De-Risking Land-Use Transformation in New Zealand

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Section 1
Background

Why Next Generation Systems?

Pushing Against our Boundaries?

New Zealand has had a successful growth model based on traditional farm enterprises

However, according to the OECD (2017), the country is experiencing:
- unprecedented levels of water scarcity and quality issues,
- very high per capita greenhouse gas (GHG) emissions,
- threats to biodiversity, and
- significant erosion.

Transformational Change

NZ is facing both external and internal challenges to its current model of primary production and it has been argued that business as usual or even incremental change is not sufficient to enable these challenges to be addressed

For example a lot of good work is being done around adoption of Good (Best) Management Practices. However, may be viewed as incremental change
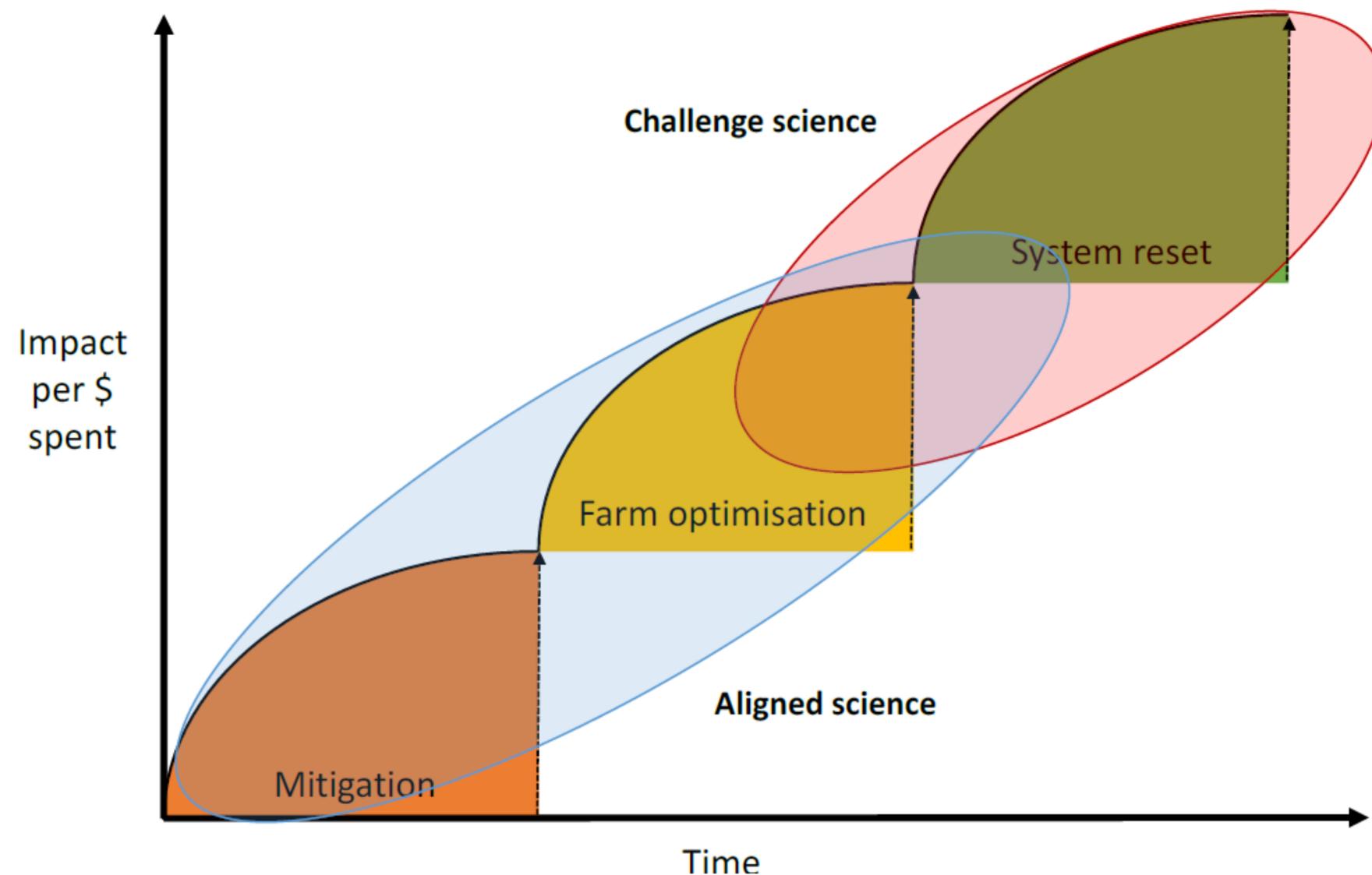

Cutting edge technology key to meeting GMP

← News archives

Transformational Change

Whilst incremental change will be valuable, solutions to the complex challenges facing the land-based sectors must provide opportunities beyond systems optimisation to transformational change

This is the area where the Our Land and Water National Science Challenge sits

Within the broader context of the OLW Challenge, the project is concerned with identifying NGS and engaging with land-use managers to support the process of transformation

Source Richard McDowell, OLW

What do we mean by Next Generation Systems?

'Next-generation systems will include redevelopment or redesign of existing enterprises and production systems, wholly new or novel enterprises, and new technologies that add options across temporal and spatial scales.

Systems may cover a broad range of pastoral, arable, horticultural and forestry industries.'

Risk

Adoption of new systems/technologies generally involves some risk to the business
- Unproven in farm situation
- Require capital investment
- Changes in management practice
- Changes in farm system
- Learning

However also have the potential to be part of risk management strategies for businesses
- Selection of less risk systems/technologies
- Improved profitability
- Reduce variability in product
- Enable compliance
- …

Section 2
Facilitating Change
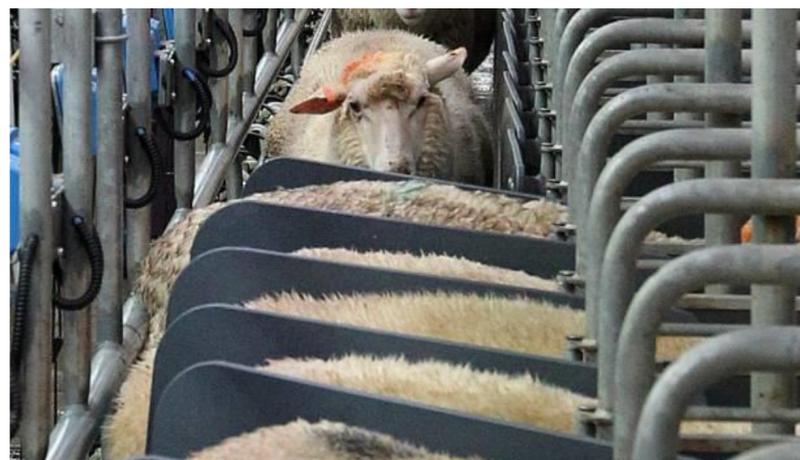
2

Pick a Winner?

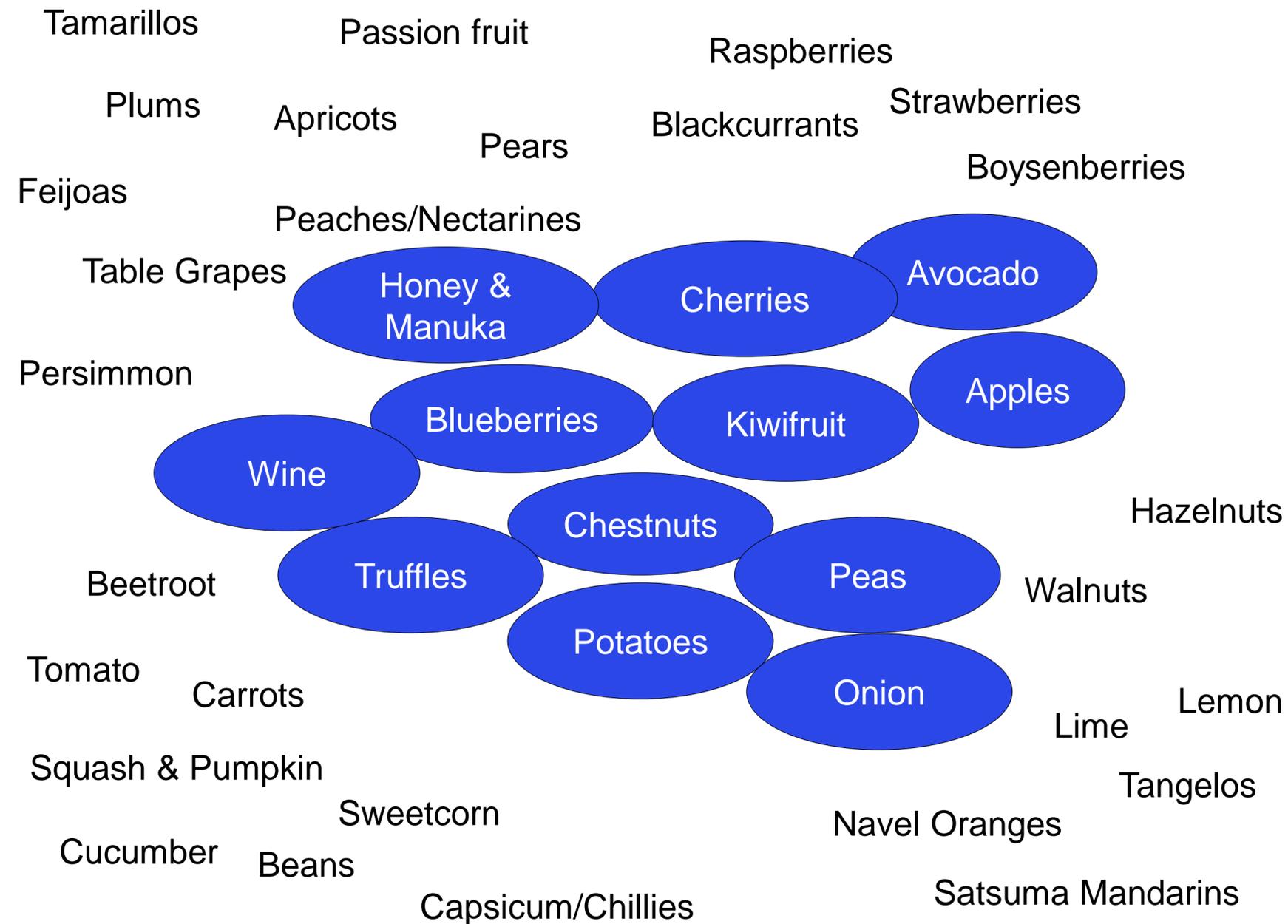Manuka Honey
Dairy Goats
Dairy Sheep
Cherries
Kiwifruit
Truffles
Hemp …

Range of Land-Use and System Changes

Tamarillos   Passion fruit

Raspberries

Plums   Apricots   Strawberries

Pears   Blackcurrants

Boysenberries

Feijoas

Peaches/Nectarines

Table Grapes

Honey & Manuka   **Cherries**   **Avocado**

Persimmon

Blueberries   **Kiwifruit**   **Apples**

Wine

Hazelnuts

Chestnuts

Beetroot   **Truffles**   **Peas**   Walnuts

Potatoes

Tomato   Carrots   **Onion**   Lemon

Lime

Squash & Pumpkin   Tangelos

Sweetcorn   Navel Oranges

Cucumber   Beans

Capsicum/Chillies   Satsuma Mandarins

Source: Renwick et al Research funded through SLMACC Evaluation of profitability and future potential for low emis
land that is currently used for livestock

Land-use Context Specific: Opportunities and Challenges Across New Zealand

Irrigation Schemes
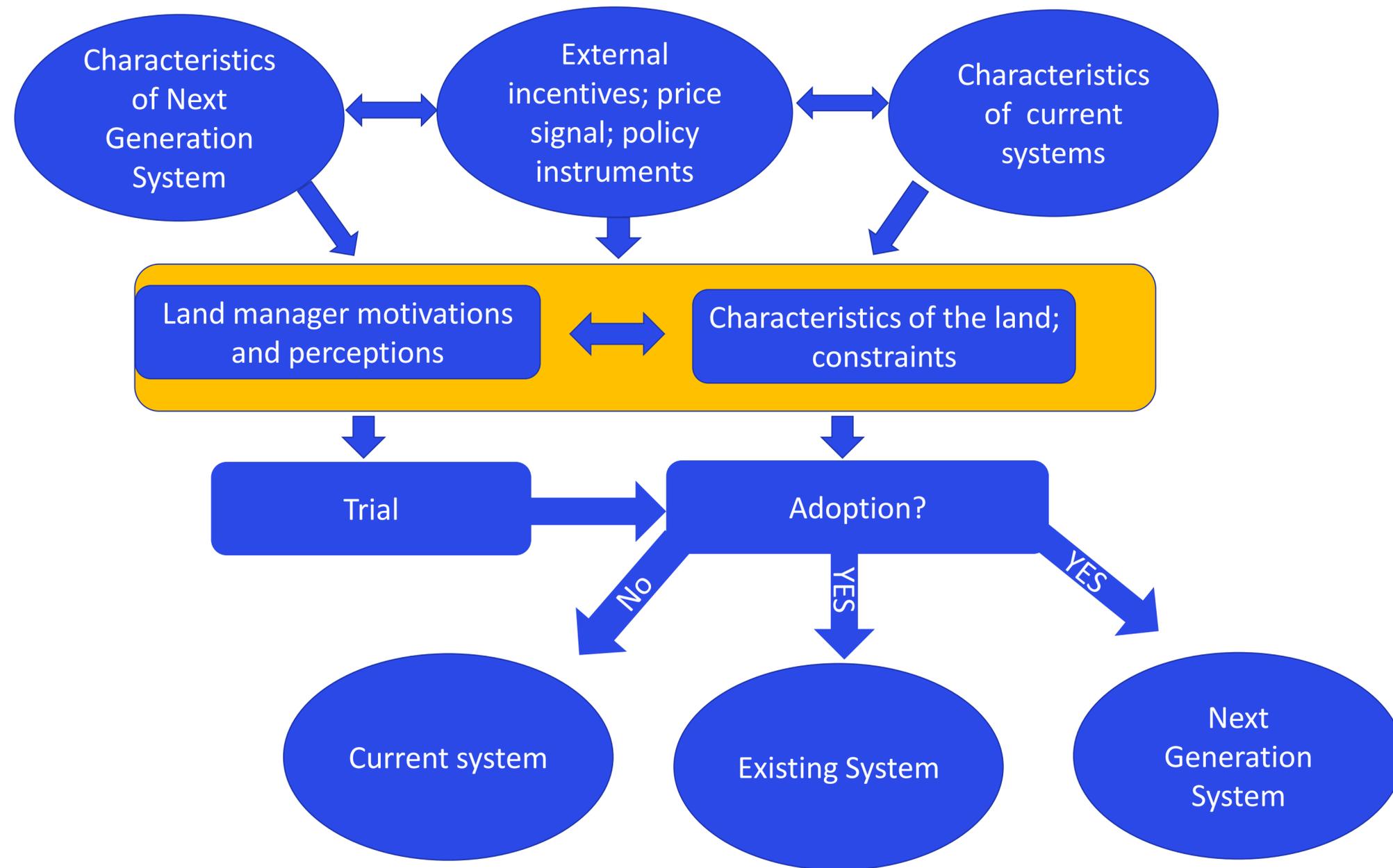Environmental Regulation
Maori Agribusiness
…
…

Need to understand the motivations and
perceptions of the land manager in order to be able
to facilitate adoption of Next Generation Systems

Framework

Characteristics of Next Generation System ↔ External incentives; price signal; policy instruments ↔ Characteristics of current systems

Land manager motivations and perceptions ↔ Characteristics of the land; constraints

Trial → Adoption?

NO → Current system

YES → Existing System

YES → Next Generation System

Leads to some questions

To what extent are these various external incentives/disincentives influencing land-use decision making?

What are the key perceptions and motivations of the land-manager in determining their land use?

How much weight are land managers placing on these external and internal factors?

Basic premise is that if we can understand these then have better chance of understanding what characteristics NGS need to have in order to facilitate their adoption

Approach to answering some of these questions

Change of system or land-use is obviously a complex decision making process involving trade-offs across a number of dimensions – social, environmental, economic etc. MCDM/A is well suited to capturing these trade-offs and has been widely used including in projects considering sustainable land-use

'Multiple criteria decision analysis (MCDA) is an advanced field of operations research and management science, devoted to the development of decision support tools methodologies to address complex decision problems involving multiple criteria goals or objectives of conflicting nature. ' Financial Times

We chose the Analytical Hierachy Process - form of MCDM developed by Saaty (1980). Involves pairwise comparisons

ŌTAKI TO NORTH OF LEVIN
SH1-SH57 Connection
Report on Multi-Criteria Analysis of Options

Prepared for New Zealand Transport Agency

November 2013

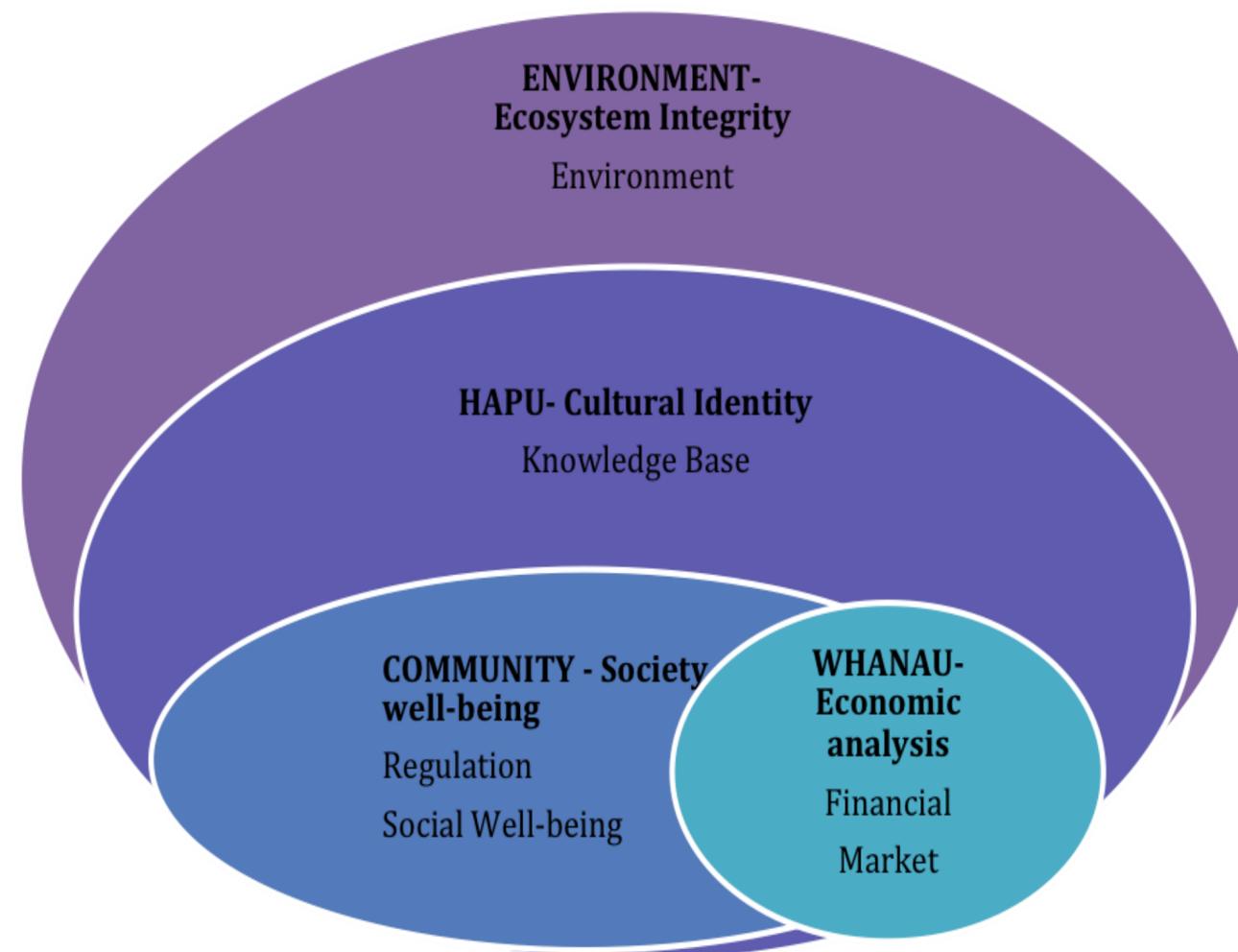**Allan Planning & Research Ltd**

Selection of Criteria: Domains

Considerable work in New Zealand
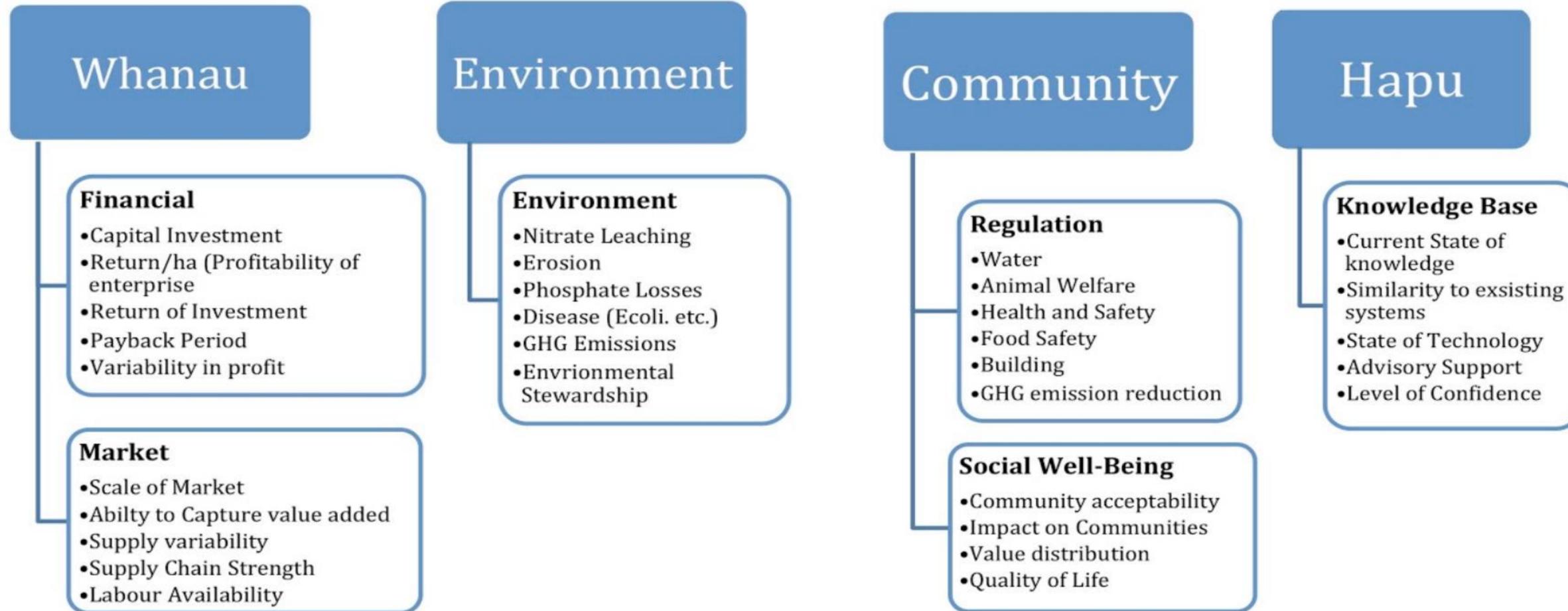- Sustainability Dashboard
- The Mauri Model

We identified 6 domains
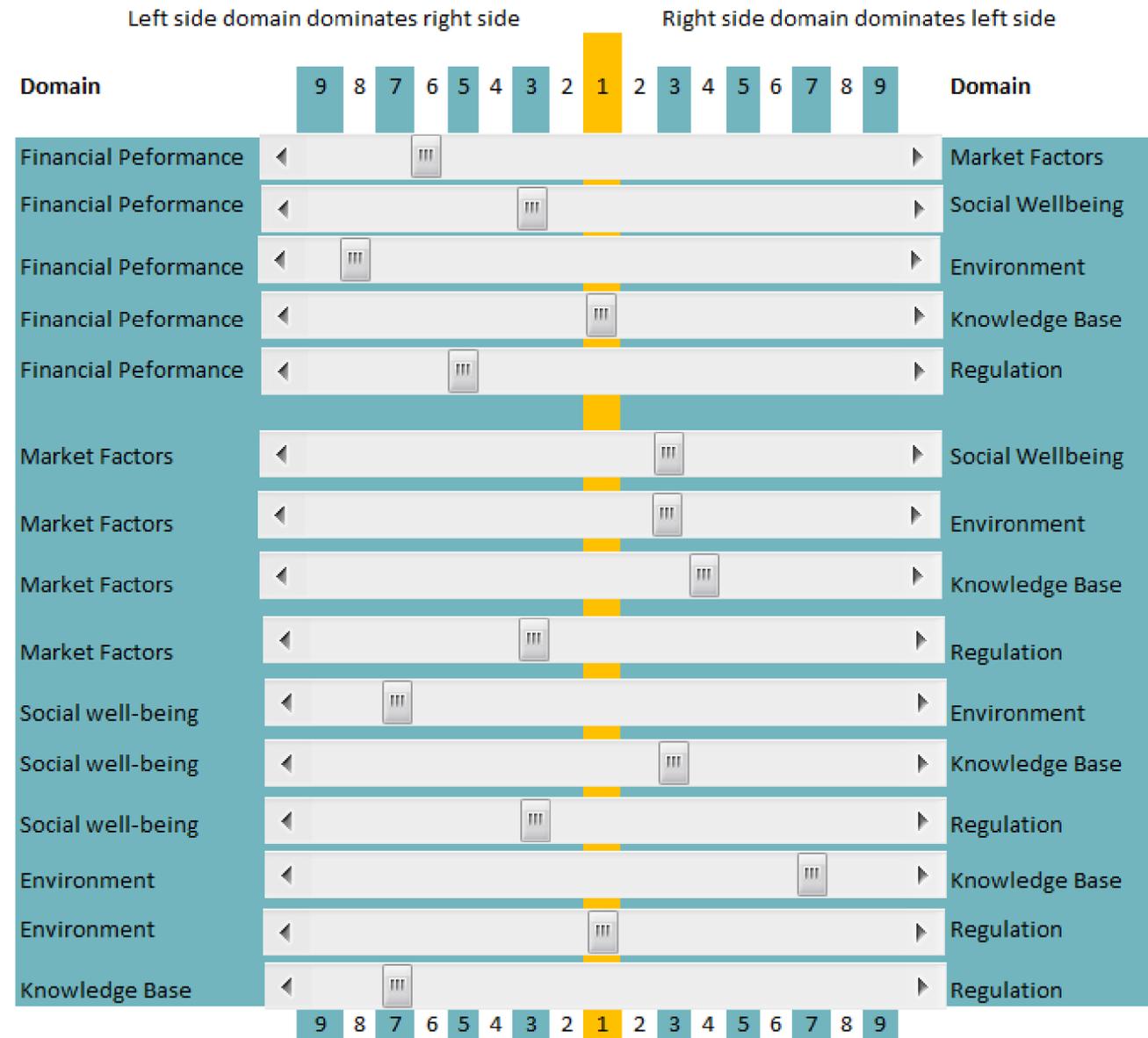
Within each domain 5/6 criteria were chosen

ENVIRONMENT-
Ecosystem Integrity
Environment

HAPU- Cultural Identity
Knowledge Base

COMMUNITY - Society
well-being
Regulation
Social Well-being

WHANAU-
Economic
analysis
Financial
Market

Criteria

Whanau

Financial
- Capital Investment
- Return/ha (Profitability of enterprise
- Return of Investment
- Payback Period
- Variability in profit

Market
- Scale of Market
- Abilty to Capture value added
- Supply variability
- Supply Chain Strength
- Labour Availability

Environment

Environment
- Nitrate Leaching
- Erosion
- Phosphate Losses
- Disease (Ecoli. etc.)
- GHG Emissions
- Envrionmental Stewardship

Community

Regulation
- Water
- Animal Welfare
- Health and Safety
- Food Safety
- Building
- GHG emission reduction

Social Well-Being
- Community acceptability
- Impact on Communities
- Value distribution
- Quality of Life

Hapu

Knowledge Base
- Current State of knowledge
- Similarity to exsisting systems
- State of Technology
- Advisory Support
- Level of Confidence
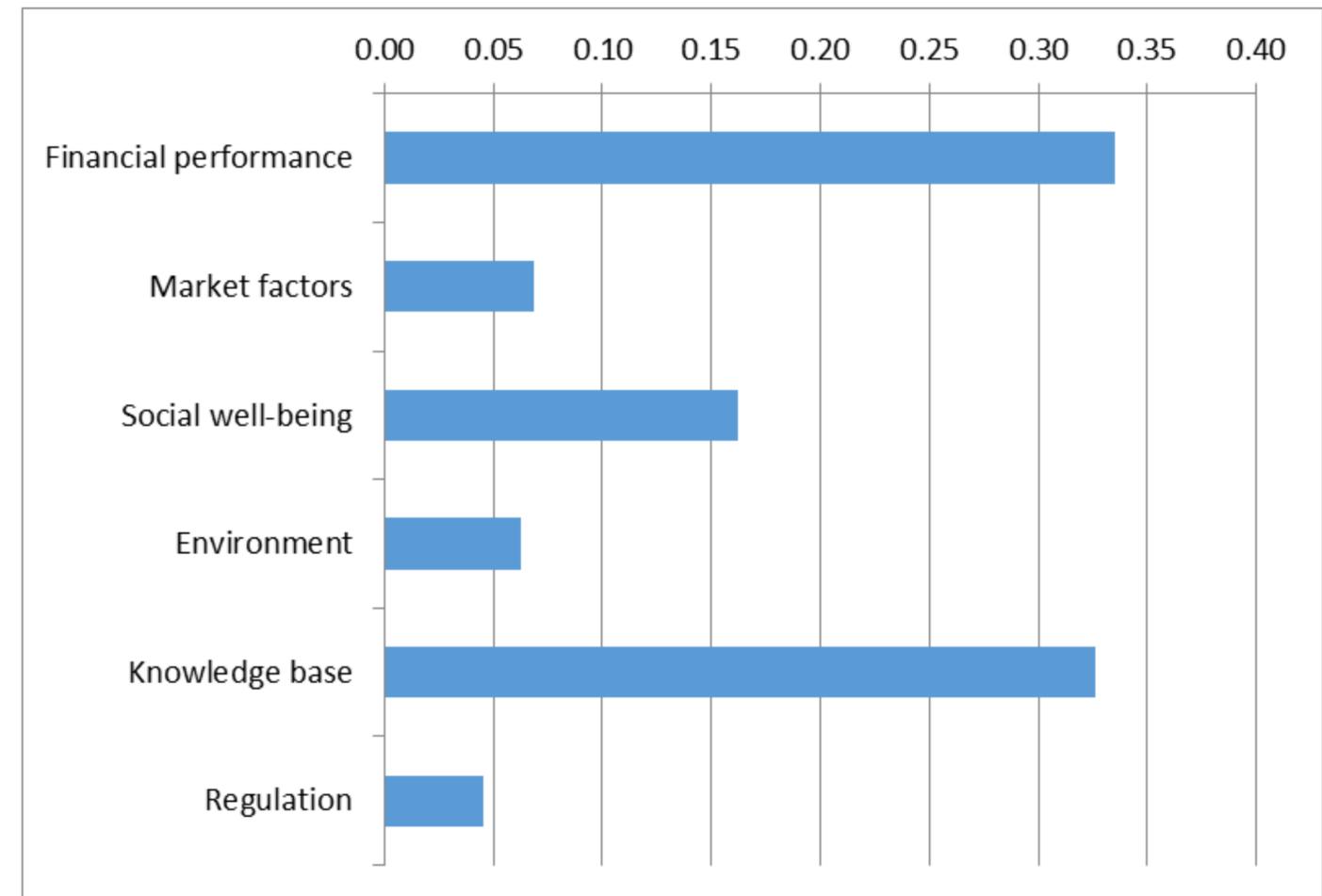
How it works

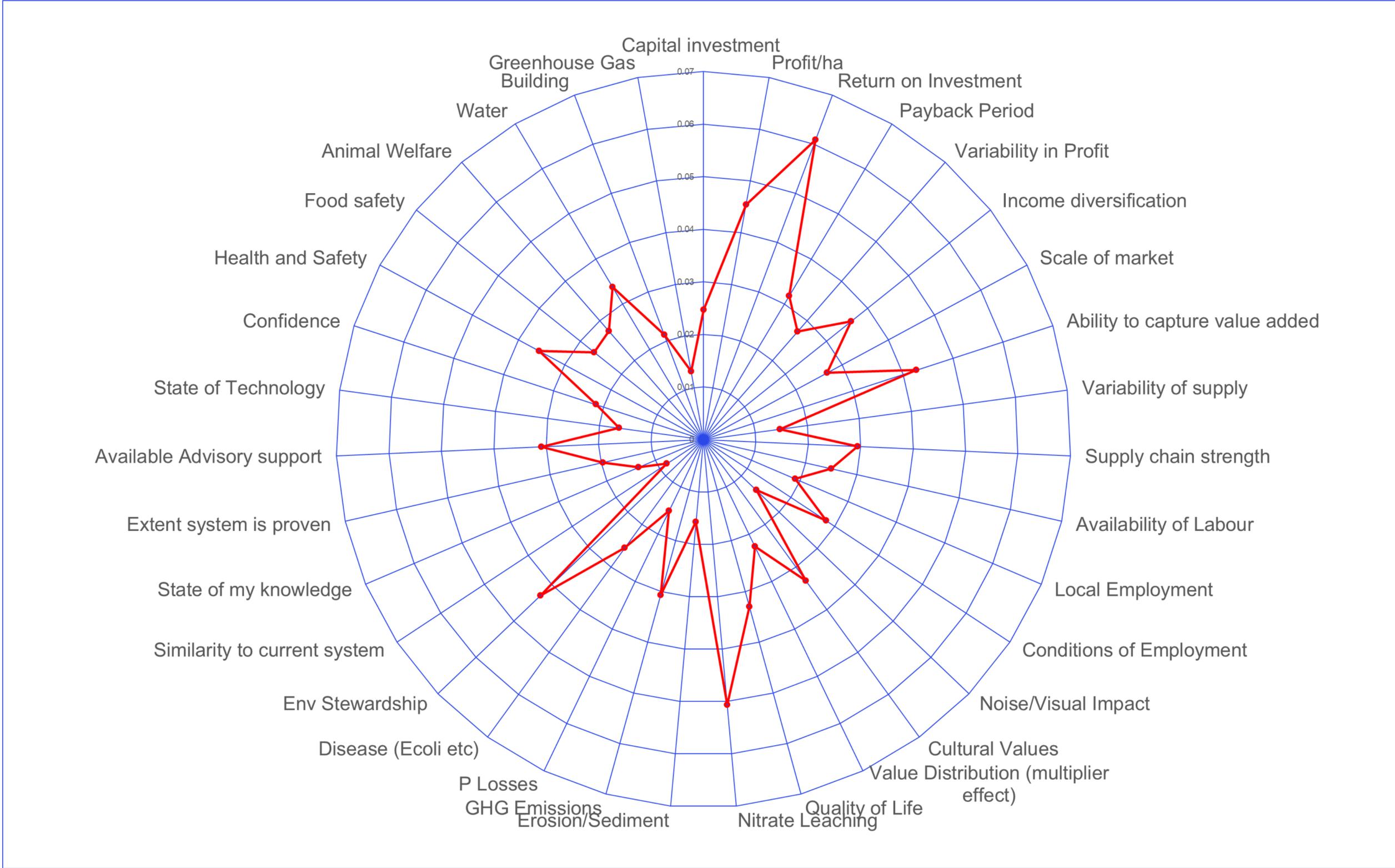| Score	Definition	Explanation
1	Equal importance	The two domains contribute equally to the decision process
3	Moderate importance	One domain is slightly more important than the other
5	Strong Importance	One domain strongly dominates the other
7	Very strong importance	One domain very strongly dominates the other
9	Extreme importance	One domain completely dominates the other in the decision process
2,4,6,8 can be used to express intermediate values		

Domain	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domain
Financial Peformance									<								>	Market Factors
Financial Peformance									<								>	Social Wellbeing
Financial Peformance									<								>	Environment
Financial Peformance									<								>	Knowledge Base
Financial Peformance									<								>	Regulation
Market Factors									<								>	Social Wellbeing
Market Factors									<								>	Environment
Market Factors									<								>	Knowledge Base
Market Factors									<								>	Regulation
Social well-being									<								>	Environment
Social well-being									<								>	Knowledge Base
Social well-being									<								>	Regulation
Environment									<								>	Knowledge Base
Environment									<								>	Regulation
Knowledge Base									<								>	Regulation
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	

An Example

Weights Generated

Case Studies

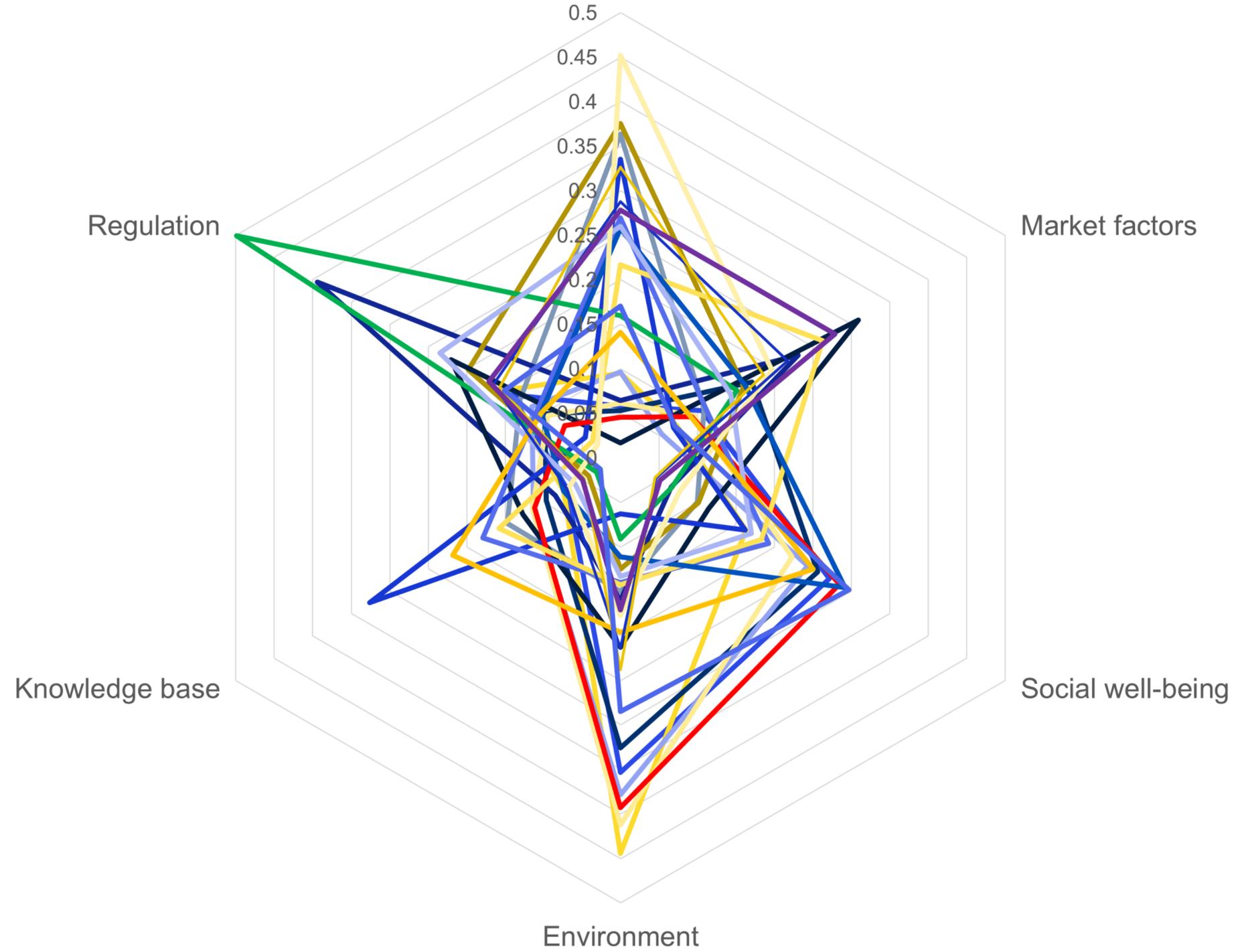| Land Manager type	Location	Driver for Change	Considering
Small Family Farmer	SI	Generate income from relatively small area	Sheep dairy
Small Family Farmer	NI	Needs value added from area constrained by strong regulatory control in terms of nitrate limits	Value added beef
Family Farmers (6)	SI	Irrigation Scheme moved from dryland to irrigated land with increased opportunities	Range of crop systems / collective action
Large Family Farmer	NI	Succession planning key. Return from arable seen as too low.	Switch to horticulture (apples, kiwifruit)
Smallholding*	NI	Needs high value added, concerned about regulatory impact	Multiple cropping linked with forestry (nuts etc)
Maori Trustees MT (4)*	NI	Harvested forestry land and now looking for alternatives	Hazelnuts, mixed tree crops, tourism, horticulture
Regenerative Farmer*	NI	Looking for sustainable land uses at scale	Hazelnuts
Maori Corporate MC (4)	SI	Looking for returns from land coming out of forestry and diversification from dairy investment	Sheep dairy, horticulture
Hill Country	SI	Looking to generate profit from traditional sheep and beef land	Range of diversified land uses
Family Farmer	SI	Regulation from water placing pressure on dairy production	Sustainable land uses

On Average

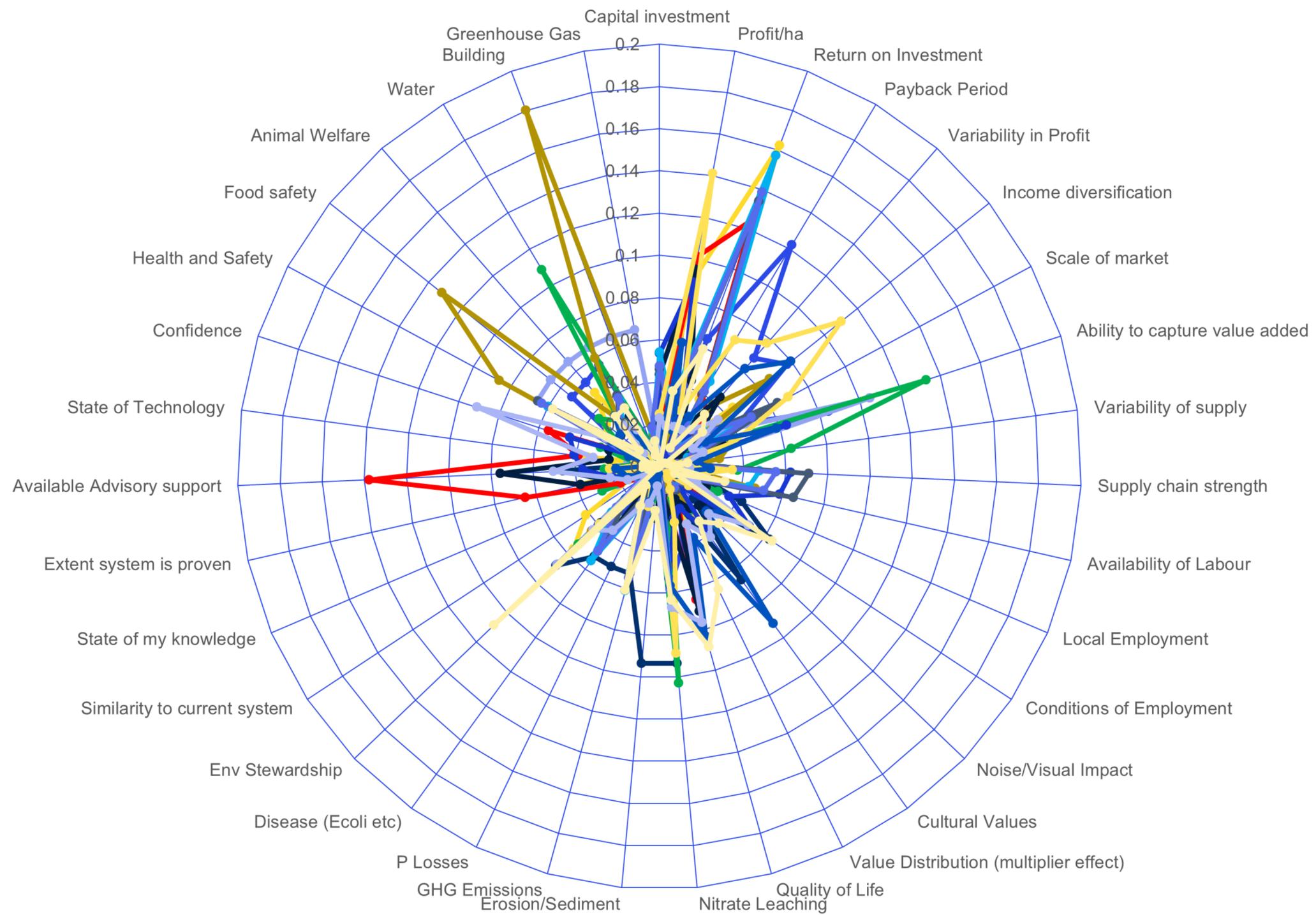Source: Renwick et al forthcoming
Research was funded through the Our Land and Water National Science Challenge: Next Generation
Systems

Chart Title

Legend: C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22

Axes: Financial performance, Market factors, Social well-being, Environment, Knowledge base, Regulation

How it is being used

Working with a number of land managers

Irrigation Schemes
Environmental Regulation
Maori Agribusiness
Maori Trust

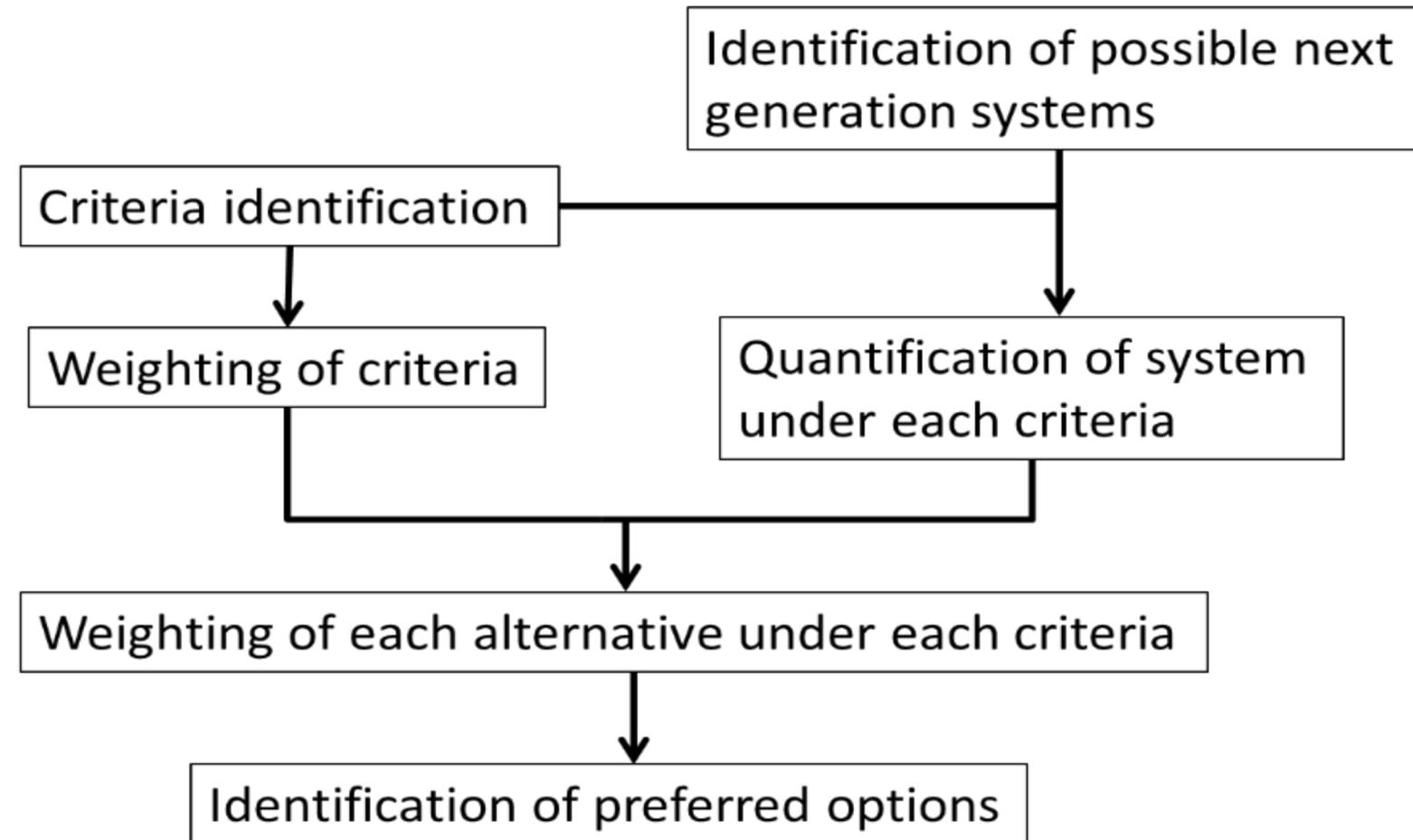# Group decision making

'After the trustees had been through the framework, they stated that they had found it useful to clarify their thoughts over future land uses. Interestingly, they also later used the results to highlight to the wider group for which they are acting as trustees, that they were aligned in their thinking and what were their key considerations.'

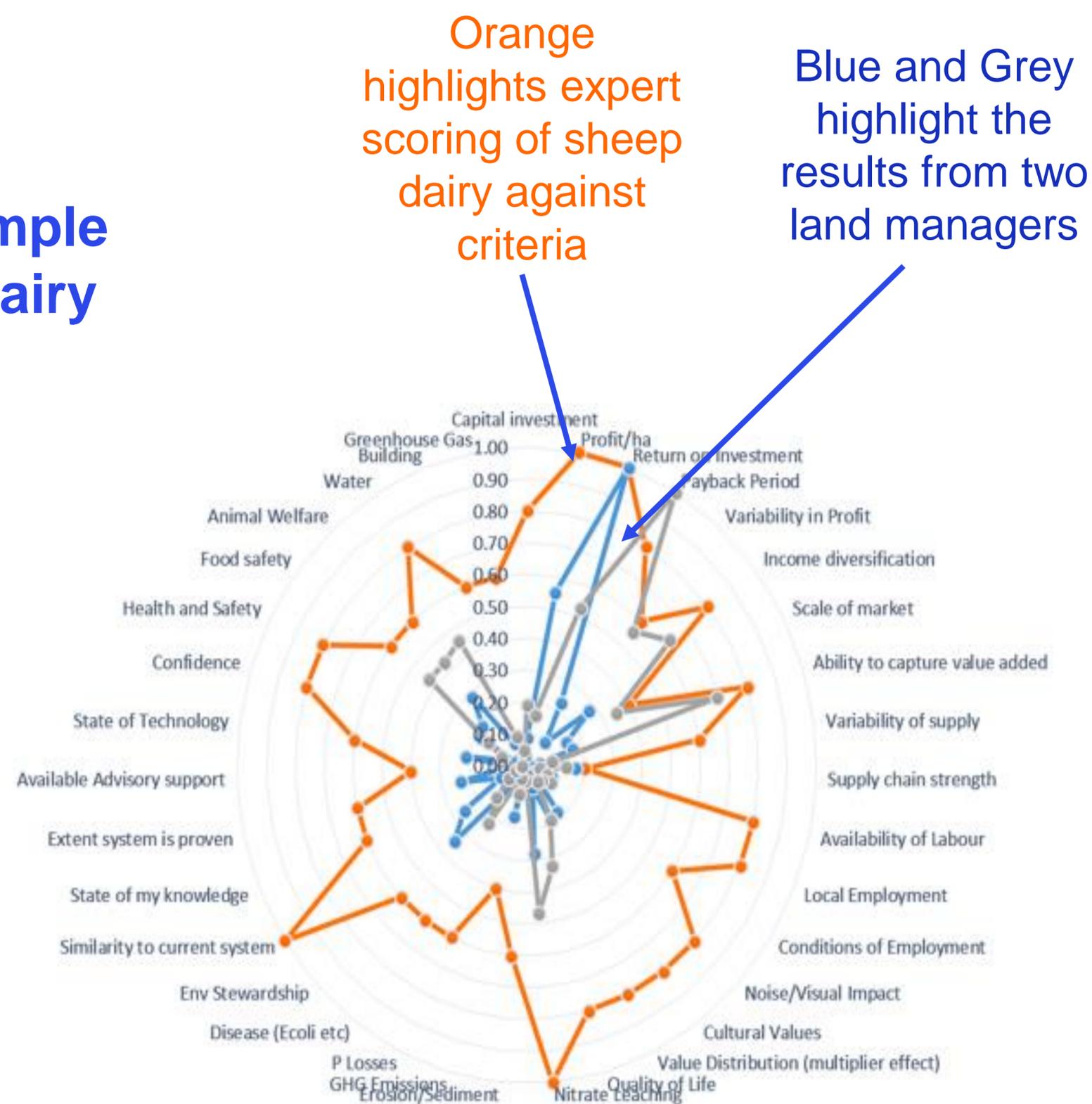LINCOLN UNIVERSITY TE WHARE WĀNAKA O AORAKI

Rating Next Generation Systems

How well does a system fit? An example with two land managers and sheep dairy

1) Obtain weights for the criteria through framework process
2) Score/rate system(s) according to the criteria (objective or subjective)
3) Multiply the rating score by the weights derived to obtain overall score for system

In this example the sheep dairy was scored out of 5 for each of the criteria (5 meaning it performed well)

Overall scores were 3.69 and 3.79 (out of 5) highlighting it scored pretty well for both land managers

Orange highlights expert scoring of sheep dairy against criteria

Blue and Grey highlight the results from two land managers

Advantages

The interactive approach (using a graphical interface) for selecting the criteria weights allows a detailed discussion with the land-user about the process of system change.

Reflection on and crystallization of what is driving the land manager

Success is a journey, not a destination. The doing is often more important than the outcome.
Arthur Ashe

Central Plains Water: Understanding the Push and Pull of Dairy

The Pull
Scale
Profitability
Market
Knowledge

The Push
Environment
Regulation
Social License

"The system is simpler, I can put a manager in place"

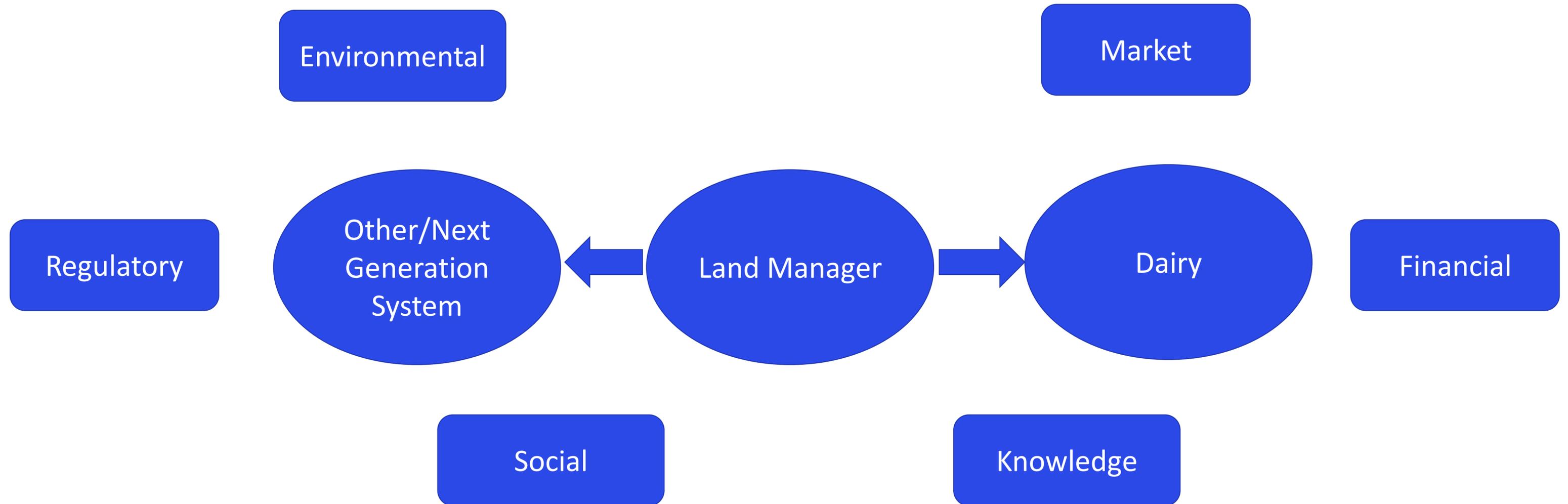"Less sense of competition and secrecy of knowledge compared to arable.

"It also means that because your money is being made from a niche product, you can't grow it at scale as this reduces the 'niche' value you're relying on."

"Our footprint now is going to be monitored and scrutinized and judged from here on in. It will have a huge effect".

"If it was all financial, I'd be dairy farming"

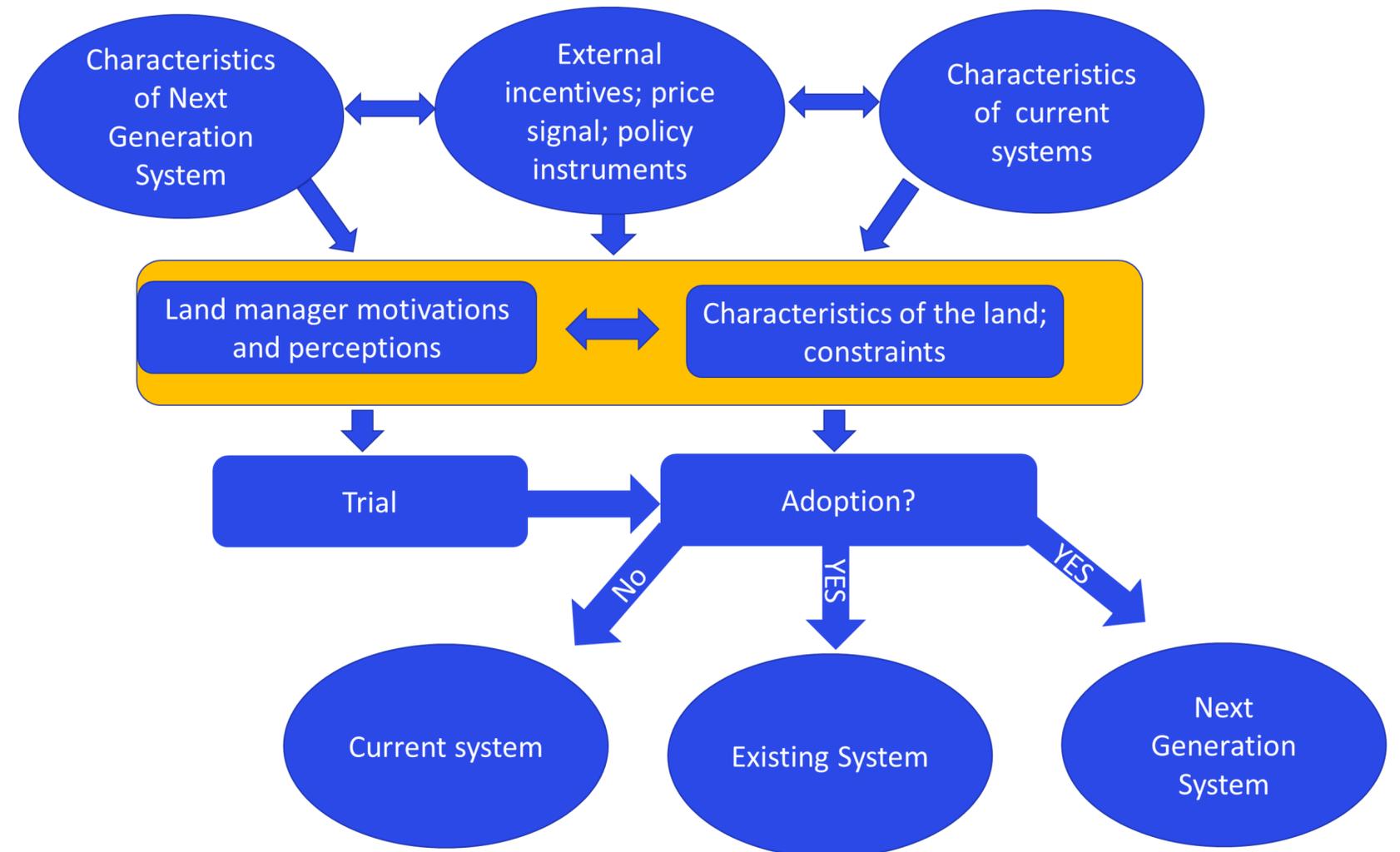"the major impact is the time it takes to comply with regulations and conduct audits"

Central Plains Water: The push and pull of Dairy

Environmental

Market

Regulatory

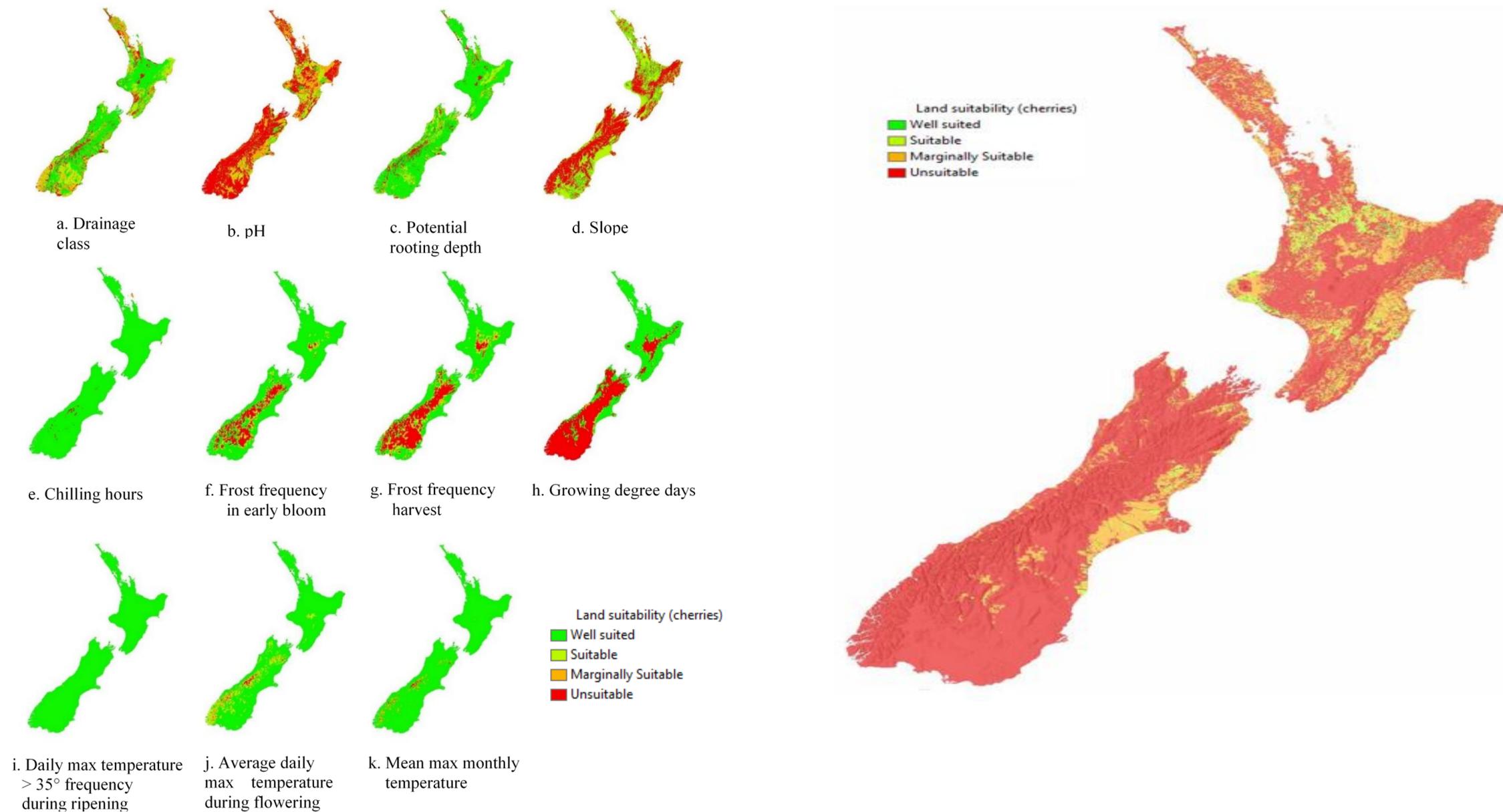Other/Next Generation System ← Land Manager → Dairy

Financial

Social

Knowledge

It seems we have systems that achieve the Environmental, Social and Regulatory needs but not the Market (particularly scale), Financial and Knowledge (and *vice versa)*

Can science help?

- In this context our approach can highlight the areas where *knowledge/information* can support the transformation:
- What is important to the decision maker?
- Do we know the answers?
- If not what *Science* is needed to fill the gap*?*

    Production (how to grow, suitability for the farm etc)

    Environment (nitrate leaching, GHG emissions etc)

    Supply chain (existence of processing, logistics etc)

    Markets (is there a market, where is it)

    Etc

Filling the gaps can reduce the risk if not remove it

An Example: Suitability

a. Drainage class
b. pH
c. Potential rooting depth
d. Slope

e. Chilling hours
f. Frost frequency in early bloom
g. Frost frequency harvest
h. Growing degree days

i. Daily max temperature > 35° frequency during ripening
j. Average daily max temperature during flowering
k. Mean max monthly temperature

Land suitability (cherries)
- Well suited
- Suitable
- Marginally Suitable
- Unsuitable

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Conclusions: Advantages (Uses) of the Framework

- Through identifying the criteria that are important in influencing adoption of new systems, attention is drawn to areas where objective information is required to support decision making.

- Can highlight where there are potential gaps in our knowledge that (transformational) science can be used help fill which in turn can reduce the risks to land managers of adopting new systems.

- The framework can also highlight how well a particular system fits with the land-users' needs and therefore give an indication of the extent of the pressure for change.

- It also can help assess the extent that new technologies etc. can shift systems so that they better meet the criteria set by land managers.

- It may used to consider decision making at different levels, for example regulators (regional councils), land managers and wider stakeholders.

Summary

New Zealand's model of agricultural growth is coming up against environmental and social (license) limits

Sustainable intensification / best management practice will not get us far enough

Transformation occurs at the land-manager level

It is context specific
- Spatially varies according to drivers
- Individual situation

System change is risky and this can hold up transformation

Understanding the decision making process gives us insights into what is required to facilitate change:
- Production Science
- Supply chain development
- Market development

Science may not de-risk land-use transformation but by providing the right information to the right land-managers it may be possible to reduce the risks involved in transformation and speed up the process

OUR LAND
AND WATER

Toitū te Whenua,
Toiora te Wai

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