



# Rangitaiki Landscape Scenarios Participatory Process

## Testing an ecosystem service based approach to inform decisions

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LINK Seminar  
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# Ecosystem services classification

## PROVISIONING

Products obtained from ecosystems

Food & fibre  
Freshwater  
Biomass fuel  
Wildfoods  
Ornamental resources  
Biochemical, natural medicines & pharmaceuticals  
Genetic resources



## REGULATING

Benefits from regulation of ecosystem processes

Air quality regulation  
Climate regulation  
Water regulation  
Erosion control  
Water purification & waste treatment  
Biological control  
Disease regulation  
Pollination  
Natural hazard regulation



## CULTURAL

Non-material benefits obtained from ecosystems

Recreation & ecotourism  
Ethical & spiritual

- Aesthetic values
- Spiritual & religious values
- Cultural heritage values
- Social relations
- Sense of place
- Cultural diversity

Inspirational & education

- Inspiration
- Educational values
- Knowledge systems



## SUPPORTING

Services necessary for the production of all other ecosystem services

Nutrient & water cycling  
Primary production (e.g. photosynthesis)

Production of atmospheric oxygen  
Provisioning of habitat

Soil formation & retention





Māori Aspirations



Tangible and Intangible Benefits



Provisioning

Regulating

Cultural

Supporting

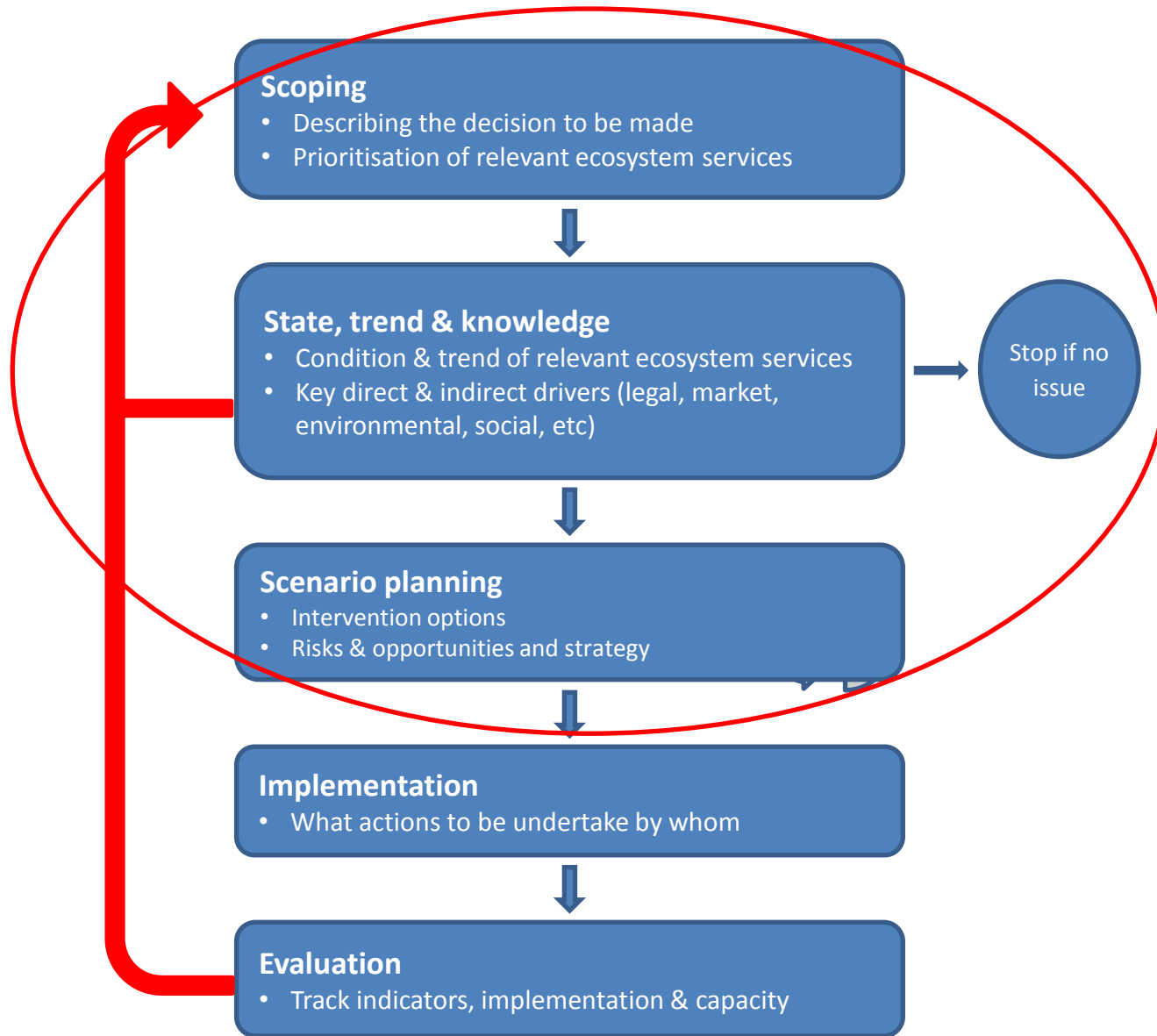
Ecosystem Services

Cultural Values



Mātauranga Māori

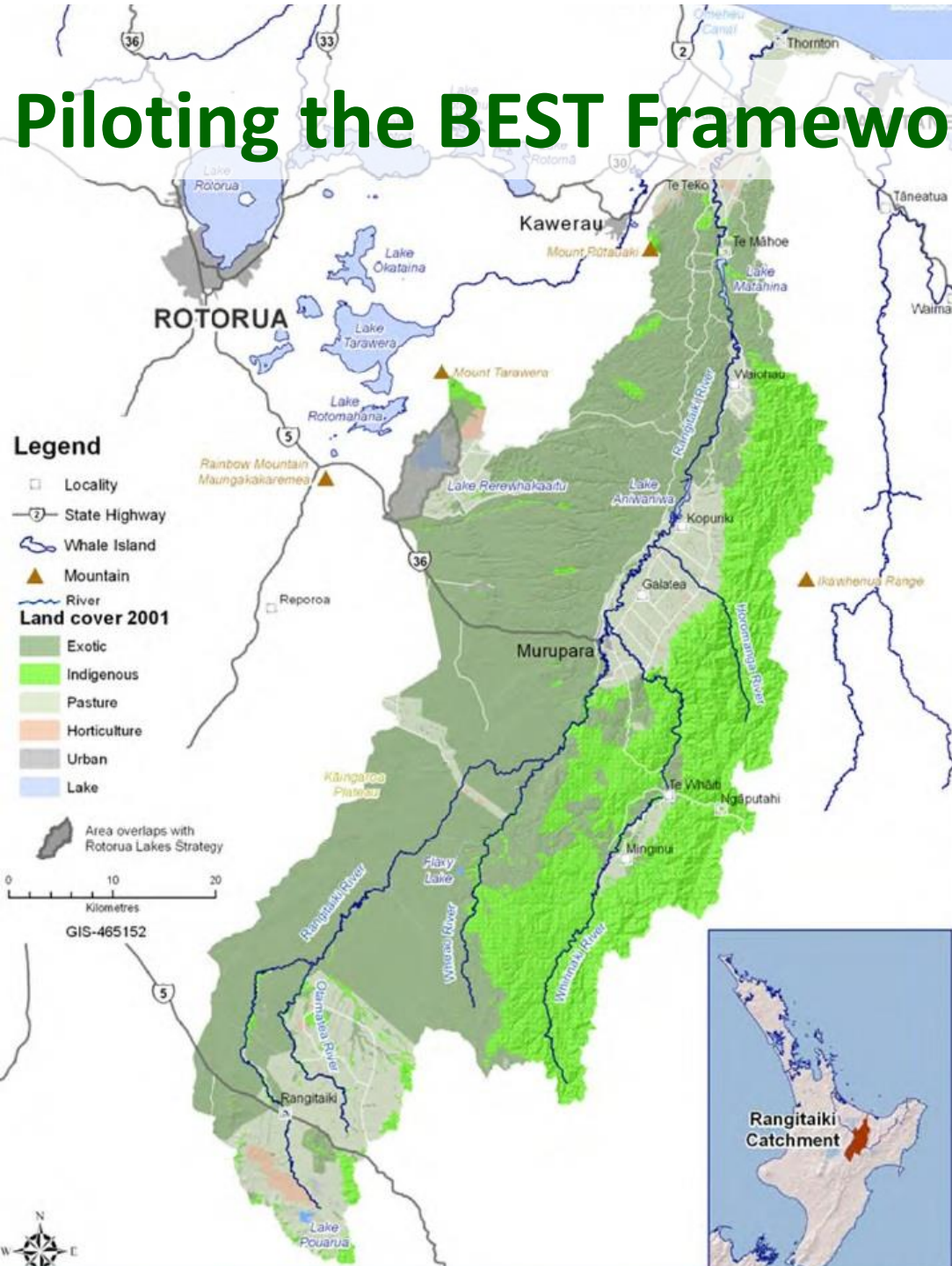
# BEST Decision-making Framework



# Purpose of the process

- Explore future options for the Rangitaiki landscapes with community members
- Identify development opportunities
  - in a way that resonated with the needs & aspiration of the community
  - that considered the range of ecosystem services
- Test how ecosystem service concepts can support natural resource decisions

# Piloting the BEST Framework in the Rangitāiki



## Why this catchment?

- Co-governance Forum --The Rangitāiki River Forum -- have clear vision for the catchment
- Diversity of landscapes, land uses & stakeholders
- Multiple potential future options
- Variety of implementation pathways

# The Group

Involved 12 people representing:

- Conservation & NGO
  - DOC
  - Environmental NGO (Fish & Game)
- Māori – 2 iwi groups, Māori dairy farmer
- Farming
  - Sheep & beef, dairy & dairy cooperative
- Local government
  - Regional councillor, district councillor
  - Regional Council staff member
- Tourism
- Missing: forestry & electricity generators

## Seven workshops

### 1. Introduction

- **Building a common platform**
- *Share knowledge and build a common understanding in the group around the Rangitāiki catchment and the ecosystem services approach*

### 2. Field trip

- **Exploring the catchment**
- *Further extend collective knowledge and understanding of the catchment and the ecosystem services it provides*

### 3. Prioritise

- **Recognising ecosystem services**
- *Identify the local natural resources, current uses and associated services critical for delivery of the groups objectives*

### 4. Future scenarios

- **Scoping future landscape scenarios**
- *Identify future drivers, translate these drivers into possible alternative future land use and management scenarios for the catchment*

### 5 & 6. Future forecast

- **Exploring the scenarios**
- *Discuss scenario findings based on modelling*

### 7. Strategise

- **Strategising**
- *Identify decisions/options for future actions*





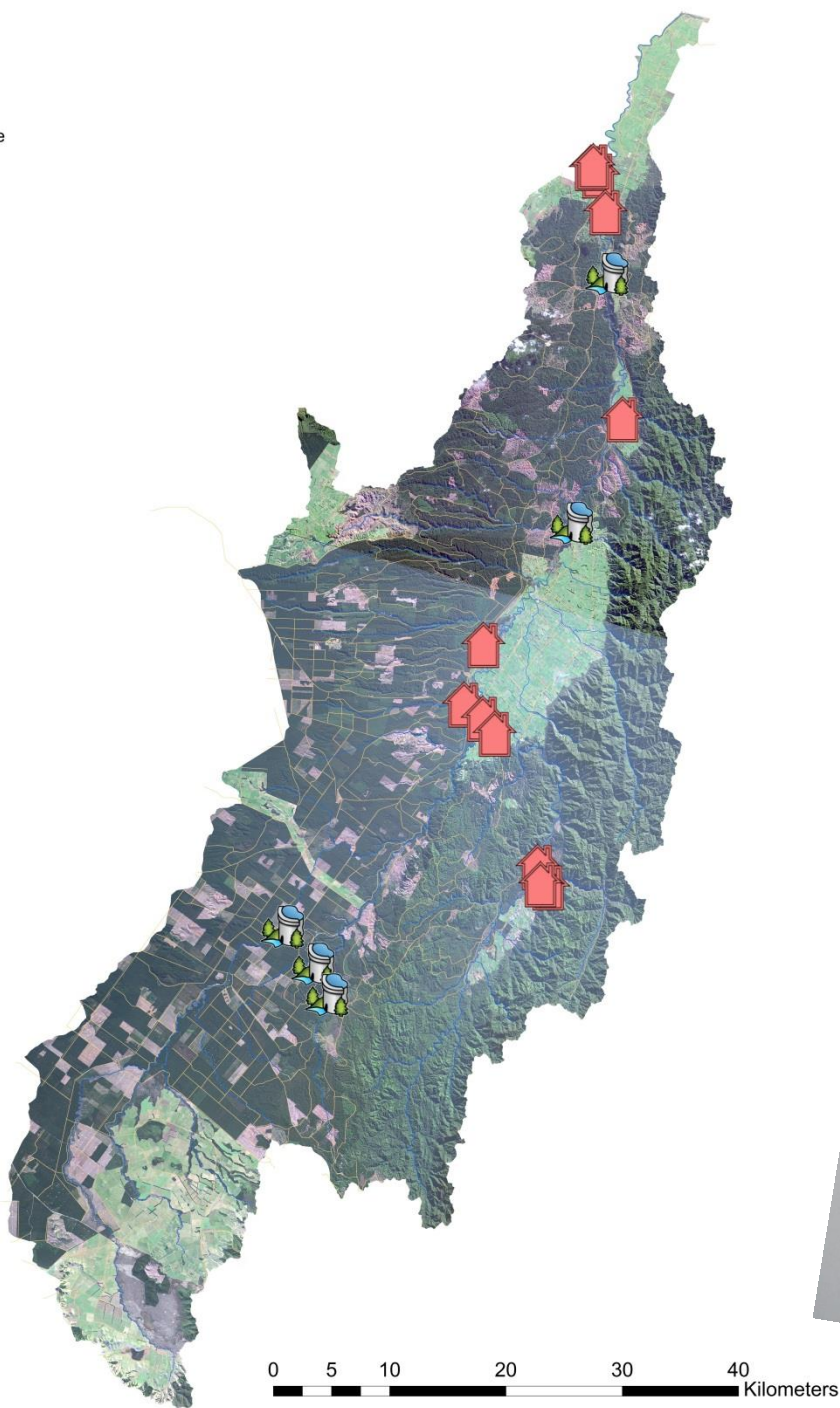
Dam



Marae

Rivers

Roads



# Rangitāiki Catchment



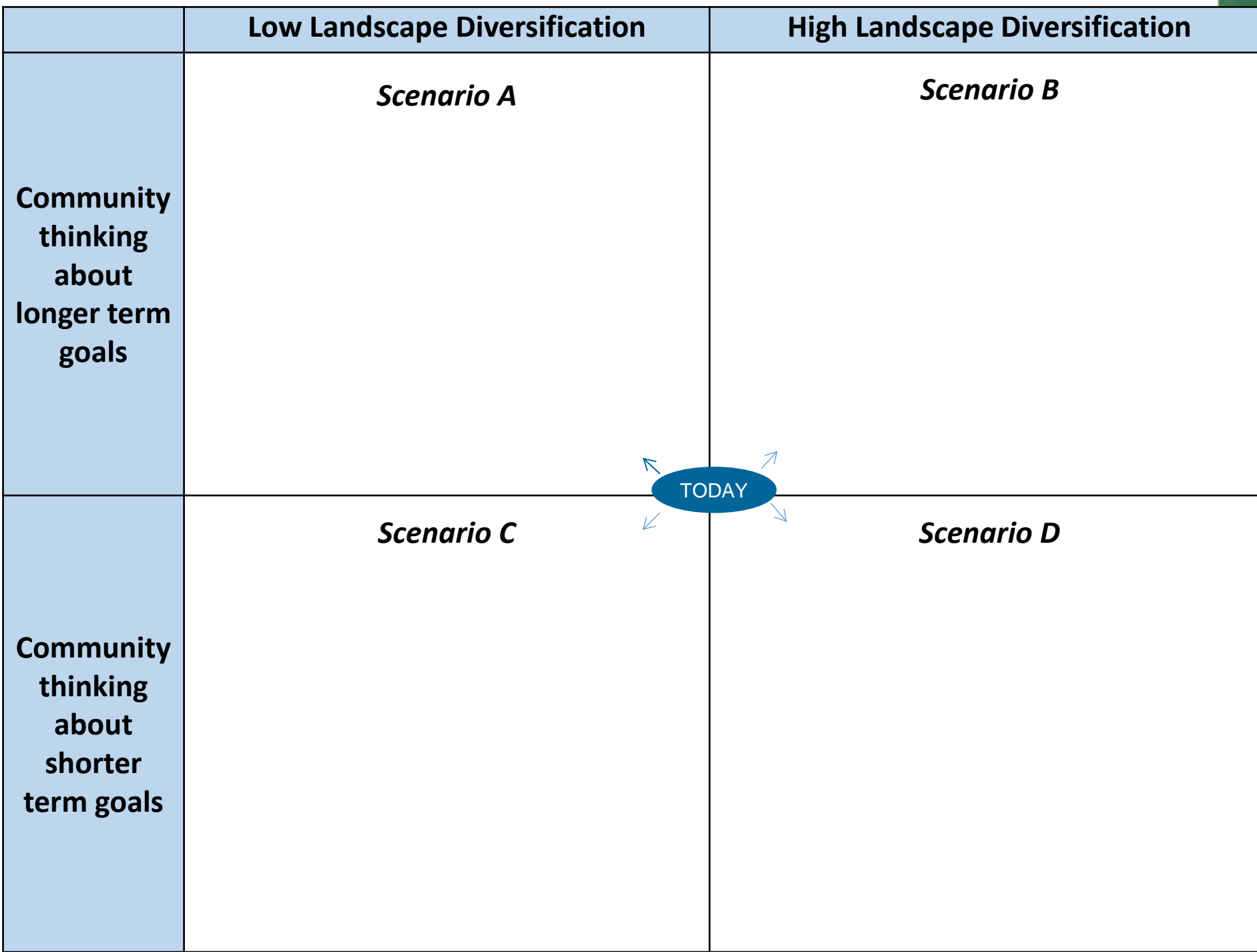
# Ecosystem Services: Prioritisation Questions

## Dependency:

1. Does current land use management in the catchment depend on this ecosystem service?
2. Does this ecosystem service have cost-effective substitutes/alternatives?

## Impacts:

1. Is the quality or quantity of this ecosystem service changing?
2. Is the change positive or negative?
3. Is the change impacting on the ability of others to use/benefit from this ecosystem service?



**Low Landscape Diversification**

**High Landscape Diversification**

*Scenario A*



*Scenario B*

- ↑ indigenous forest logging
- ↑ agroforestry
- ↑ irrigation
- dairy → high value crops
- ↑ kiwifruit

Tourism: mix of options available  
Social/cultural: ↑ jobs, cohesion, cultural use, biodiversity



*Scenario C*



*Scenario D*

- ↑ dairy
- ↑ kiwifruit
- some Forestry → Sheep and Beef
- Tourism/social/cultural: little change

**Community thinking about longer term goals**

**Community thinking about shorter term goals**

## High Landscape Diversification

**Community  
thinking  
about  
longer term  
goals**

### *Scenario B*

↑ indigenous forest logging  
↑ agroforestry  
↑ irrigation  
dairy → high value crops  
↑ kiwifruit



### **Scenario D**

*As in Scenario B*

Southern part:  
↑ sheep and beef  
↑ dairy sheep

Central Plains:  
Fully irrigated  
↓ dairy  
↑ high value crops

### **Scenario E1**

*As in Scenario D*

5,000 ha of LUC 3 Forestry  
→ vegetables

### **Scenario E2**

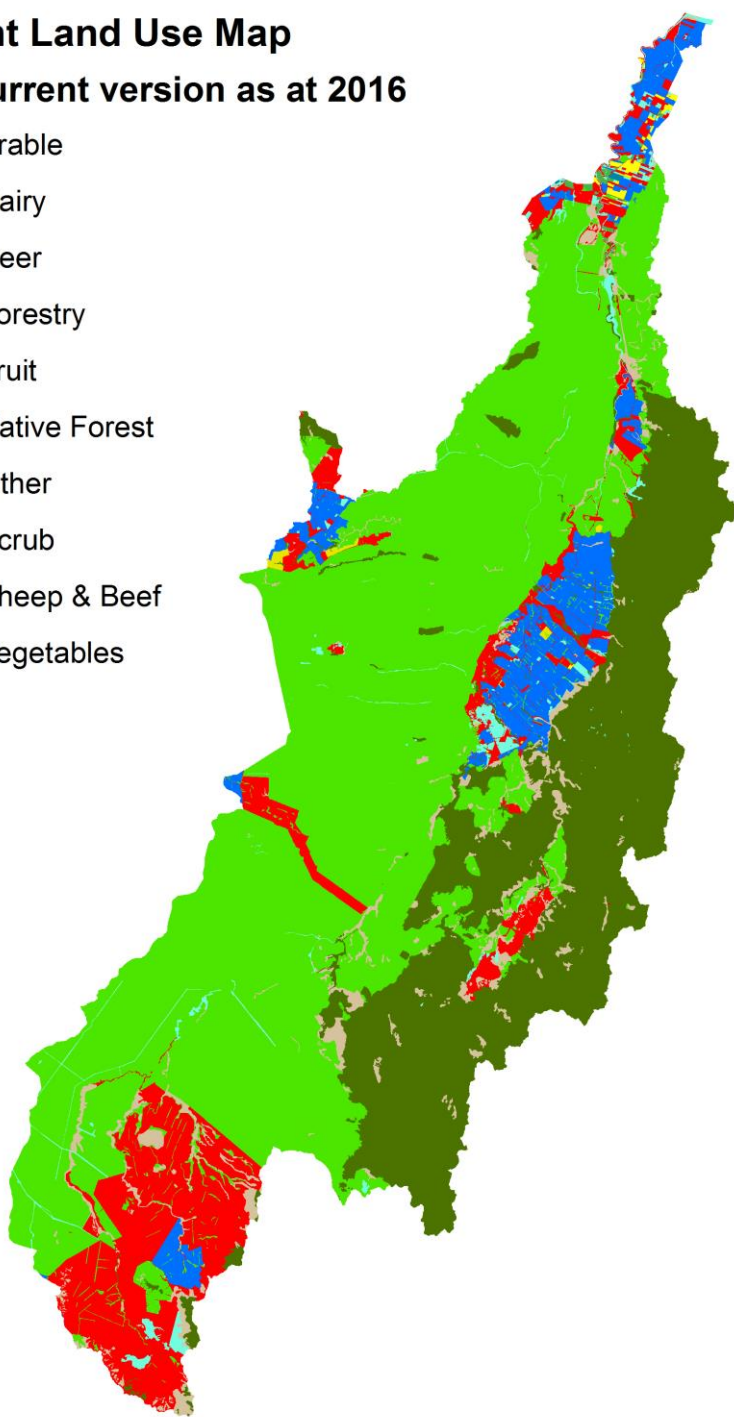
*As in Scenario D*

50,000 ha of LUC 4 Forestry  
→ Sheep and Beed

## Current Land Use Map

Best current version as at 2016

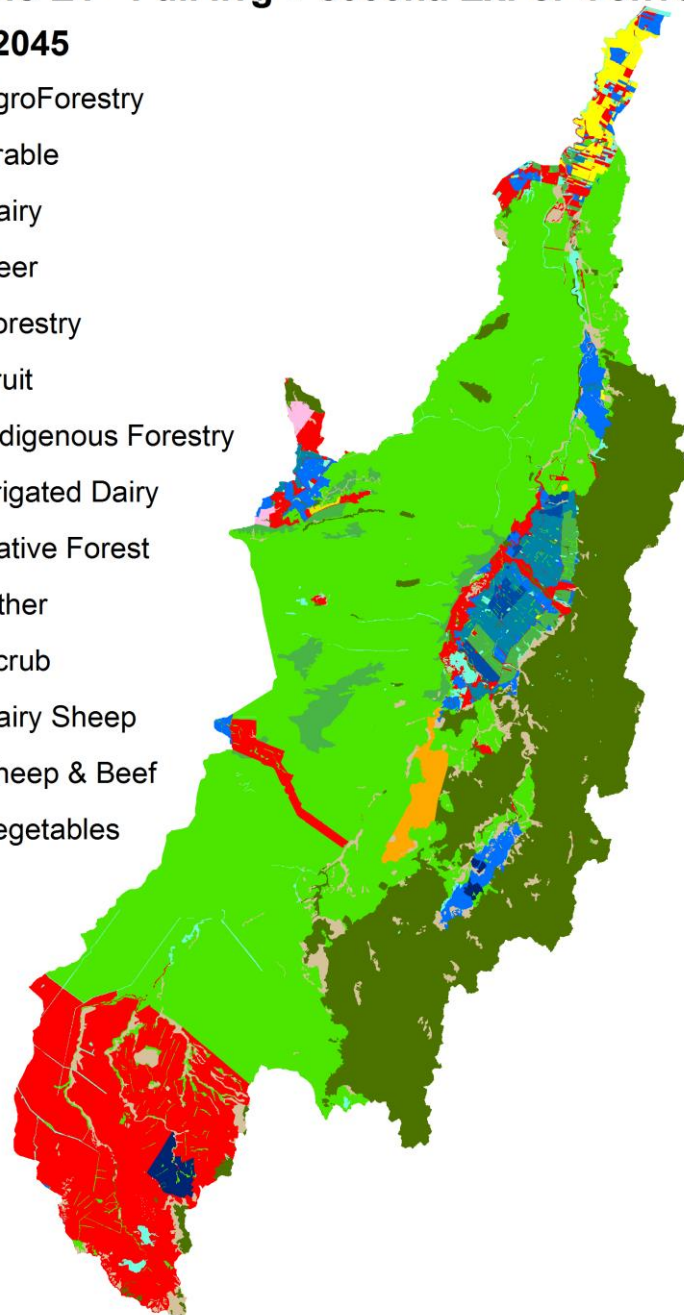
- Arable
- Dairy
- Deer
- Forestry
- Fruit
- Native Forest
- Other
- Scrub
- Sheep & Beef
- Vegetables



## Scenario E1 - Full Irrg + 5000ha ExFor Convert

Out to 2045

- AgroForestry
- Arable
- Dairy
- Deer
- Forestry
- Fruit
- Indigenous Forestry
- Irrigated Dairy
- Native Forest
- Other
- Scrub
- Dairy Sheep
- Sheep & Beef
- Vegetables



# Summary - % Change vs Current

	Scenario B - Long Term	Scenario C - Short Term	Scenario D	Scenario E1	Scenario E2
<b>Profit</b>	23.5%	5.5%	28%	30.5%	19.5%
<b>Net GHG Emissions</b>	1.7%	-2.4%	-5.8%	-10.4%	-55.2%
<b>N Leaching</b>	4.5%	6.2%	2.7%	7.4%	24.4%
<b>P Loss</b>	-2.0%	0.8%	1.0%	0.9%	25.3%
<b>Sediment</b>	-2.9%	0.1%	0.7%	1.2%	19.8%
<b>E.coli</b>	-7.2%	7.4%	-13.7%	-13.4%	45.9%
<b>Labour*</b>	~101%	~9%	~182%	~186%	~192%

\* Related to primary production activities only

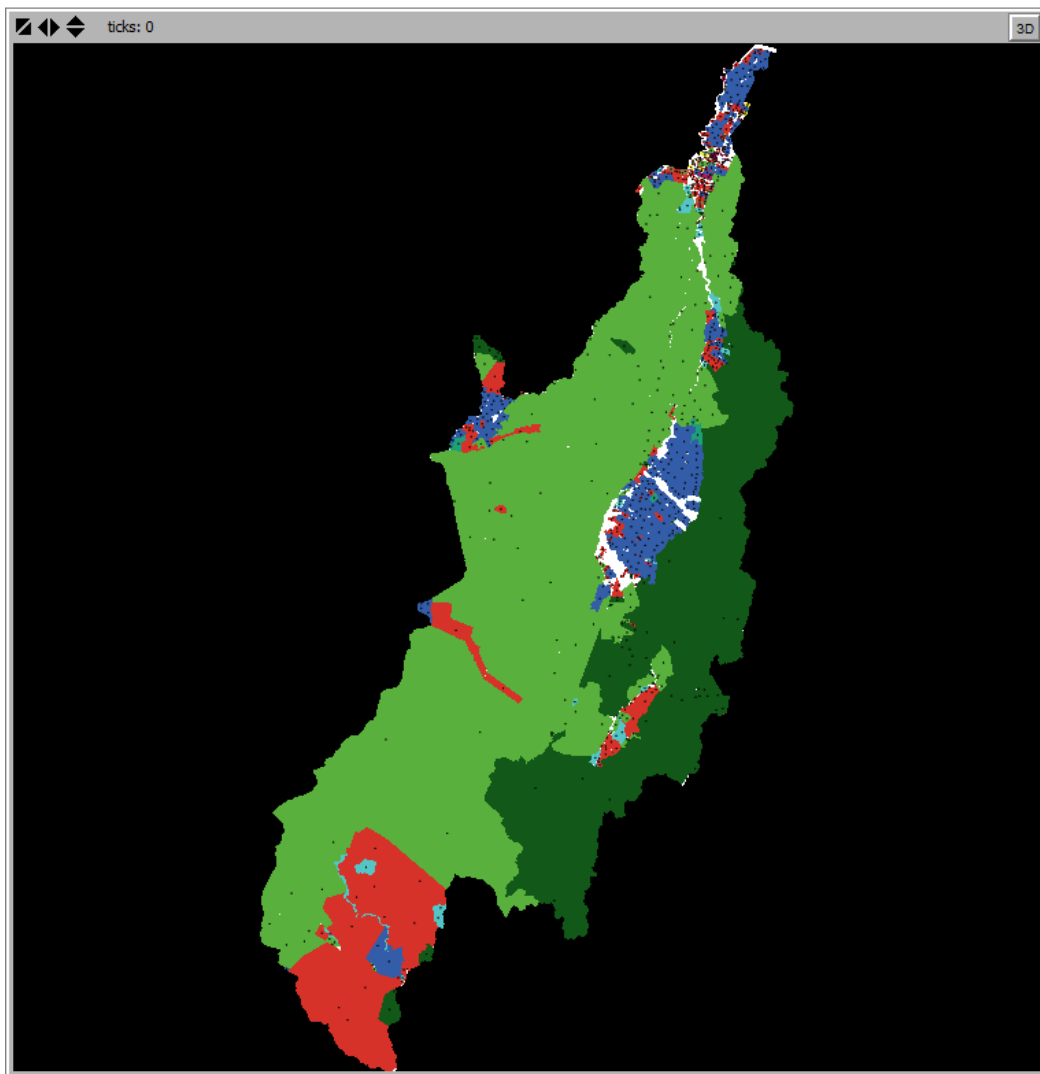
# Scenario Modelling

- Guide – Scenario E1
- SRDM
- Economic (Current Prices)
  - Prices
  - Production
- Social
  - Change in succession
  - Effects of
    - Strong vs. Weak networks





# ARLUNZ



Setup  
Step 1 Round  
Go

Toggle Farmers  
Toggle Farms

Land Use  
Initial Land Use  
LUC  
Farm Outlines

Model Controls  
duration 5  
On/Off ASCII-Grid-Reporting?

Initial Farmer Attributes  
succession-rate 0.75

Market Attributes  
ghg-price 0

Randomness  
On/Off random?  
seed-value 183244576

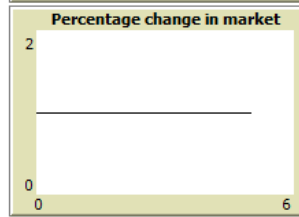
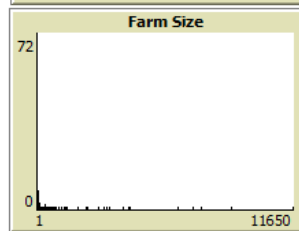
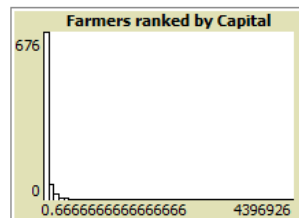
Farmer Networks  
On/Off network-effects?  
social-network-change 0.30  
geographic-network-cha... 0.10

Folder within which the results will be stored  
exp\_results\_folder  
Rangi\_Test

decision-making-approach  
homogeneous

Region  
Rangitaiki

Farmer Info	Farm Info
# of Farmers 790	count farms 791
	Avg Farm Size 143.9545



NetLogo

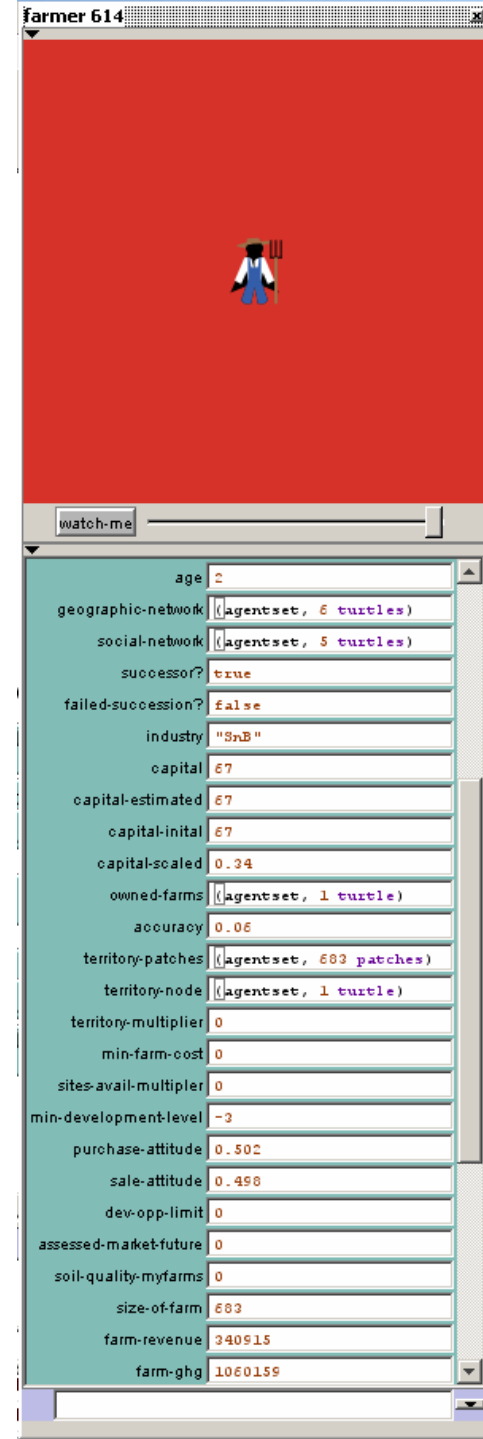


**Morgan FJ, Brown P, Daigneault, A. 2015. Simulation vs. Definition: Differing Approaches to Setting Probabilities for Agent Behaviour. Land. 4(4):914-937. <http://dx.doi.org/10.3390/land4040914>**

**Morgan FJ, Daigneault A. 2015. Estimating Impacts of Climate Change Policy on Land Use: An Agent-Based Modelling Approach. PLoS ONE 10(5). <http://dx.doi.org/10.1371/journal.pone.0127317>**

# ARLUNZ Farmer agents

- Satisficing approach
- Primarily profit/production driven
- Land use change is tempered by:
  - Land use
  - Farm stage
  - Social and geographic networks
- Behaviour parameterised using specified probabilities



The screenshot shows a NetLogo window titled "farmer 614". The main view is a red field with a small farmer icon. Below the field is a "watch-me" button. A scrollable list displays the agent's internal state:

age	2
geographic-network	(agentset, 6 turtles)
social-network	(agentset, 5 turtles)
successor?	true
failed-succession?	false
industry	"S&B"
capital	67
capital-estimated	67
capital-initial	67
capital-scaled	0.34
owned-farms	(agentset, 1 turtle)
accuracy	0.06
territory-patches	(agentset, 683 patches)
territory-node	(agentset, 1 turtle)
territory-multiplier	0
min-farm-cost	0
sites-avail-multiplier	0
min-development-level	-3
purchase-attitude	0.502
sale-attitude	0.498
dev-opp-limit	0
assessed-market-future	0
soil-quality-myfarms	0
size-of-farm	683
farm-revenue	340915
farm-ghg	1060159

# ARLUNZ - Time and Networks

## Successor

Birth and socialisation

Full-time on farm

Business expansion

Transition of responsibilities

Takeover of farm



Takeover of farm

Consolidation

Business expansion

Transition of responsibilities

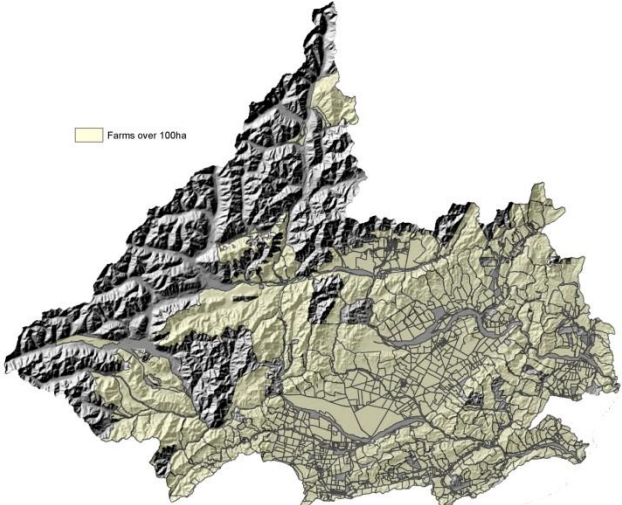
Retirement

## Incumbent

Burton, Forthcoming

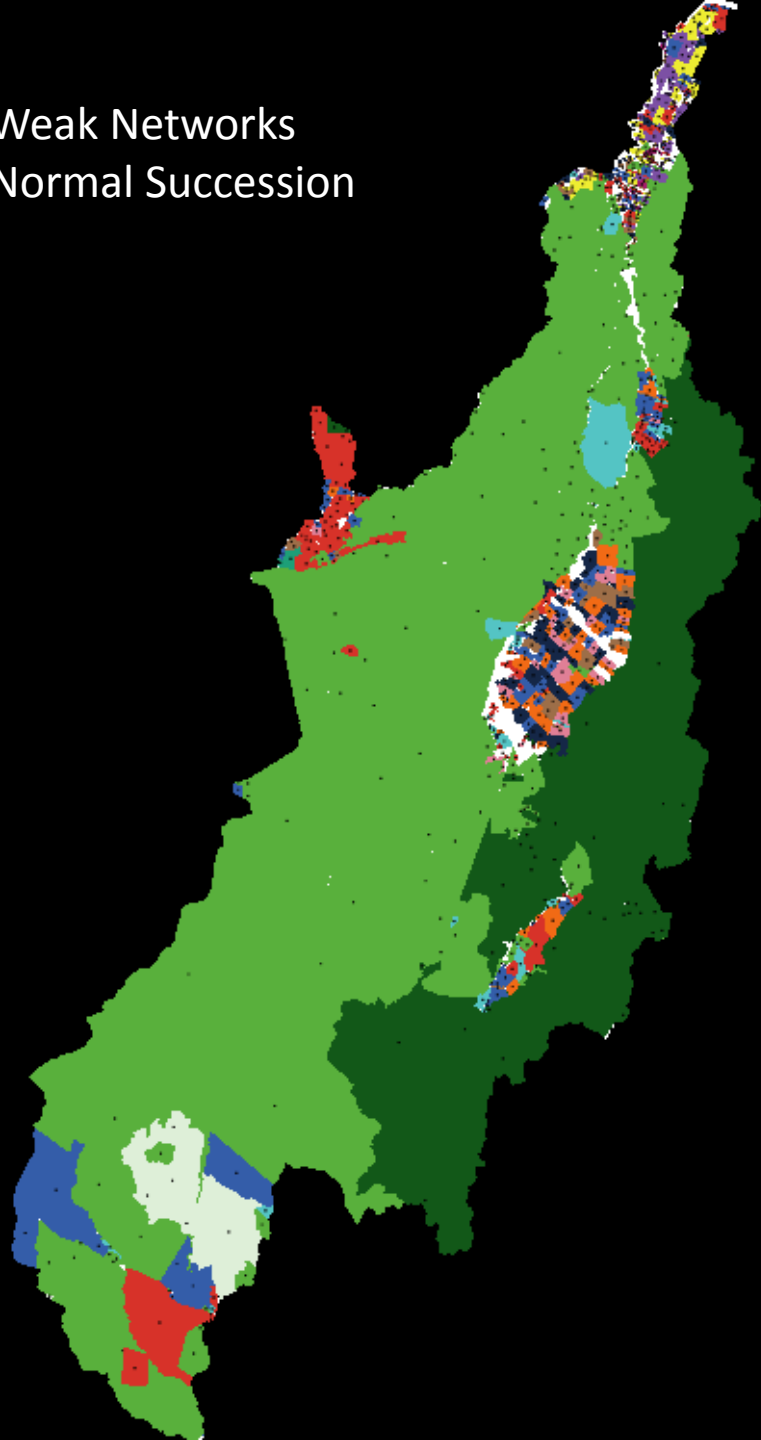


**Social Network**

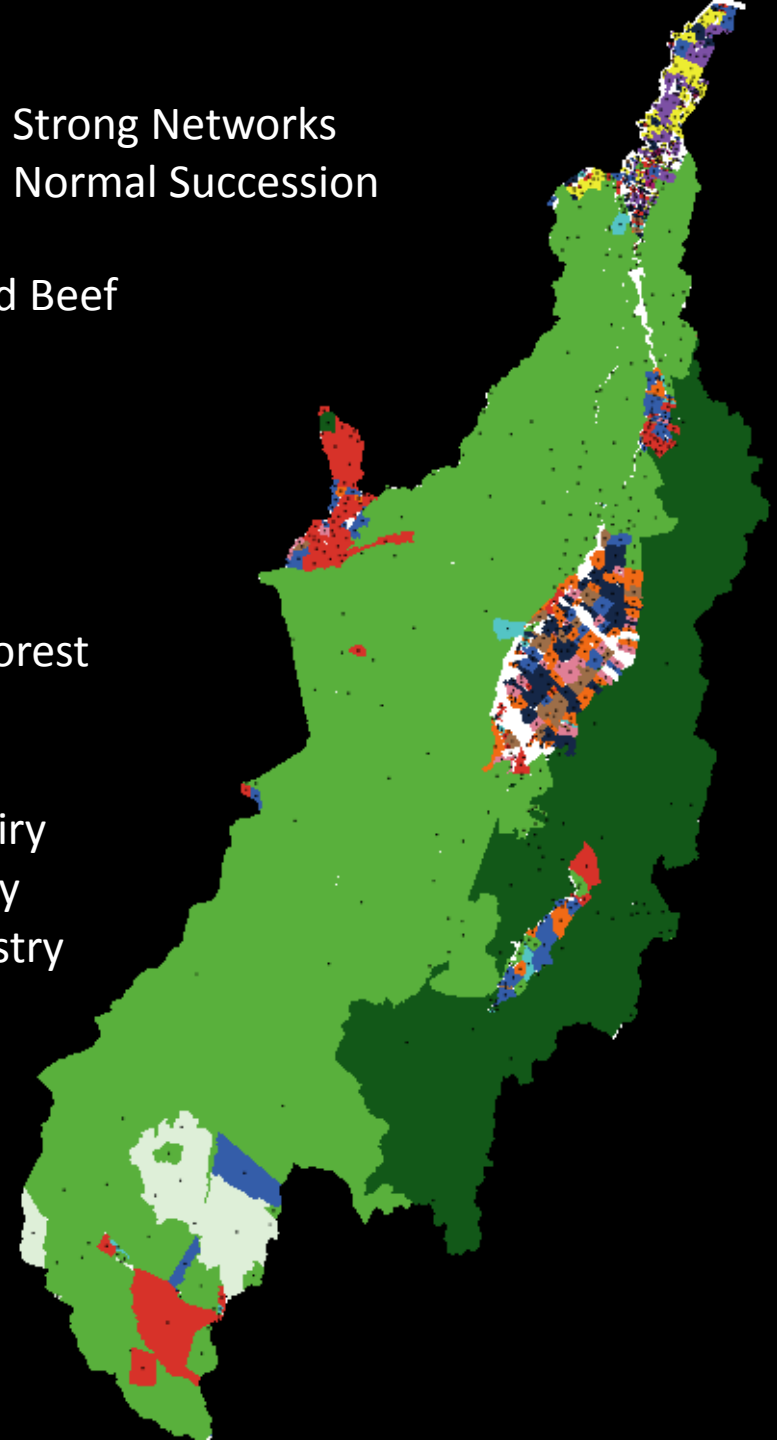


**Geographical Network**

Weak Networks  
Normal Succession

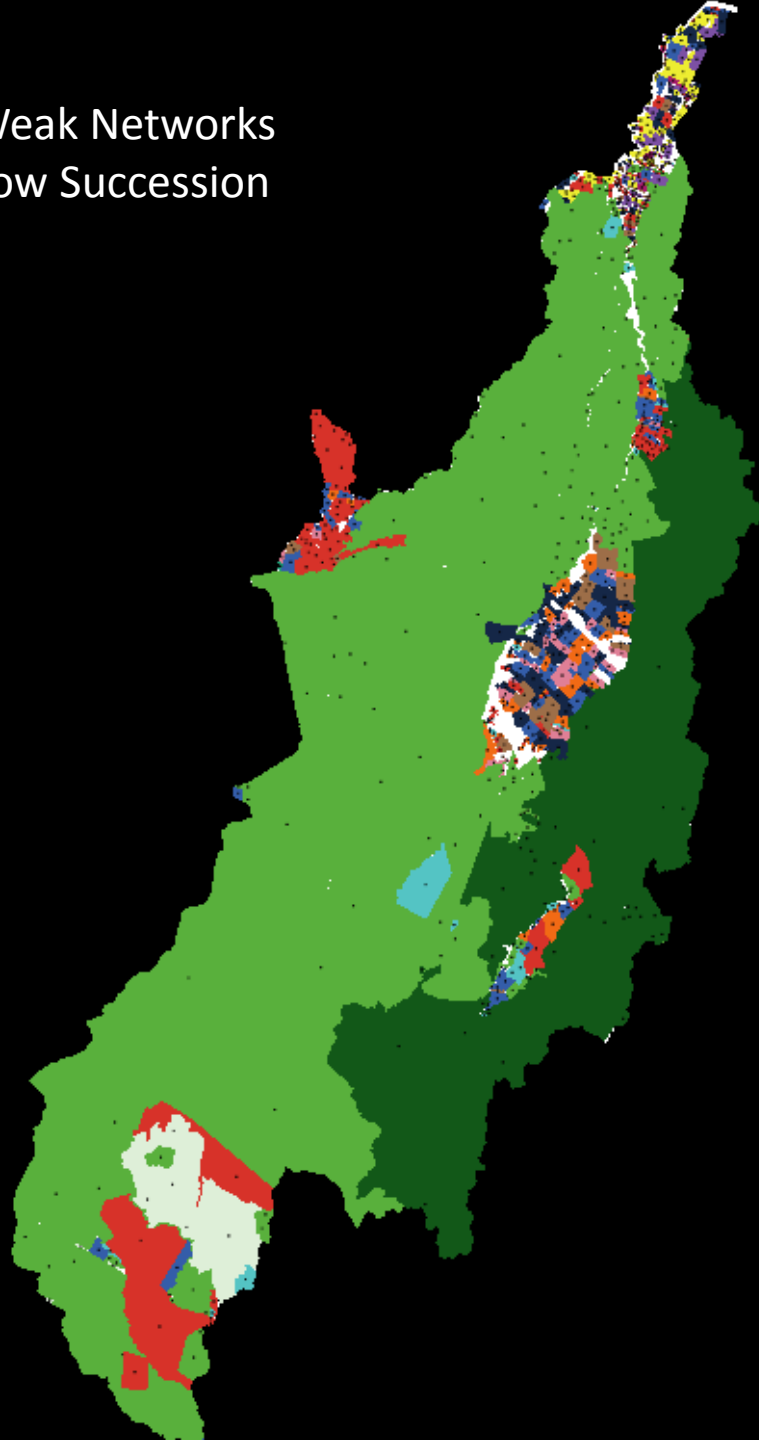


Strong Networks  
Normal Succession

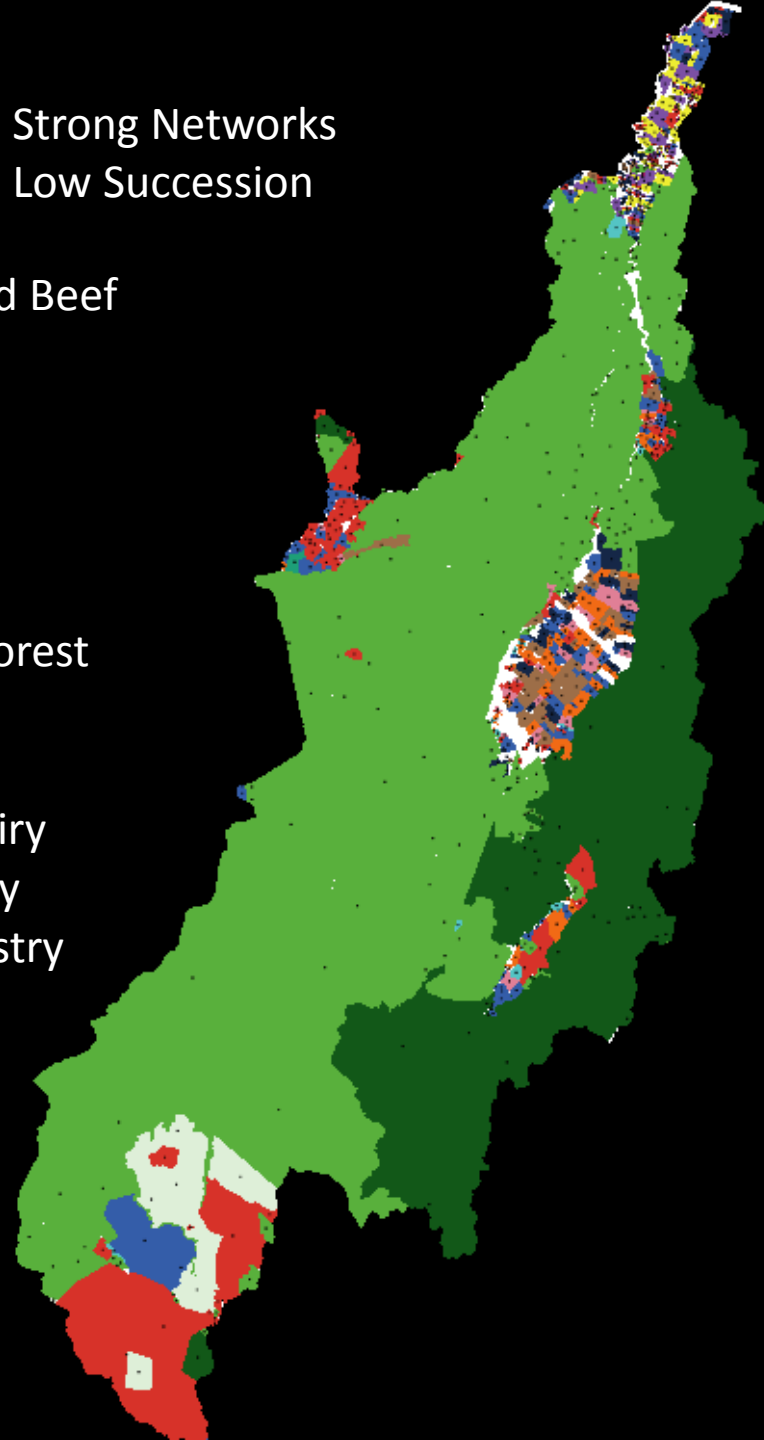




Weak Networks  
Low Succession



Strong Networks  
Low Succession



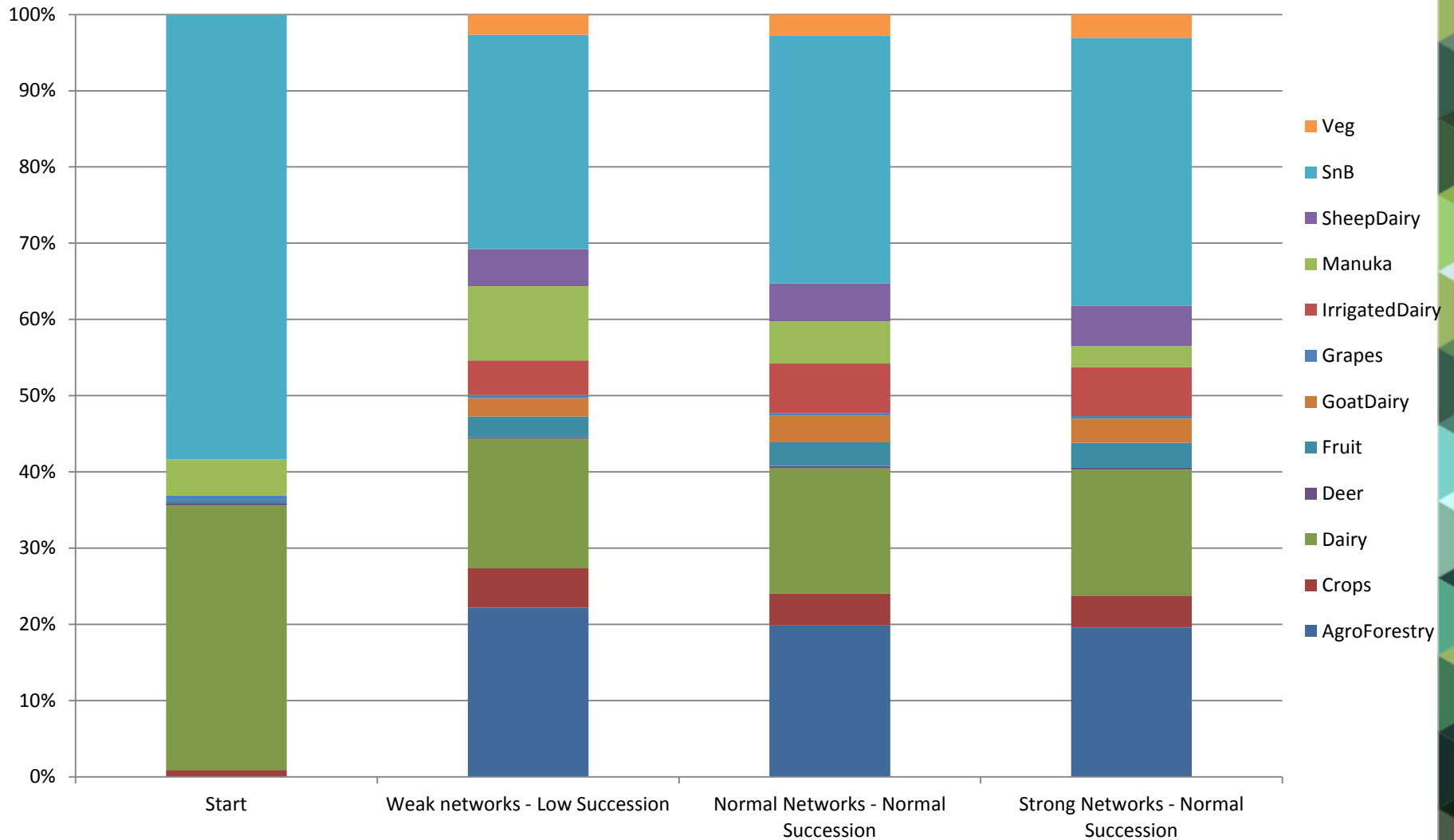
# Summary - % Change vs Current

	<b>Scenario D</b>	<b>Scenario E1</b>	<b>Weak network Low succession</b>	<b>Normal network Normal succession</b>	<b>Strong network Normal succession</b>
<b>Profit</b>	28%	30.5%	14.7%	18.4%	20.9%
<b>Net GHG Emissions</b>	-5.8%	-10.4%	8.5%	8.9%	8.8%
<b>N Leaching</b>	2.7%	7.4%	-0.9%	7.6%	9.8%
<b>P Loss</b>	1.0%	0.9%	-24.7%	-13.3%	-10.1%
<b>Sediment</b>	0.7%	1.2%	-6.1%	-5.9%	-6.1%
<b>E.coli</b>	-13.7%	-13.4%	-29%	-30%	-27%
<b>Labour*</b>	~182%	~186%	~49%	~46%	~51%

\* Related to primary production activities only

# Change in land use

## Excluding Natural Forest and Exotic Forest





# Regulating Services

Scenarios	D	E1	WN, LS	NN,NS	SN, NS
Air quality reg: pollen	↑↑↑↑	↑↑↑↑↑	↓	↓	↓
Climate reg	↓↓↓	↓↓↓	↑	↑	↑
Water reg: flow	↑↑↑↑	↑↑↑↑	↓	↓	↓
Erosion control	—	↓	↑	↑	↑
Water purification & waste treatment	N	↓↓↓	—	↓	↓
	P	—	↑↑	↑	↑
Biological control					
Disease regulation	↑↑	↑↑	↑↑↑	↑↑↑	↑↑↑
Pollination					
Natural hazard reg					

# Cultural Services

Scenarios	D	E1	WN LS	NN NS	SN NS
Recreation & eco-tourism					
Ethical & spiritual values					
Educational & inspirational values					

# Supporting Services

Increase	↑
Decrease	↓
Little/no change	—
No data (estimate)	↑ — ↓

Scenarios	D	E1	WN,LS	NN,NS	SN,NS
Habitat provision: all forest	↓↓↓	↓↓↓↓	↑	—	↓

# Provisioning Services

Scenarios	D	E1	WN,LS	NN,NS	SN,NS
Crops	↑↑↑↑	↑↑↑↑↑	↑↑↑↑	↑↑↑↑	↑↑↑↑
Livestock: Milk	↓↓↓	↓↓↓	↓	↓	↓
Livestock: Meat	↑↑↑	↑↑↑	↓↓	↓↓	↓↓
Capture Fisheries					
Wildfoods: honey	↓	↓	↑↑	↑	↓
Timber & wood	↓↓↓	↓↓↓↓	↑↑	↑↑	↑↑
Fibres & resins	↑↑↑	↑↑↑	↓↓	↓↓	↓↓
Ornamental resources					
Biomass Fuel	↓↓↓	↓↓↓↓	↑↑	↑↑	↑↑
Freshwater					
Genetic resources					
Biochemicals, natural medicines & pharmaceuticals: Rongoa & ginseng	↑ ↑	↑ ↑	↑ ↑↑↑	— ↑↑	↓ ↑↑

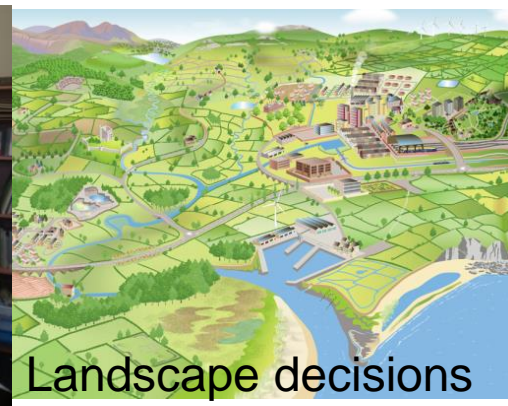
# Opportunities Identified

- Re-configure catchment conversations
- Utilise the enormous forest areas differently
- Grow tourism
- Raise the profile of the catchment
- Develop rongoā products
- Undertake spatial planning for the catchment
- Attract big business and industry to the catchment
- Make this catchment a place to study

# What were the hard bits?

- Availability of knowledge/data/info
- Choice of indicators
- How to include indigenous cultural values
- Language & communication
- Use in decision-making

	Global Climate	Regional and Local Climate	Water Testing and Flows	Erosion Control	Ecosystem service									
					Water Purification	Waste Treatment	Disease Mitigation	Pollination	Recreation	Carbon Sequestration	Soil Formation	Primary Production	Water Cycling	
Indigenous Forest	6	16	16	12	16	0	3	0	16	12	1	16	5	
Scrubland	0	0	1	1	0	0	0	0	0	2	0	0	0	
Exotic Forest	12	12	16	16	16	0	2	0	12	12	1	14	10	
Wetland	2	1	3	3	1	1	0	0	3	0	0	1	1	
Farmland	0	0	0	0	0	0	0	0	0	1	0	0	0	
Scrub and/or														
Matigouri	1	0	1	1	0	0	0	0	3	0	0	0	0	
Sub-alpine Shrubland	0	1	1	0	1	0	0	0	2	0	0	0	0	
Mixed Exotic Shrubland	0	1	0	0	1	0	0	1	1	0	0	1	0	
Grass and/or Brum	1	0	0	0	0	0	1	0	0	1	0	0	1	
Flatland	0	0	0	0	0	0	0	0	1	0	0	0	0	
Grassland, Tall Tussock and/or														
Grassland	1	7	17	1	15	0	0	0	7	16	1	6	0	
Low Prod.	2	1	4	1	3	0	0	0	4	9	1	4	1	
Saltmarsh	17	17	41	12	35	1	5	1	21	53	8	13	10	
Exotic Grassland	4	1	7	4	3	0	0	0	12	2	3	2	2	
Short rotation Crops	0	1	1	0	1	1	2	0	0	0	0	0	0	
Perennial Crops	0	0	0	0	0	0	0	1	0	1	0	0	0	
Urban														
Parkland	0	3	3	1	3	0	3	0	3	1	0	0	0	
Artificial														
Built Up Area (Urban)	0	3	3	1	3	0	3	0	3	1	0	0	0	
Surface Misc	0	0	0	0	0	0	0	0	0	0	0	0	0	



Landscape decisions

# Key messages

- Clear messaging throughout the process
- How indigenous peoples value are recognised
- Usefulness of building up the modelling to tell the story with the group
- A good lunch goes a long way!



# Many Thanks

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		Ecosystem service													
		Global Climate	Regional and Local Climate	Water Timing and Flows	Erosion Control	Water Purification	Waste Treatment	Disease Mitigation	Pollination	Habitat Provision	Nutrient Cycling	Soil Formation	Primary Production	Water Cycling	
Land Cover	Forest	Indigenous Forest	6	16	30	12	30	0	3	0	18	32	1	15	5
		Deciduous Hardwoods	0	0	1	1	0	0	0	0	0	2	0	0	0
		Exotic Forest	12	12	36	18	28	0	2	0	12	49	8	14	10
	Scrub and/or Shrubland	Manuka/Kanuka	2	1	3	3	1	1	0	0	3	8	0	1	1
		Fernland	0	0	0	0	0	0	0	0	0	1	0	0	0
		Matagouri	1	0	1	1	0	0	0	0	0	3	0	0	0
		Sub-alpine Shrubland	0	1	1	0	1	0	0	0	0	2	0	0	0
		Mixed Exotic Shrubland	0	1	0	0	1	0	0	1	1	0	0	1	0
		Gorse and/or Broom	1	0	0	0	0	0	1	0	0	1	0	0	1
	Grassland, sedgeland & saltmarsh	Flaxland	0	0	0	0	0	0	0	0	1	0	0	0	0
		Tall Tussock Grassland	1	7	17	1	15	0	0	0	7	16	1	6	0
		Low Prod. Grassland	2	1	4	1	3	0	0	0	4	9	1	4	1
		High Prod. Exotic Grassland	17	17	41	22	35	1	5	1	21	51	8	13	10
	Cropland	Short-rotation Crops	4	1	7	4	3	0	0	0	0	12	2	3	2
		Perennial Crops	0	1	1	0	1	1	2	0	0	0	0	0	0
Artificial surfaces	Urban Parkland	0	0	0	1	0	0	0	1	0	1	0	0	0	
	Built-Up Area (Settlement)	0	3	3	1	3	0	3	0	3	1	0	0	0	
	Surface Mine & Dump	0	0	0	0	0	0	0	0	0	0	0	0	0	

No. of Studies

	0
	1 - 5
	6 - 10
	11 - 20
	21 - 30
	> 31



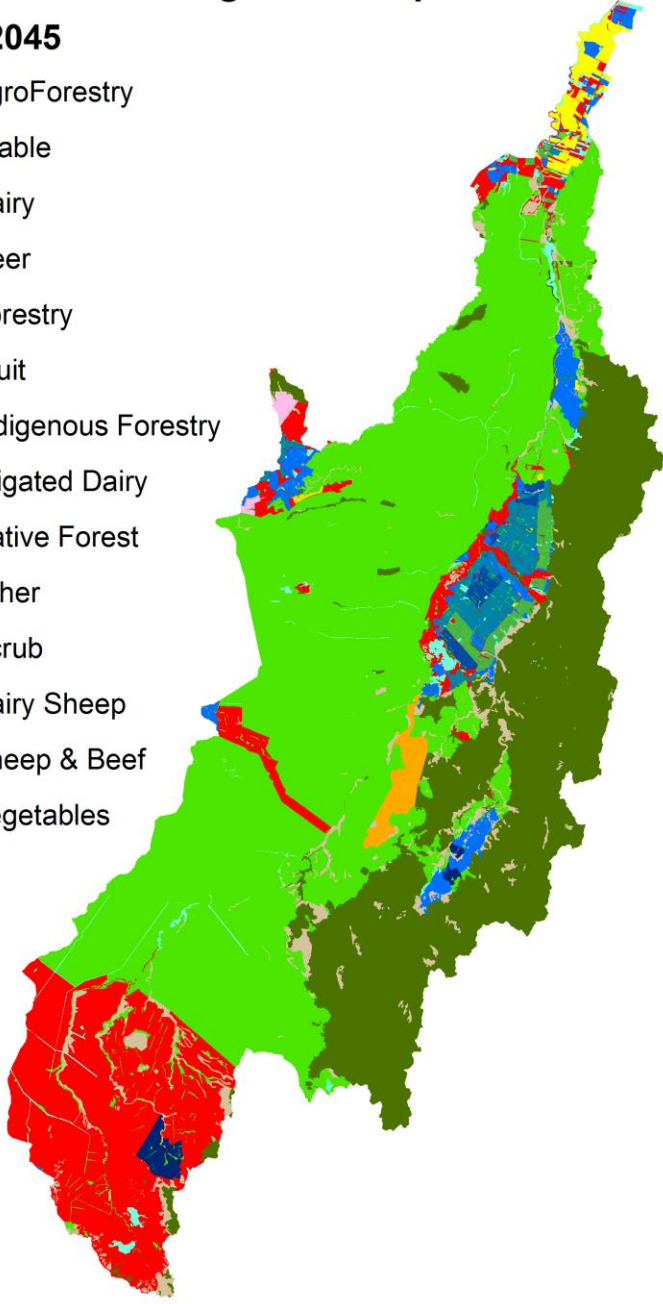
# Pathways for the Rangitāiki

objectives	Potential Ecosystem services Indicators
Tuna are protected	Water quality, N, P and sediments - Little impact
Habitats that support indigenous biodiversity are created protected & enhanced	Area of native vegetation - Depends (only small though)
Water quality restored	Water quality: N, P and sediments - P improves - N likely increases
Prosperity is enabled within limits	Number of jobs & catchment profit - Improves
Relationship between communities is encouraged	Strengthened networks between land owners show a range of benefits which we modelled
Practice of kaitiakitanga is recognised & provided for	Cant be modelled, but can be practiced
Naturalness is respected	Area of native forest vegetation unchanged, but slight increase in native scrub (Manuka)
Access to river is maintained and enhanced	Cant be modelled, but can be practiced

### Scenario D - Full Irrg + Conv Up Catchment

Out to 2045

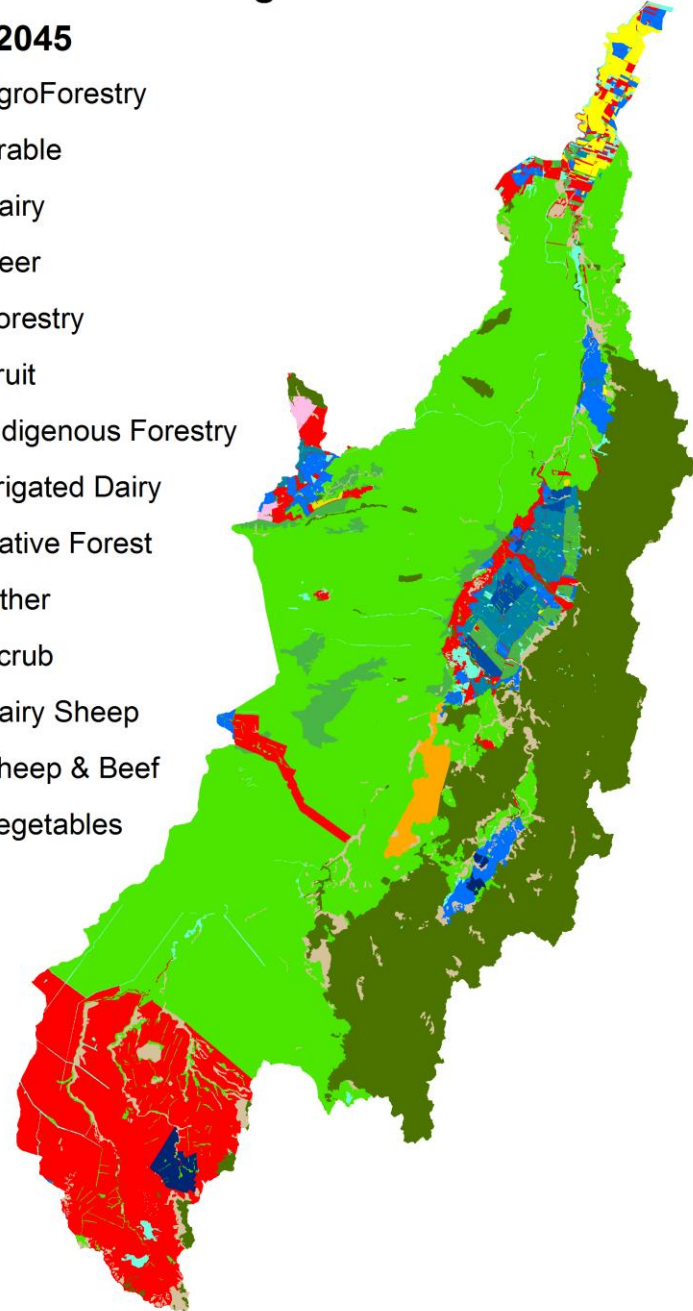
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- Indigenous Forestry
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- Native Forest
- Other
- Scrub
- Dairy Sheep
- Sheep & Beef
- Vegetables



### Scenario E1 - Full Irrg + 5000ha ExFor Convert

Out to 2045

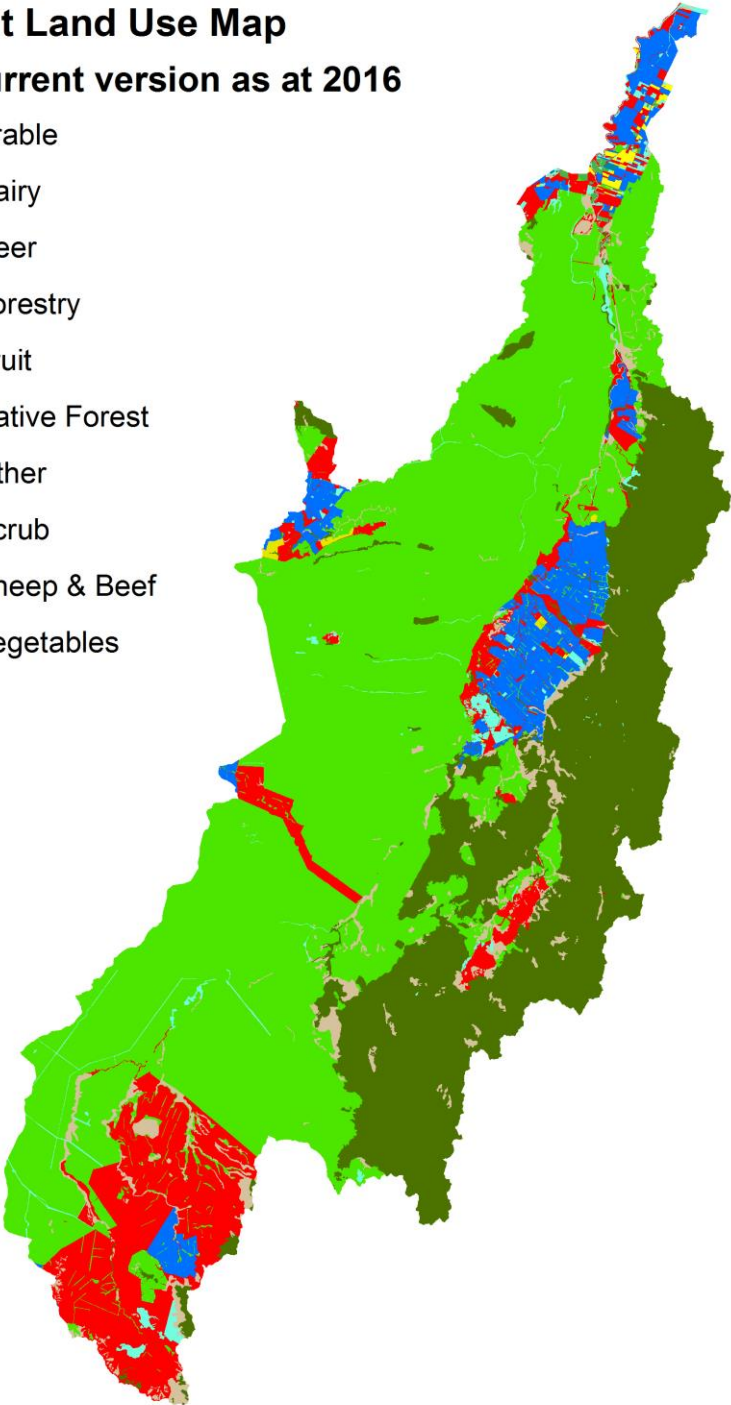
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# Current Land Use Map

Best current version as at 2016

- Arable
- Dairy
- Deer
- Forestry
- Fruit
- Native Forest
- Other
- Scrub
- Sheep & Beef
- Vegetables



# Preferred Scenarios

→ Somewhere between D and E1

- **Scenario D:**

- Galatea is irrigated – mostly fruit/veg & some dairy
- Top of catchment is SNB

- **Scenario E1**

- Galatea is irrigated – mostly fruit/veg & some dairy
- Top of catchment is SNB
- ~5,000 ha of LUC3 land in Kaiangaroa Forest moves into veg (depending on LUC suitability)