



Pohewa Pae Tawhiti (*Visualising Horizons*)

Integrating multiple model frameworks to develop
mitigation and land use change scenarios for
farmers and landowners

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The First 110 years of the Dairy Industry¹



Land Wars 1860

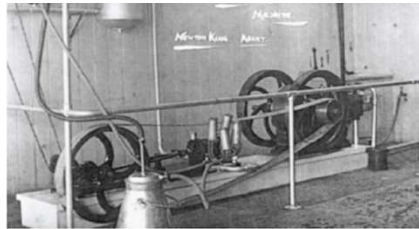
Treaty of Waitangi 1840

Declaration of Independence 1835

First Cooperative, Otago

First ships to Sydney

Introduction of Shorthorns



First milking machines

First milk powder produced

NZ Dairy Board

NZ Agricultural College

NZDRI

Anchor Butter Factory, Waikato



1814

1845

1871

1886

1890

1904

1923

1926

1927

¹ <https://www.dairybarnsystems.co.nz/knowledge-centre/a-timeline-of-dairy-in-nz/>

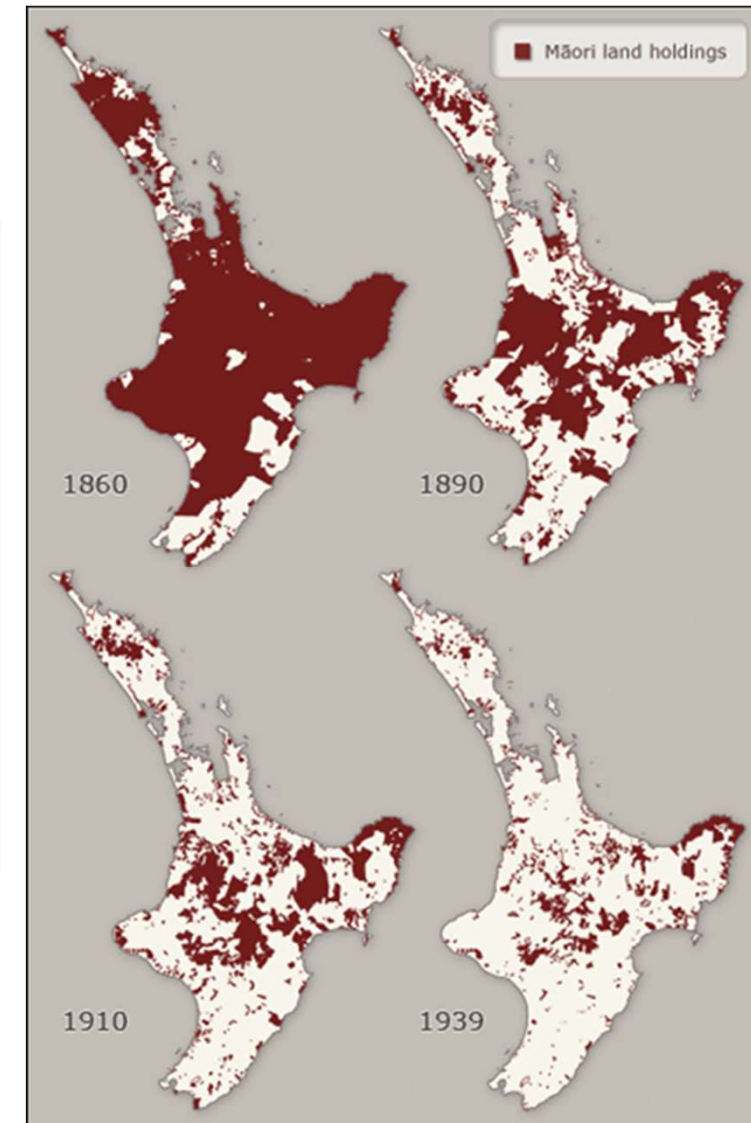
The country's first co-operative dairy factory was established at John Mathieson's 'Springfield' farm on the Otago Peninsula in 1871. The Otago Peninsula Co-operative Cheese Factory Co. Ltd began producing Scottish- style 'Dunlop' cheese in September that year, the first manager being J.L. McGregor.

Deforestation of New Zealand² And the loss of Maori land³



² Deforestation Maps: <https://envirohistorynz.com/2009/11/21/237/> and <https://teara.govt.nz/en/interactive/11674/deforestation-of-new-zealand> see also Paul, T., Kimberley, M.O. & Beets, P.N. Natural forests in New Zealand – a large terrestrial carbon pool in a national state of equilibrium. *For. Ecosyst.* **8**, 34 (2021). <https://doi.org/10.1186/s40663-021-00312-0>

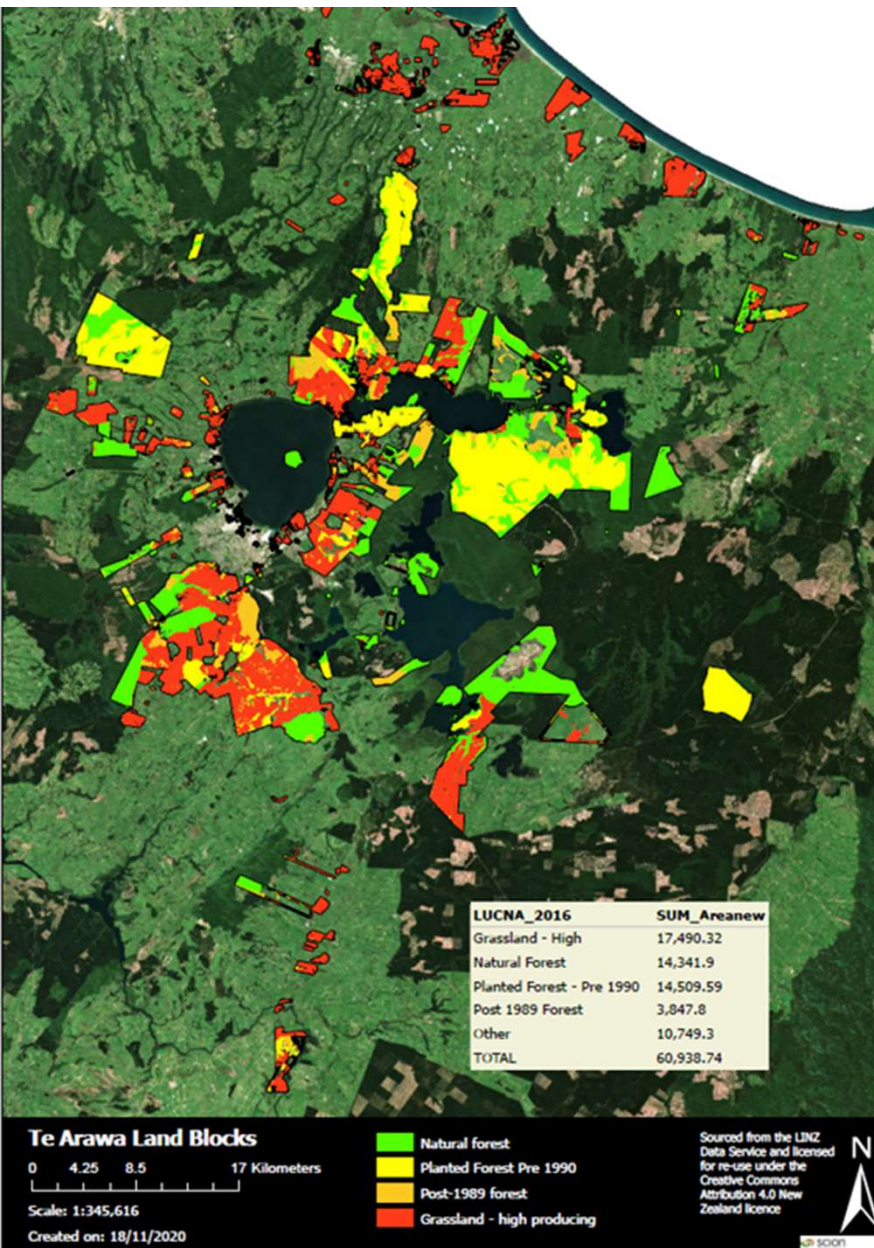
³ Māori land loss, 1860-2000', URL: <https://nzhistory.govt.nz/media/interactive/maori-land-1860-2000> (Ministry for Culture and Heritage), updated 21-Apr-202. The majority of the SI was confiscated between 1840 and 1864



Ownership Structures - large number of small blocks fragmented land titles; a small number of large entities that control the majority of land

Key Facts – Blocks and Area

- 10 blocks are over 1,000 Ha comprising 31,671 (49%) of total land area in Te Arawa
- 47 blocks (2.3%) make up 45,447 Ha (71%) of total land area in Te Arawa
- 1,549 blocks are less than 5 Ha in size



Pohewa Pae Tawhiti (Visualising Horizons)

Guided Process for Decision Making

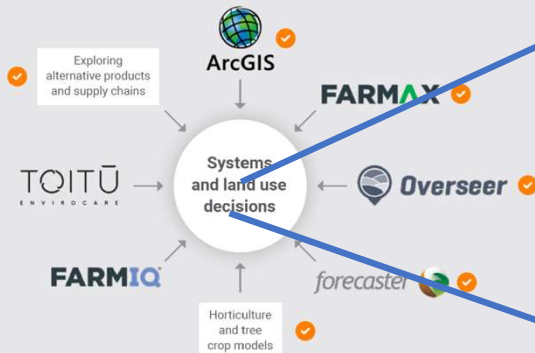
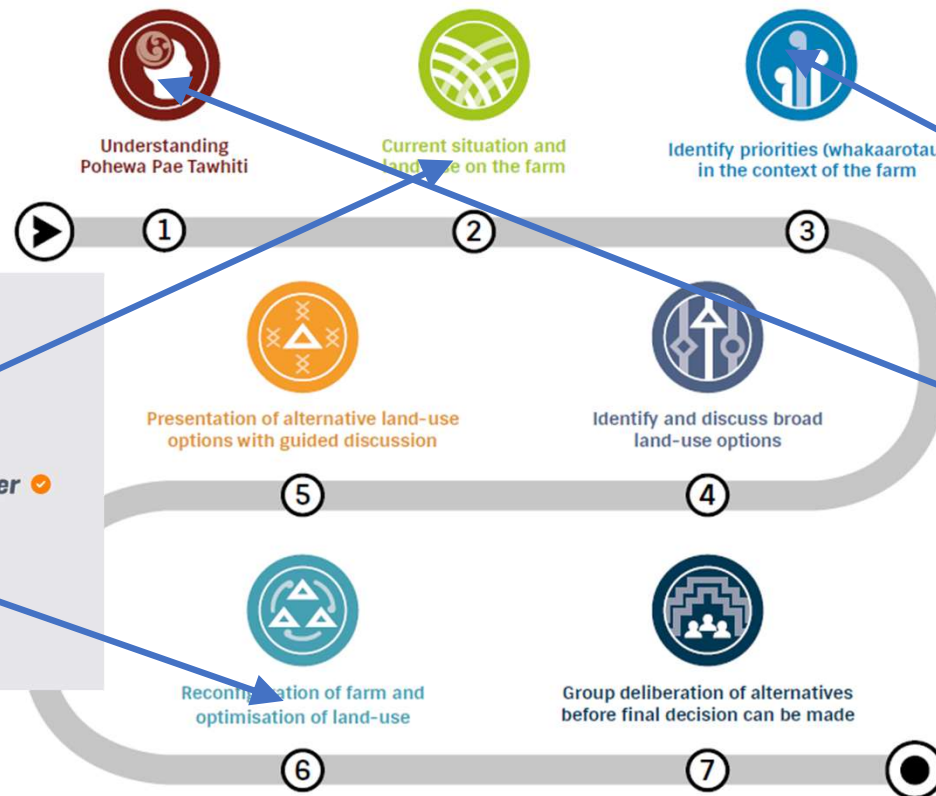
The Pohewa Pae Tawhiti Framework

Takahuri Whenua (The Changing Land)

Matatau Whenua (Knowledge of the Land)

STRUCTURE OF MATATAU WHENUA FRAMEWORK:

PHASE:	STAGE:	GUIDE QUESTIONS:
Setting the Purpose (Te Take) (p8-9)	Purpose - Kaupapa	Decide the purpose for gathering traditional knowledge – <i>Why do we do this?</i>
	Site - Whenua	Decide on the areas of interest for landowners – <i>Which areas are we interested in?</i>
	People - Tangata	People involved in the kaupapa – <i>Who will be involved, and what would they do?</i>
Gathering Knowledge (Kōhi Kōrero) (p10-11)	Approach - Tikanga	A strategy used to gather, process and share the knowledge – <i>How will we do this?</i>
	Knowledge - Kōrero	Types of knowledge and information sources – <i>What and where can we look for knowledge?</i>
	Processing - Whiri	How that knowledge will be processed – <i>What do we do with the knowledge?</i>
Sharing Knowledge (Kōhi Mātauranga) (p12-13)	Plan sharing - Ma wai?	How and to whom will the results be shared with appropriately – <i>Who do we inform?</i>
	Share - Toha atu	Where will the results be shared and followed – <i>Where to next?</i>
	Decide - Whakatau	Making decisions about land-use change <i>How will the results impact on land-use change</i>



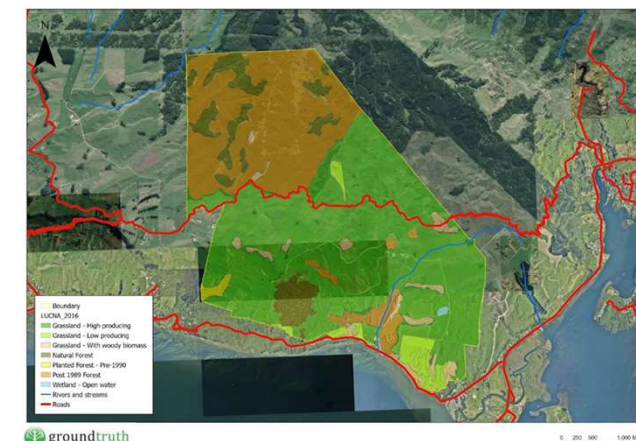


Figure 1: Takahuri Whenua tools and models

Farm System Mitigation Scenarios

	Pastoral Area (ha)	Area planted in Forestry or Horticulture (ha)	Cows Wintered 1 July (head)	Stocking rate (Cows/ha pastoral area)	Milksolids/peak cow (kgMS)	CH ₄ emissions (kg CO ₂ e/ha)	N ₂ O emissions (kg CO ₂ e/ha)	N Fertiliser CO ₂ emissions (kg/ha)	Net CO ₂ e over pastoral area (T/ha)	Total property net CO ₂ e (T/ha)	Total GHG % change from Base	(kg N/ha/yr)	% Change from Base	EBITDA (\$ effective ha/yr)	% change from Base model
Base model	570.5	0	1,094	1.9	307	3,446	915	61	8.5	4.4		29		\$2,241	
Reduce SR 10%, no improvement in productivity	570.5	0	984	1.7	308	3,142	850	61	7.8	4.1	-8%	27	-7%	\$1,831	-18%
Reduce SR 10%, Increase per cow production	570.5	0	984	1.7	372	3,360	887	61	8.3	4.3	-3%	28	-3%	\$2,457	10%
1/2 Nitrogen	570.5	0	1,061	1.9	308	3,375	836	32	8.2	4.2	-4%	27	-7%	\$2,183	-3%
No Bought-in Supplement	570.5	0	962	1.7	308	3,159	901	61	7.9	4.1	-7%	28	-3%	\$2,331	4%
Forestry - plant 56ha in pines	514.5	56	1,050	2.0	308	3,340	882	59	9.1	3.2	-27%	28	-3%	\$2,218	-1%
Forestry - plant 56ha in other exotic softwood	514.5	56	1,050	2.0	308	3,340	882	59	9.1	3.3	-13%	28	-3%	\$2,185	-3%
Forestry - plant 56ha in natives	514.5	56	1,050	2.0	308	3,340	882	59	9.1	3.9	-14%	28	-3%	\$2,101	-6%
Horticulture - 10 ha Chestnuts	560.5	10	1,072	1.9	308	3,378	905	64	8.5	4.3	-2%	29	0%	\$2,282	2%
Arable - 10ha Oats	560.5	10	1,072	1.9	308	3,378	899	61	8.5	4.3	-2%	28	-3%	\$2,128	-5%

S1 – Reduce cows by 10% = GHGs ↓ -9% and profit ↓ -18%

S2 – Reduce cows by 10% + Productivity = GHGs ↓ -3% and profit ↑ +10%

King, T.T. & Journeaux, P. (2024). Takahuri Whenua (The Changing Land): A decision support framework for GHG emissions reductions and land diversification. Journal of NZIPIM, March 2024(23-29).

Guided Process for Decision Making

The Pohewa Pae Tawhiti Framework



Figure 1: Pohewa Pae Tawhiti Framework to assist decision making

	Group Weighting
Tōnuitanga (prosperity)	25.7%
Whakatipuranga (growing generations)	22.9%
Tiakitanga (guardianship)	26.3%
Taituarātanga (support)	25.2%

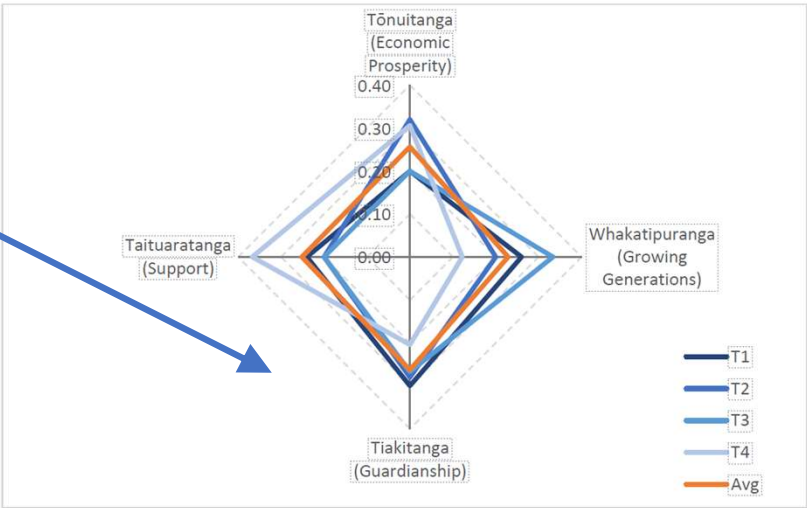
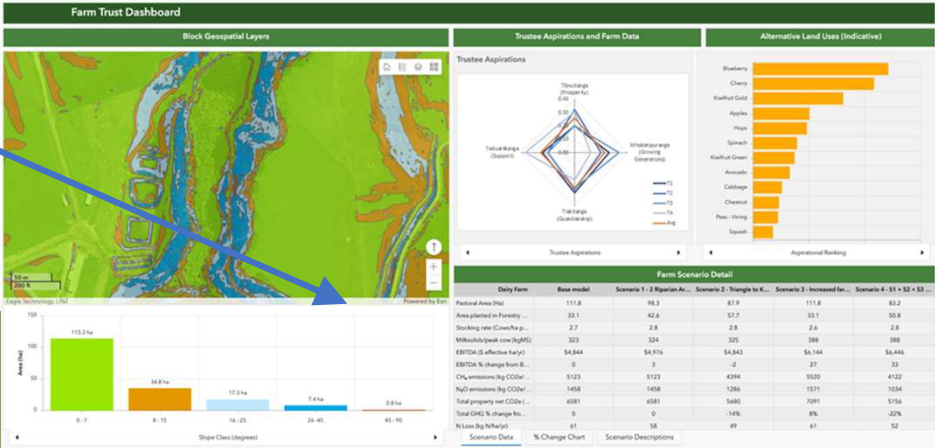


Figure 6: Whakaarotau Choice Model weightings



Where do alternative proteins, precision fermentation, low emission dairy etc. fit?

- Market channel development and in-market partners are critical
- Lack of alternative processing and supply chain infrastructure
- High risks for individual farmers
- Collective approaches are critical to reduce and manage risk

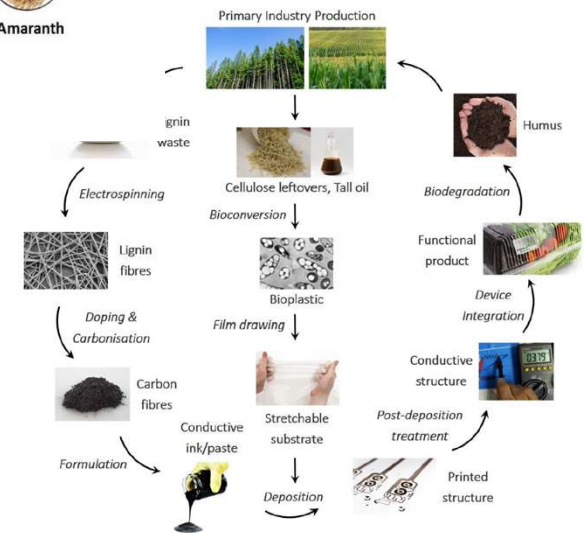
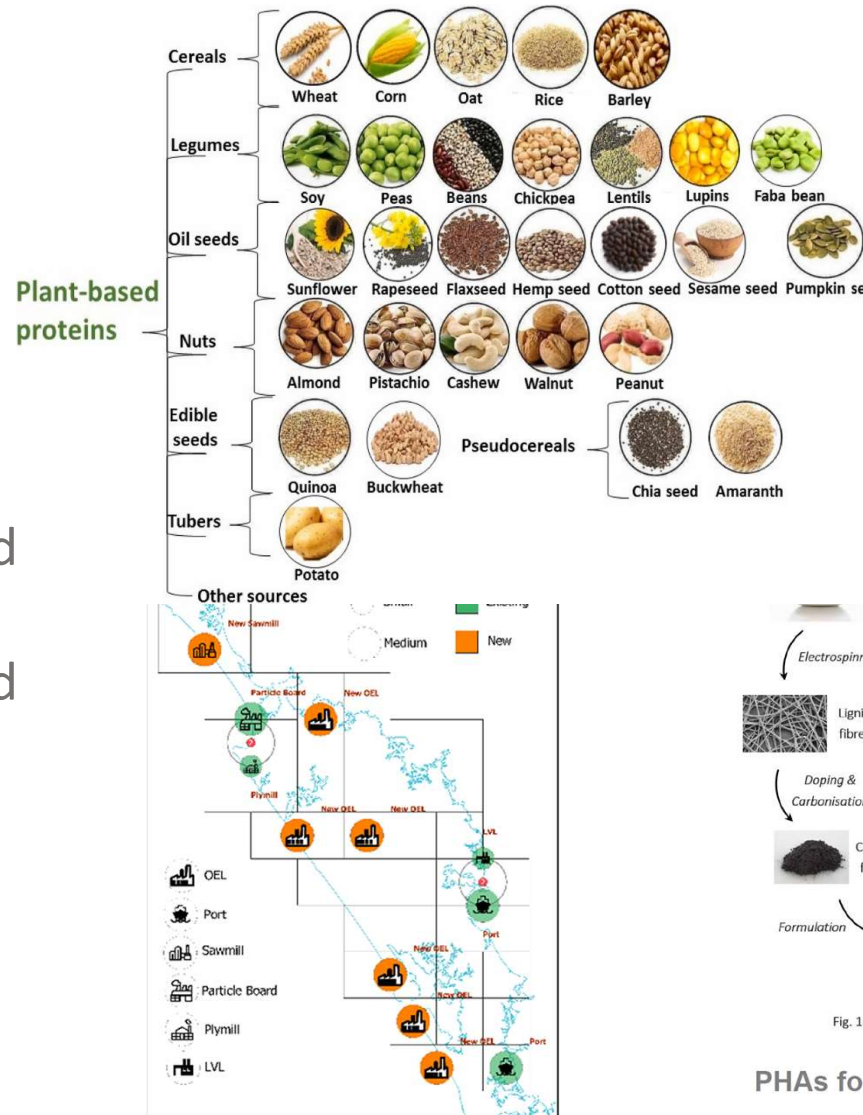


Fig. 1: GPE as an industry contributing to the circular bio-economy

PHAs for Digitalization of packaging

Collective Supply Networks

- Exploring supply network options across collectives and across catchment and district boundaries
- Lowers risk profile for individual farms
- Investment needed - into processing and market infrastructure
- Needs to be farmer/grower driven

