Applying, assessing and enhancing resilience across primary industries

Applications of SEA in the primary sector

Dr Nick Cradock-Henry
Governance & Policy
Manaaki Whenua
Landcare Research

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

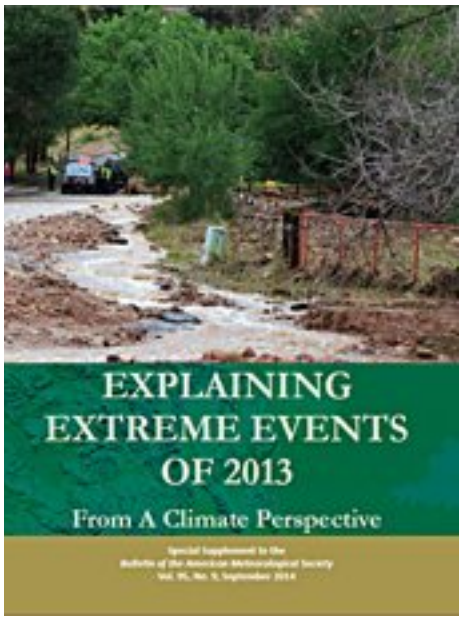
LUKE HARRINGTON, SUZANNE ROSIER, SAM M. DEAN, STEPHEN STUART, AND ALICE SCAHILL

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).

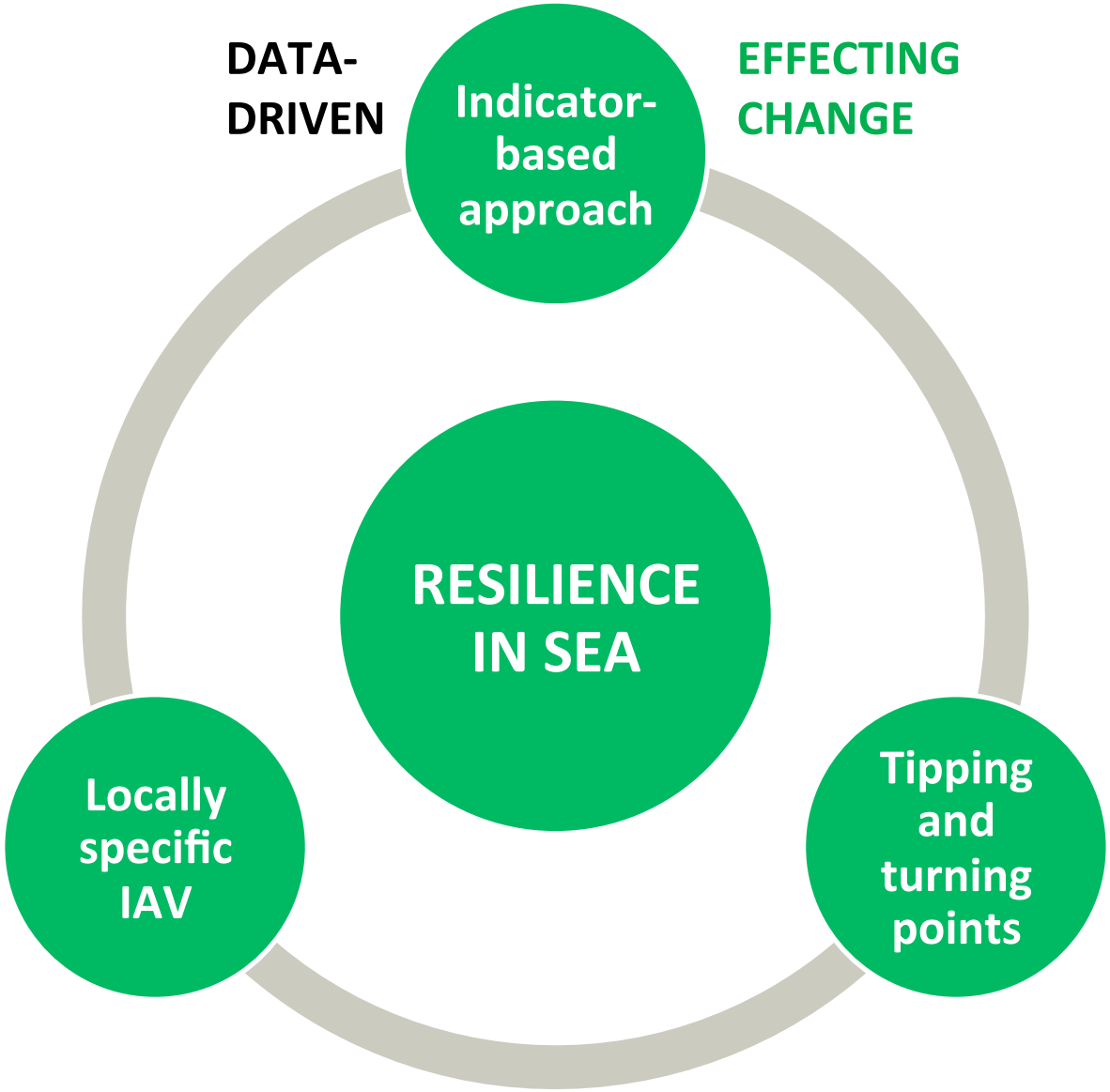
record total number of dry days of 78.2 for January to March.

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 *et al.* (2014)

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


DATA-DRIVEN
Indicator-based approach
EFFECTING CHANGE
RESILIENCE IN SEA
Locally specific IAV
Tipping and turning points

Operationalising resilience through an indicators-based approach

EVALUATE THE RELATIONSHIP BETWEEN INTENSIFICATION AND CLIMATE CHANGE

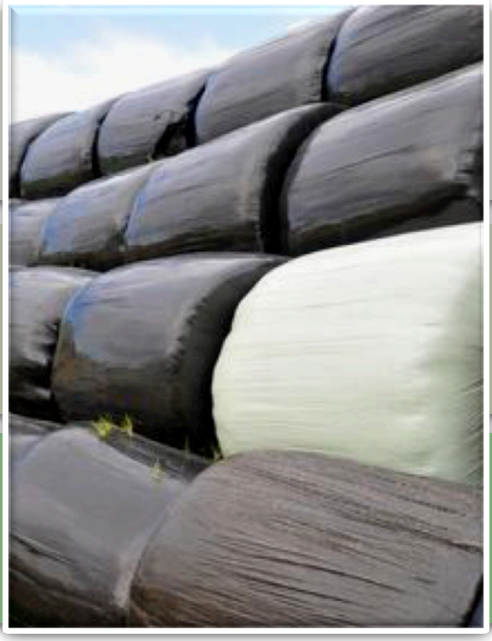
DEVELOP AN OPERATIONAL FRAMEWORK FOR RESILIENCE

Ministry for Primary Industries
Manatū Ahu Matua

DairyNZ

RESILIENT SYSTEMS

"RESILIENCE CANNOT BE MEASURED DIRECTLY… IT IS AN EMERGENT PROPERTY ARISING FROM INTERACTIONS WITHIN COMPLEX SYSTEMS…"

	Buffered	Self-Organised	Adaptable
Agro-ecological			
Social			
Economic			

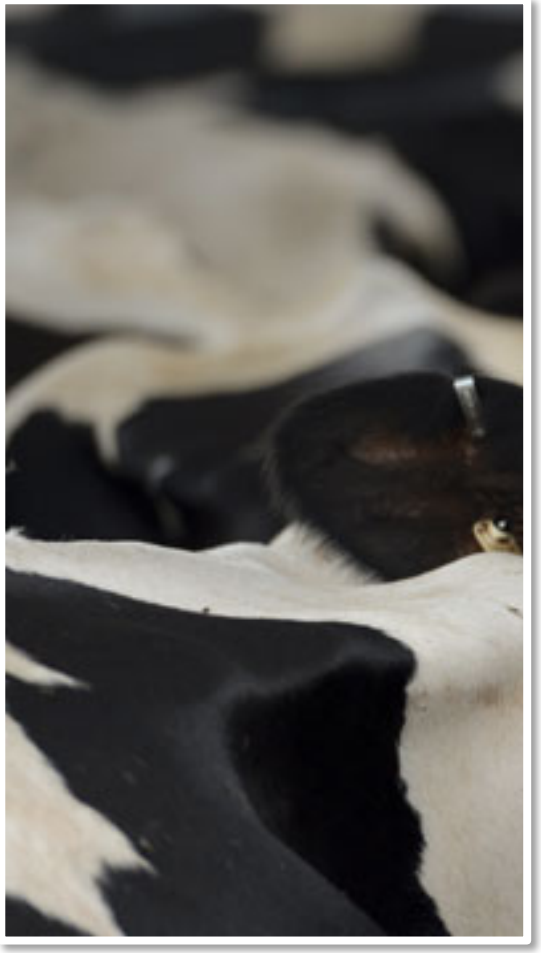
AGRO-ECOLOGICAL

- Location constraints/opportunities
  - Exposure (flood, SLR)
  - Rainfall amount
- Soil characteristics and management
  - Building buffering capacity of soil
  - Visual soil assessment
- Pasture, feed and stock management
  - Species diversity
  - Grazing management
  - Supply chain for feed
  - Stocking rate
- Water security and quality
- Trees
  - Shelter, shade, stock fodder

SOCIAL

- Awareness of risk
  - Understand risks associated with climate change
- Positive outcome expectancy
- Ability to plan, learn and reorganize
- Attachment to place
- Environmental values
- Social capital
  - Informal and collective life of a community
- Trust in and participation with government
  - Confidence in risk information
  - Participation in decision-making

ECONOMIC



- Financial resources
  - Includes social capital, e.g. relationship with bank manager
- Profitability
  - Margin on production
- Off-farm income
  - Non-climate sensitive
- Feed security
- Management practices that reduce impacts of climate events
- Diverse local economy

APPLICATION AND COMPARISON

ORGANIC

- *+ Climate/+Market*
  - Premium for milk
  - Ecological integrity
- Rules and regulations *(- flexibility)*

LOW-INPUT

- *+ Exposure to climate/market*
  - Proactive
  - + Capacity for change?

HIGH-INPUT

- *+ Exposure to market/climate*
  - Price, availability
  - Security of supply
- Future environmental limits?
  - flexibility, - buffer

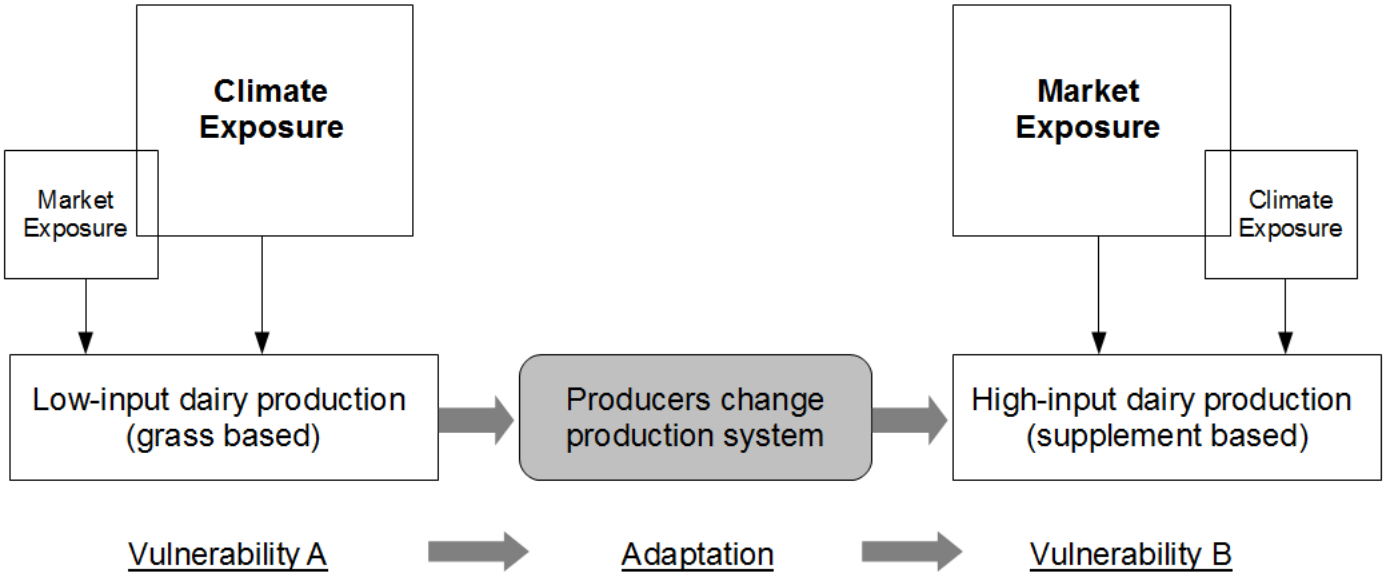
DYNAMICS OF VULNERABILITY AND RESILIENCE

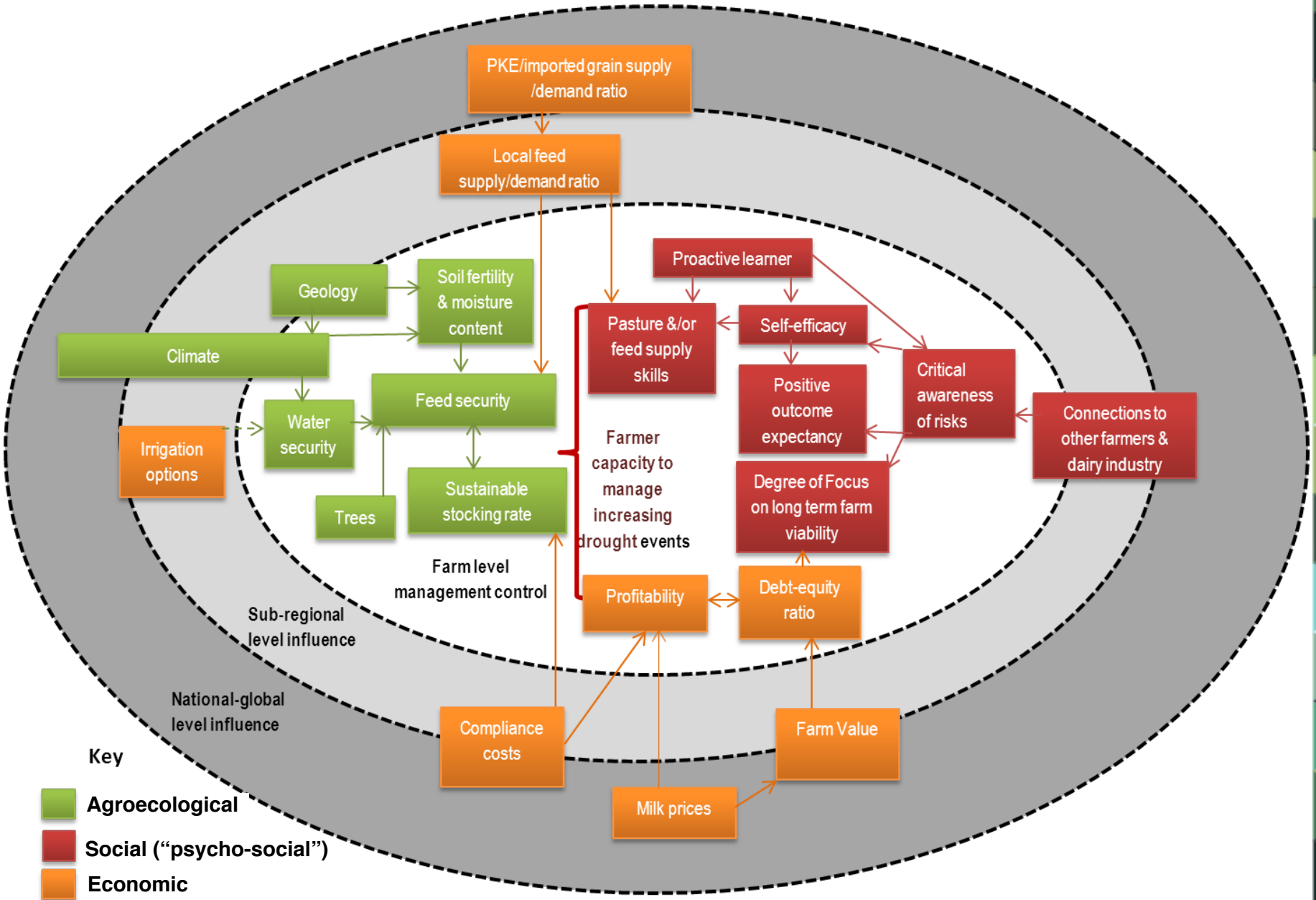
Palm kernel ship anchored off Tauranga denied discharge

10:40 AM Tuesday Oct 18, 2016 — 3 comments

SHARE:

Bulk carrier ship MV Molat entering port of Sunderland in 2013. Photo / Twitter.





Cradock-Henry and Mortimer (2013)

Adaptation turning points in sheep and beef farm systems

SUPPORTING ON-FARM DECISION MAKING UNDER CLIMATE CHANGE

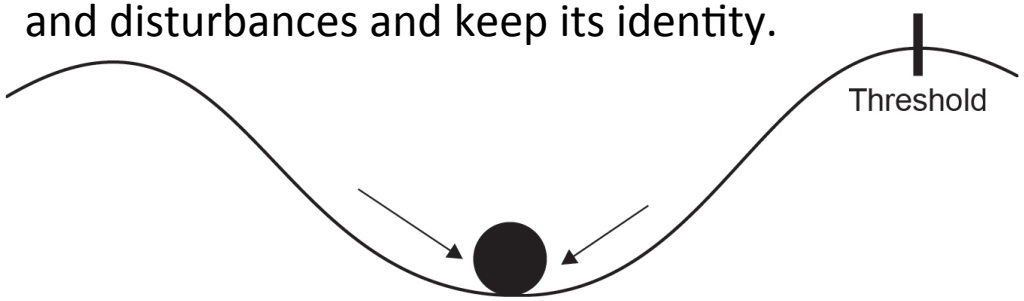
DEDUCTIVE-INDUCTIVE APPROACH: EVALUATE EXISTING MODEL, DEVELOP A NEW, SPECIFIC MODEL

Ministry for Primary Industries
Manatū Ahu Matua

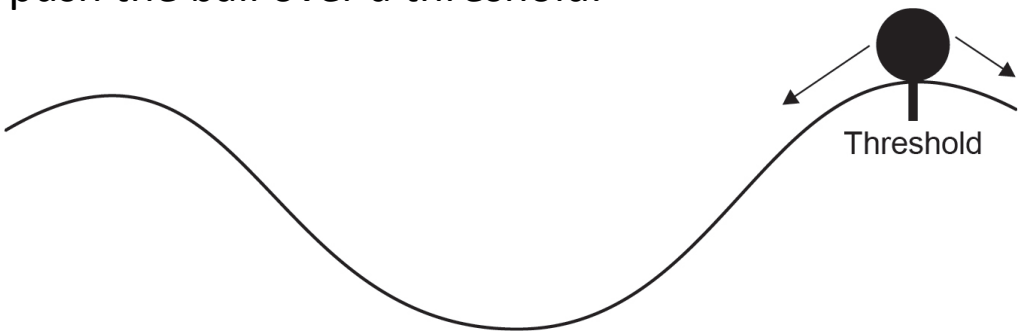
beef+lamb new zealand

Adaptation turning points in sheep and beef farm systems

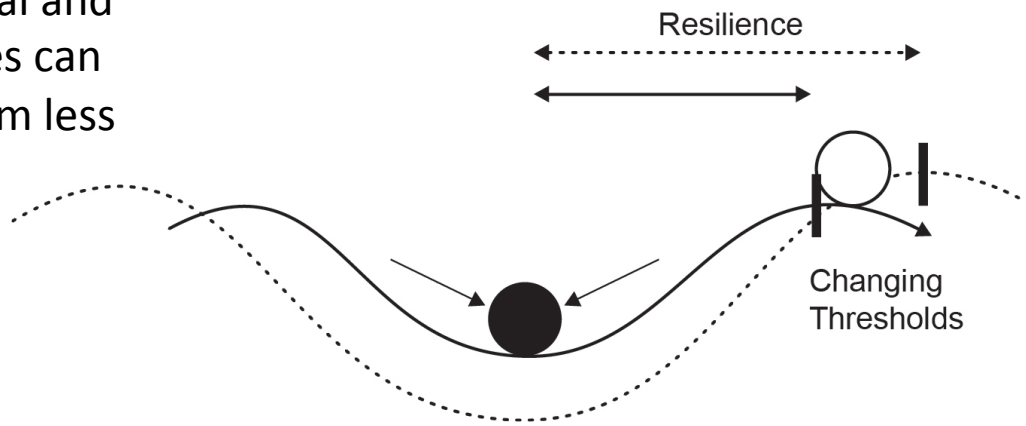
A **stable, resilient system** can cope with shocks and disturbances and keep its identity.



In an **unstable system**, a small disturbance can push the ball over a threshold.



Environmental and social changes can make a system less resilient.



Adaptation turning points in sheep and beef farm systems

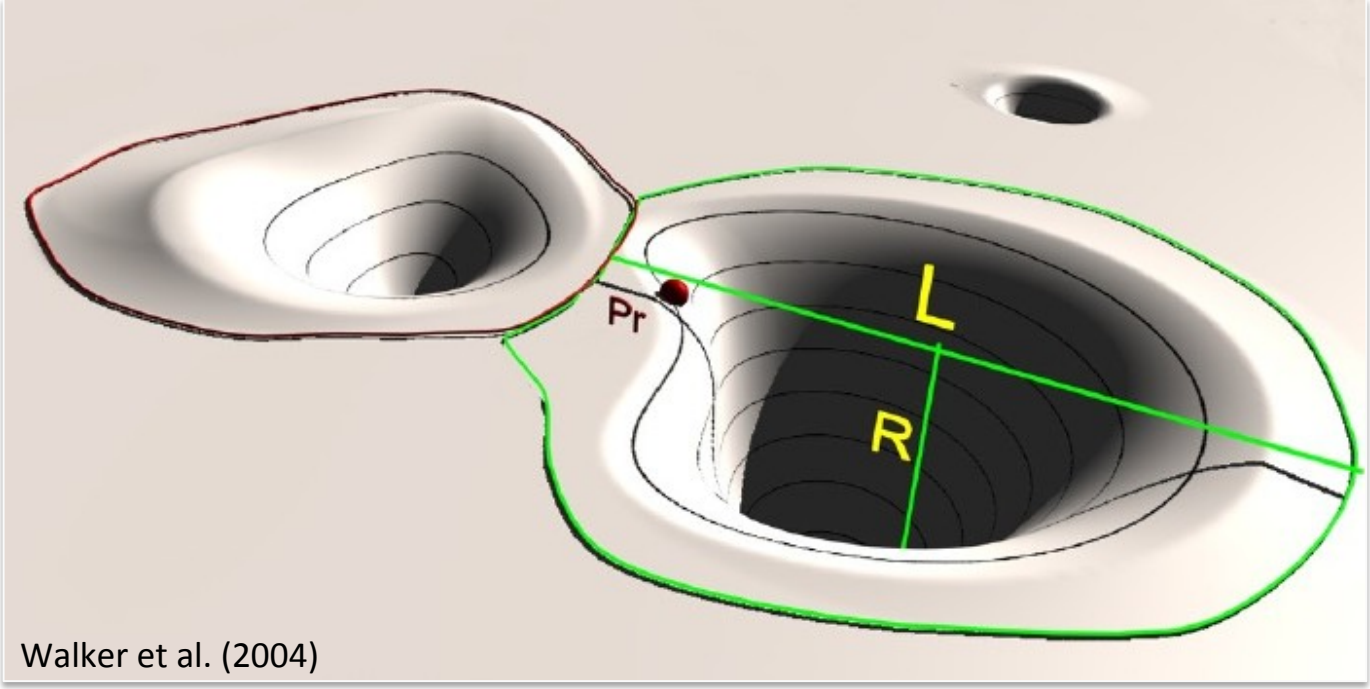
LANDCAPE STABILITY MODEL

- Move between existing state (basin) to another, future state
- Cross system-critical thresholds (social, economic, ecological)

Resistance **(R)** to disturbance

Latitude **(L)** of response

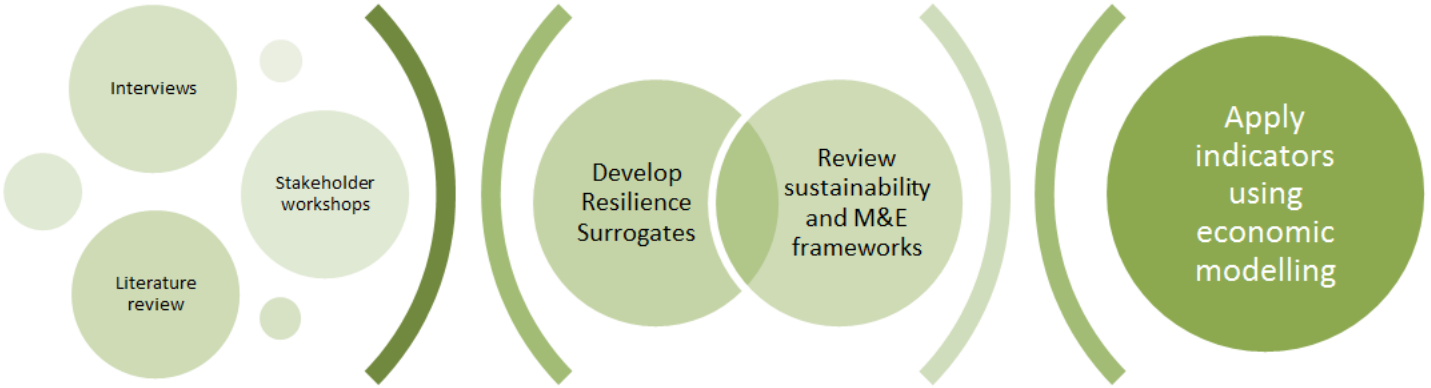
Precariousness **(Pr)** proximity to threshold



Walker et al. (2004)

What are the thresholds relevant for sheep and beef land managers?

How can movement towards or away from thresholds be evaluated?



Characterise resilience

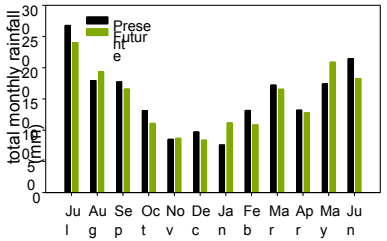
- Describe context ("Resilience of what, to what?")
- Identify slow and fast variables
- Identify farm activity sub-systems

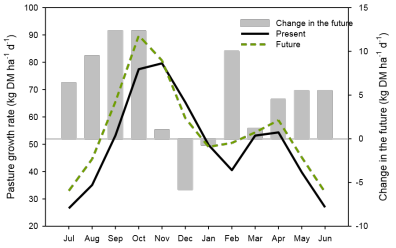
Resilience indicators

- Proxies for measuring resilience
- Link to indicators for monitoring and evaluation

Test the indicators

- Test suitability of indicators to provide insight into system dynamics





Stability landscape aspect	Surrogate	Description
Resistance	Exposure	Extent to which farming system is exposed to adverse climatic conditions (e.g. location, aspect, etc.).
	Sensitivity	The degree to which the farming system is sensitive to adverse climatic conditions.
	Coping range	Level of critical threshold above or beyond which, normal operation is not possible.
Latitude	Age	Degree to which capacity to absorb losses or respond to adverse events is influenced by age of farmer.
	Debt	Degree to which flexiblity and responses are constrained by debt levels.
	Information	Climatic and farm management information that is used in decision making.
	Communication	Access to reliable communication.
	Access	Dependence on a particular resource or location.
	Product	Diversity of products produced on the farm.
	Markets	Diversity of market segments (e.g. early season) or segments a farm is producing for.
	Productivity	Amount/total yield of products produced on the farm.
	Suppliers	Diversity of suppliers for inputs (e.g. lambs, feed, fuel).
	Processors	Diversity of processors that the farm is able to supply.
	Networks	Connectedness of the farm and its activities, within and across a region to allow for greater diversification in the face of adverse conditions (e.g. neighbors assisting in flood events)
	Pluriactivity	Access to off-farm income, not affected by adverse climate.
	Health and well-being	Physical and emotional well-being of farmer/staff and family.
Precariousness	Frequency	Extent to which activities on the farm are disrupted under current climate conditions.
	Severity	Degree to which activities are affected under current climate conditions.
	Recurrence interval	Frequency with which farm is affected under current climate conditions.

Cradock-Henry and McKusker (2015)

Adaptation turning points in sheep and beef farm systems

Domains: Social, Governance, Economic and Environment

Indicators: mix of qualitative/quantitative

Domain	Proposed Indicator	Measure
Economic	Efficiency	Farm Working Expenses as a percent
	Liquidity	Debt to equity ratio
	Cashflow	Bills paid on time
	Farm productivity	Kg meat/ha, product/ha
	Transportation infrastructure	Roading quality (both on-farm and in district)
	Diversification	Product diversification
		Market diversification
		Land diversification
		Off-farm income
		Pasture as percentage of feed consumed
	Risk strategies	Stocking rate flexibility
		Stored feed on hand
	Product quality	Price premiums available

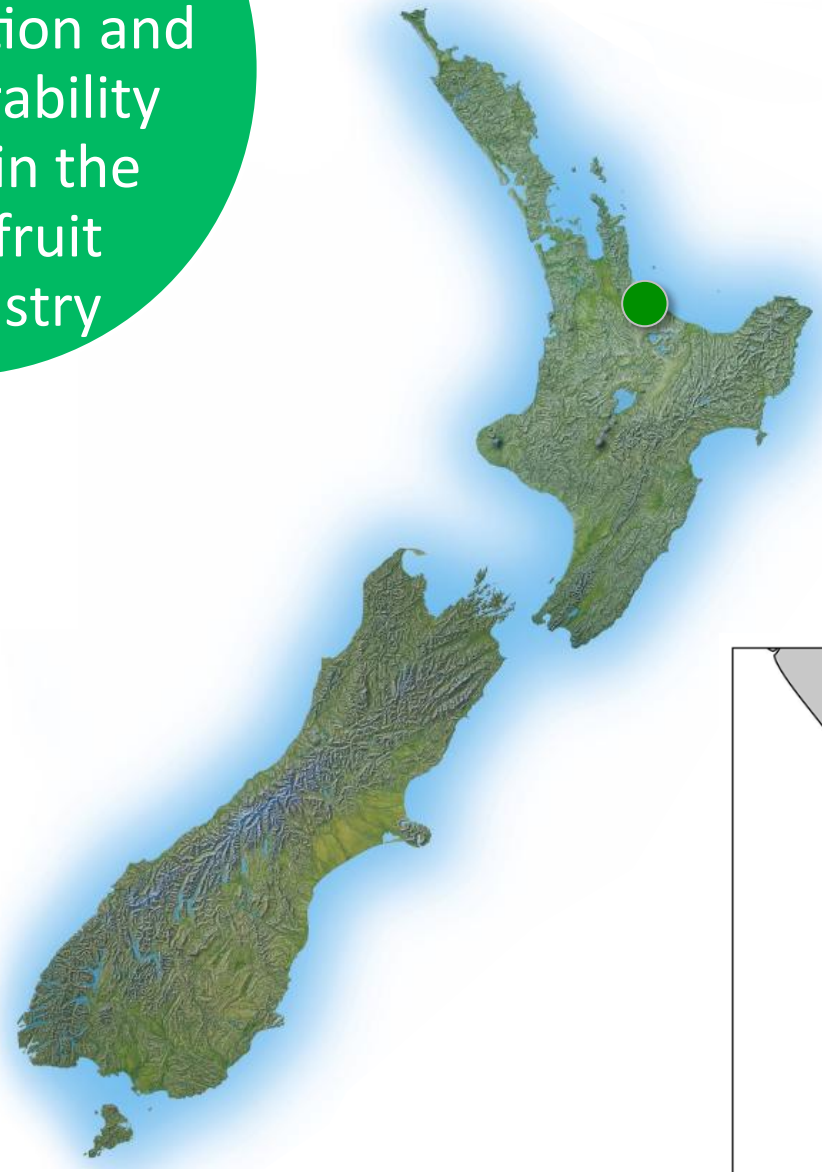
Cradock-Henry and McKusker (2015)

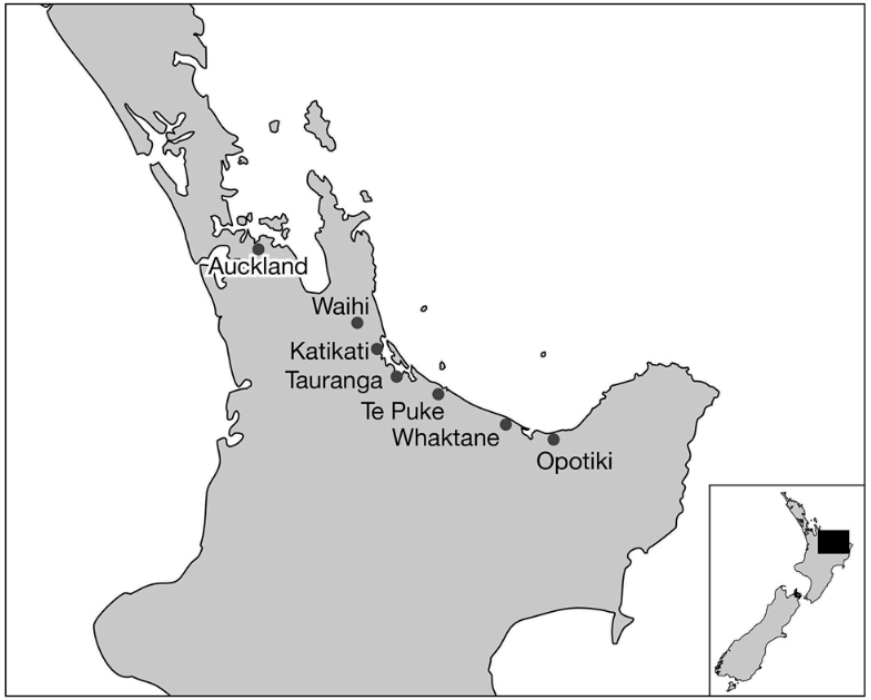
Impacts, Adaptation and Vulnerability (IAV) in the kiwifruit industry

ASSESSING IMPACTS, ADAPTATION AND VULNERABILITY IN THE KIWIFRUIT INDUSTRY

STRATEGIC ADAPTATION PLANNING IN THE CONTEXT OF MULTIPLE STRESSORS

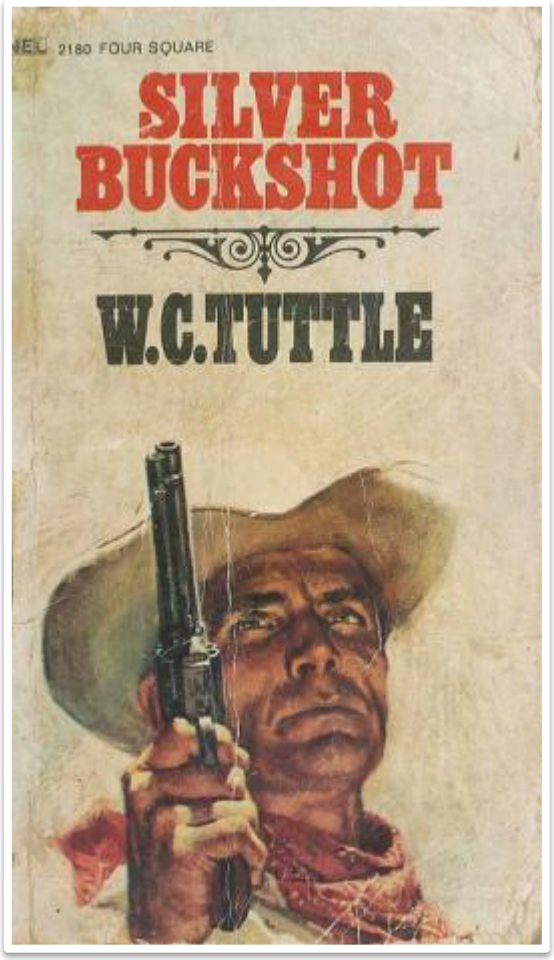
Impacts, Adaptation and Vulnerability (IAV) in the kiwifruit industry





ENHANCING POLICIES AND PLANS

Not silver bullet, valuable heuristic.



- Integrate into policy and planning at different scales:
  - Farm Environment Plans
  - East Coast Hill Country Strategy (HBRC)
  - Value chains (Carbon Disclosure)
- Integrate RA with SEA: improve decision making and reducing the risk of undesirable consequences of climate change and to improve long-term environmental stability and sustainability.

Thank – you

Landcare Research
Manaaki Whenua

Dr Nick Cradock-Henry
CradockHenryN@landcareresearch.co.nz