit in Bay of Plenty)

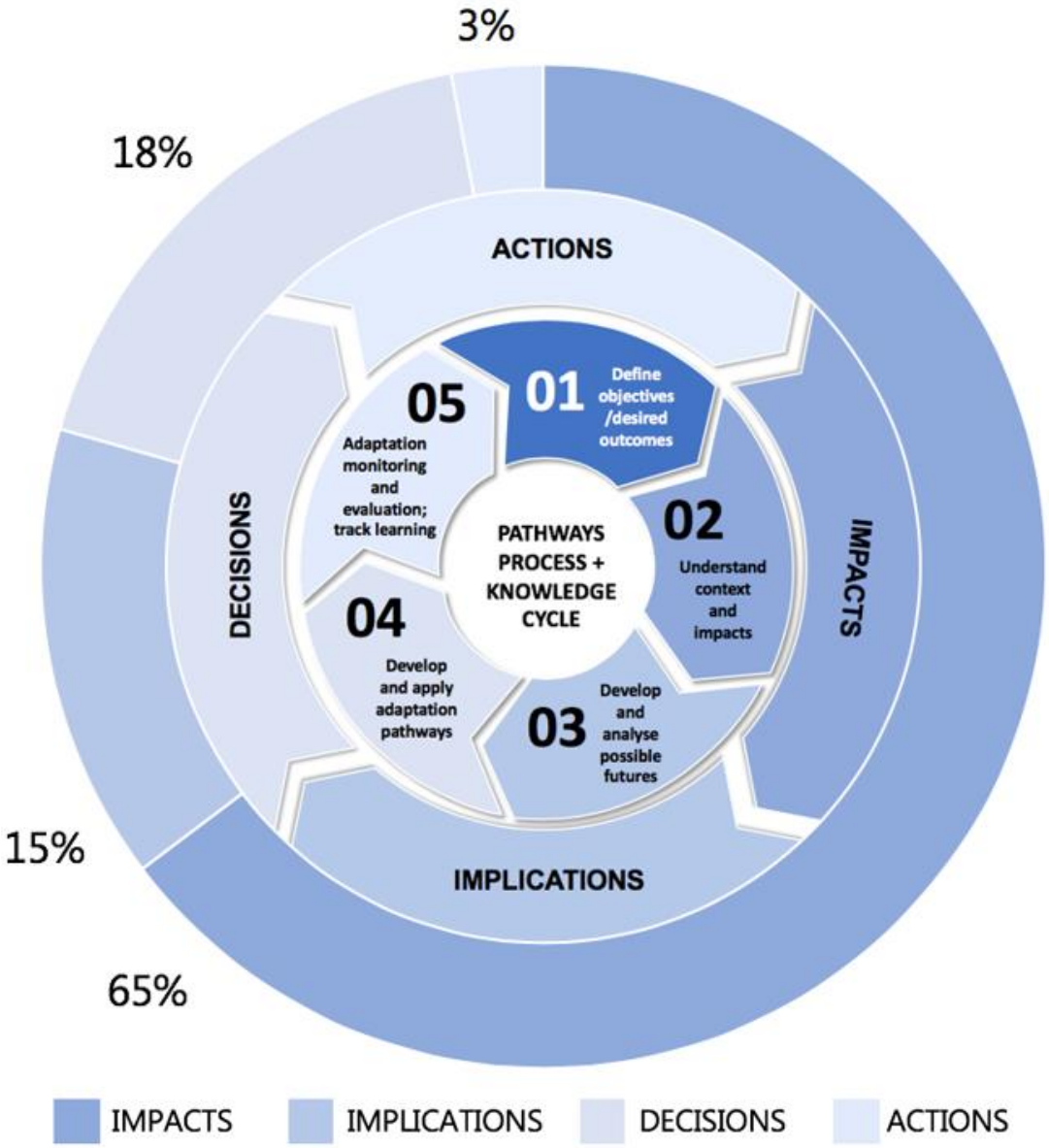


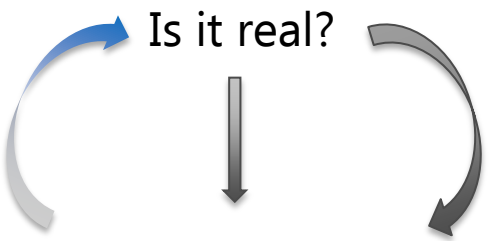
Now

Future – warmer temperatures, less precipitation, no winter chilling.

Cradock-Henry et al. 2018

Robust knowledge for adaptation





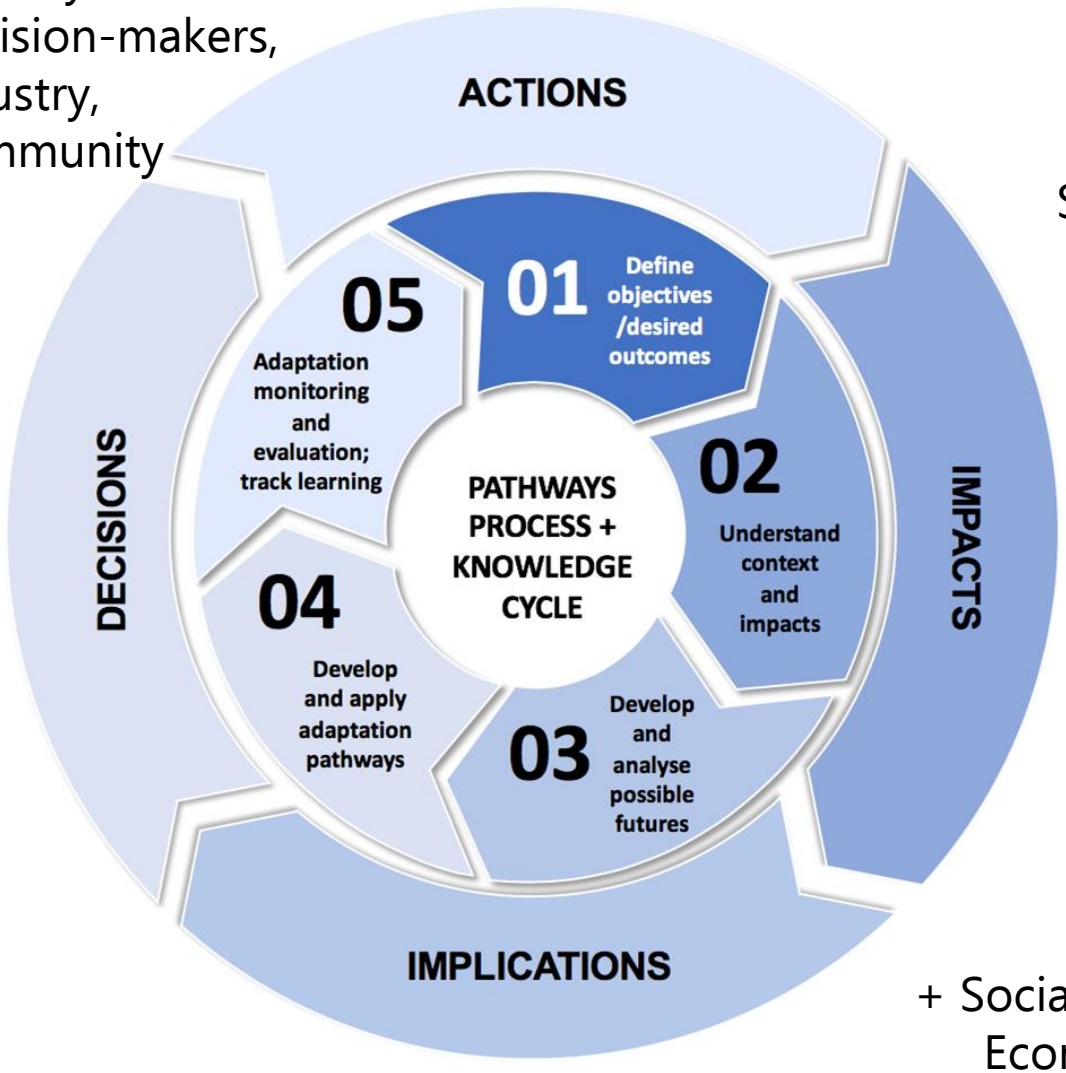
Can we do anything about it or its impacts?

How do we take action?

How do we know we are doing the right thing?

Diverse ways of knowing and understanding adaptation

+ Policy- and Decision-makers, Industry, Community



Scientists

+ Social Scientists, Economists, Stakeholders

- Adaptation still poor cousin… some change is locked so shift to adaptive planning
  - Implications, **Decisions** and **Actions**
  - Stakeholders struggle w/what climate change means to them, and what's needed.
  - Novel adaptation: options beyond the norm
  - Explore new long term options
- Sector specific knowledge necessary.
- Factors that lead to adaptation intention, decision and action.
- Climate futures are becoming more known, but adapt under uncertainty still inevitable.
  - Robust decision support systems, tools, processes and practices for resilient climate futures.

Barriers and enablers

- Uncertainty, resources, and psychosocial factors are the greatest impediments to more effective adoption.
  - Other, more pressing concerns.
  - Scepticism hampered strategic thinking.
  - Urgent information needs can help support strategic planning efforts.
- Greater integration and coordination across primary industries for adaptation is needed.
  - Mitigation provides a model: synergy between sectors, sharing lessons across regions.
  - New forms of communication and enhanced engagement.
- Tools and policy measures for decision making under conditions of uncertainty.
- Bespoke information to meet end users' needs: T-shaped information (breadth and depth)

SLMACC Outcomes

- Successful program SLMACC a success.
  - Diverse funding across multiple sectors with a biophysical economic and social lens.
- What we **do** know about climate change and the primary industries is largely due to the fund.
- Supported critical questions at the time.
- Built capability and capacity throughout the science ecosystem.
- Provided state-of-the-science evidence to primary industry stakeholders and decision makers.

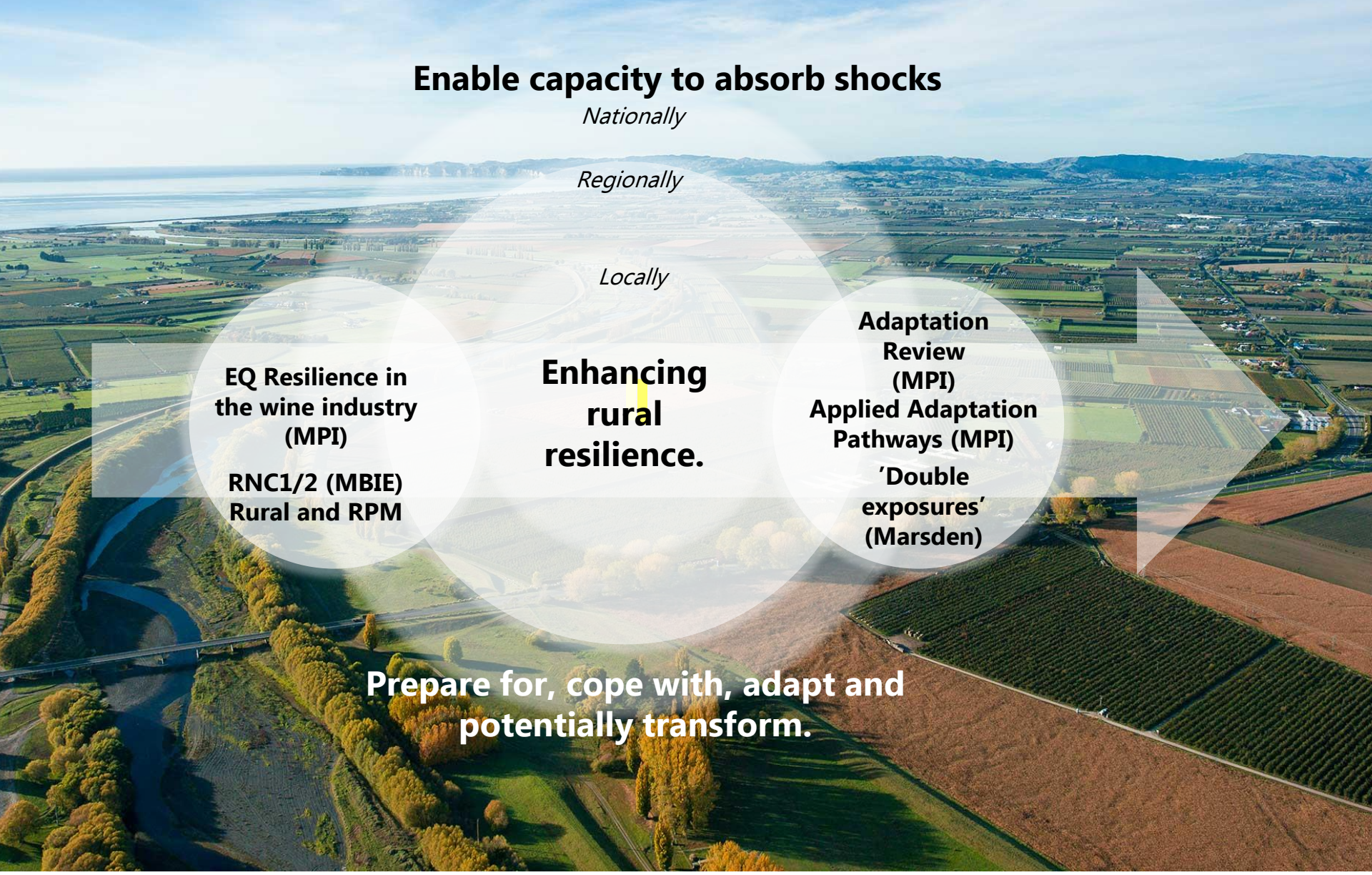
Conclusions

- There is no “silver bullet”; no single knowledge type needed.
- A variety of strategies and approaches required:
  - Complex systems perspectives
  - Modelling insights with practitioners’ experiences, values and attitudes as well as governance perspectives.
- Help understand underlying structures of decision-making and behaviour.

"… 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 CHB 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 ET leading to higher irrigation requirements, against a backdrop of increasing community concern around water allocation."

- Wine grower, Central Hawke's Bay



Evolution of research: risk-reduction, identifying responses to reduce vulnerability, to **building resilience.**

Cradock-Henry, N.A., Fountain, J., Buelow, F., 2018. Transformations for Resilient Rural Futures. Sustainability 10, 1952. https://doi.org/10.3390/su10061952

Thank you

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