

Local Grain Economy

Pathways to Transition Framework



Figure 1. The current processing mill at Minchins Milling, where a bigger mill is under construction. Image Source: Heidi McLeod

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'Ko au te whenua, ko te whenua, ko au'

'I am the land and the land is me'

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1. Introduction

This Report outlines research that explored opportunities to invigorate local food networks in Aotearoa by looking at examples of value chain disruption where processing has been handed back to farmers and fishers. Typically, these food production processes are the domain of highly commercialised operators or offshore companies who have bought out or upsized small businesses. This has caused diminished agency for Aotearoa's food producers.

The project team has a fundamental belief in transforming Aotearoa's food system to create an economically, environmentally, socially, and culturally just system. In a complementary way, this Report supports the *National Science Challenge's* objective "To enhance the production and productivity of New Zealand's primary sector, while maintaining and improving the quality of the country's land and water for future generations". In addition, the project has aligned with and will continue to advocate for the local food network workstream proposed through the *Mana Kai Initiative*¹ and *Eat New Zealand's* work on a Local Grain Economy in collaboration with the *Foundation for Arable Research*.

Increasing food security for New Zealanders is paramount and requires the creation of a resilient food system. Reimagining local food systems and creating agency for small-scale food processors is a vital component, as is facilitating diverse supply and production chains. This creates resilience in Aotearoa's food system. Food security in Aotearoa is delivered through a network of supply chains, both domestic and international, but while Aotearoa has enviable levels of food production, most are exported. In contrast, Aotearoa imports goods that are no longer significantly produced or processed here. This has made people reliant on supply chains originating from overseas and represents an element of risk and a lack of food security. However, this gap provides an opportunity to reinvigorate local food value chains. Producers and processors operating at this scale are often well-placed or invested in regenerative or sustainable farming practices, providing additional benefits.

Aotearoa's imports are dominated by grains, enough to feed 9 million people six servings a day yearly (Rush & Obolonkin, 2020). In Aotearoa, there is the land and industry support to grow much more arable food, but, as is the case in many sectors, power and control sit in the processing part of the value chain. Additionally, in relation to grain, the mills have little or no incentive to ensure flour is grown within New Zealand. Consequently, arable farmers are in price competition with much bigger global players.

Eat New Zealand is committed to recognising and supporting connections with Māori and is currently working in collaboration with Ngāi Tahu on 'Feast Matariki', a national event that seeks to build the capability of Māori food producers, mahika kai experts and storytellers such as growers, harvesters, and chefs.

Eat New Zealand will continue to work in this space and encourage participation in a Local Grain Economy that creates opportunities and valuable outcomes for mana whenua.

This Report and research give effect to the *National Science Challenge's* strategic objectives by creating different value chains, distributing more value from farmers to eaters, and encouraging mixed farm systems that include a mosaic of land use. The research project has focused on what is required to enable arable farmers to develop processing initiatives to grow and support a local grain

¹ Information about this initiative can be found here: <https://www.theaotearoacircle.nz/mana-kai-initiative> (*Mana Kai Initiative*, n.d.)

economy and to improve equity in local food value chains. All the growers, harvesters, processors, and bakers we talked with were holistic and regenerative/organic/biodynamic in their approach. This was not by design but rather a reflection of how small-scale operators run their businesses, creating environmental, social, cultural and economic wellbeing.

The Research team believe we have contributed to the *National Science Challenge's* Mission and Objectives through two key strategic areas:

Future Landscapes

In the future, landscapes contain mosaics of land use that are more resilient, healthy, and prosperous than today. At a time of global food disruption and challenges, the weakness of many food supply chains has been exposed.

Strategic Area 1: Be able to see what diversity possible and match land use is to what it is suitable for.

Capacity for Transition

The Subcontractor understands what it will take and have the tools to help transition to resilient, healthy, and prosperous futures.

Strategic Area 9: Manage pressures and remove the barriers to a transition

The Project team will focus on what enables arable farmers to transition to new processing initiatives, specifically grain mills, to support a local grain economy. This will involve looking at how farmers in the case studies have brought about change and overcome barriers to enable successful and effective initiatives that contribute to local value chains.

2. Executive Summary

Aotearoa has the capacity to supply much more milling wheat to New Zealand eaters, but growing a local grain economy requires fundamental investment or support of infrastructure at the small to medium scale. On-farm mills are an example of supply chain disruption, handing agency back to farmers, allowing them to be price setters rather than price takers. This means they can solve issues around food security in Aotearoa and expand options for land use. This market behaviour is mirrored by businesses using micro-abattoirs (meat), on-farm pasteurisation (milk), and community fishing hubs (fish). Collectively they imagine thriving local food systems beyond just fruit and vegetables. This work extrapolates those ideas to model potential local food systems for Aotearoa, which consider food waste and local procurement. The outreach of this research will be used to connect with arable stakeholders and invite the participation of Māori to regain agency and reassert their sovereignty over their kai.

Why is growing Aotearoa's local grain economy critical?

Aotearoa's food imports are dominated by grains², meaning we currently have insufficient production locally to feed us, using healthy food guidelines. Our food supply chains are vulnerable to interruption. Examples include those seen throughout Covid and climate-related catastrophes in countries we import from, such as droughts, floods and fires. There are also geo-political events, such as the war in Ukraine (the world's largest grain exporter in 2002/2023)³. New Zealand has the land and inclination of farmers and bakers to grow much more of our own arable food. However, our processing mills have little incentive to request that grains are New Zealand grown, leaving our farmers in price competition with bigger global companies and market patterns. By creating a thriving local grain system, we can give farmers the opportunity to be price setters, not price takers. This will increase diverse land use choices, especially in Canterbury, as income per hectare will be more comparable with other farming systems, such as dairy. We do not need to grow grains just as animal feed but also for high-quality human food. We can connect eaters directly with one of the essential parts of our daily plate, making grains much more visible, in terms of provenance, than they currently are.

What is required to enable arable farmers to develop on-farm processing mills to support local food security?

Cleaning and milling capacity is required strategically throughout New Zealand. Most grain is currently grown in the South Island but required in the North (based on population and bakery demand). Infrastructure is required in both islands to ensure food security. Whether this is on-farm or in-bakery is not significant - it comes down to who has the space and resources to instil and manage the processing of grains. It is important that there is a bioregional view of the number of on-farm mills to ensure that farmers can work collectively rather than in competition, ensuring viability.

How have the people we have talked to overcome barriers to enable success?

² Rush & Obolonkin, 2020.

³ Based on Ukraine wheat exports by country - Statista, 2023.

They have disrupted, transitioned, or augmented the supply chain by directly connecting with customers. In doing so, they have created initiatives that deliver multiple positive externalities. These include the regeneration of soils, enhancement of ecosystems, increased connection and well-being for producers and eaters, and creating space for more cultural tino rangatiratanga and tikanga Māori.

What significant improvements in arable farming systems can we recommend?

Improve support for people who are pioneering and investing their own time and resources in trying to do more for New Zealand eaters and producers. Ensure that funding decisions, investment decisions, regulations, policies and strategies are inclusive of these smaller-scale operators working differently from the mainstream in the marketplace. There is space for both to exist. We recommend investment into mills and support services such as seed cleaning, logistics, and grain transportation reviews.

How will what we learned support the invigoration of local food networks in Aotearoa?

If acted upon, the support of food system pioneers in the arable sector (and beyond) would significantly contribute to our local and national food system. It would do this by broadening the marketplace and encouraging more food producers into the supply chain, creating diversity and resilience. Successful entrepreneurship will be seen as inspirational, and these producers are delivering the best of what Aotearoa can offer. They provide foods that are produced sustainably, unrestricted from large-scale commercial imperatives of economies of scale or international trade edicts. This increase in the availability of nutrient-dense foods to local eaters, and in many cases, improve access to affordable food. However, this is a balancing act between the negative externality costs of food produced in the predominant mainstream food supply chains. Growing the domestic market is an obligation and a readily achievable benchmark that supports food security and resilience against food system interruption. It does not detract from New Zealand's export-focused commitments, allowing New Zealand food producers to enhance domestic and international agrifood production. Innovative, connected, resilient farmers in New Zealand contribute to our global narrative as a world-leading food producer.

How do on-farm or on-site mills support a local grain economy?

Increasing the small-scale processing of arable crops creates more opportunities for differentiated arable products for bakers and retailers looking for more specialised products for their businesses. This, in turn, provides more scope for differentiated arable or agricultural food production, increasing our food diversity, resilience and security all at once. Achieving this helps to transition Aotearoa's food system to one that is economically, environmentally, socially, and culturally just. In doing so, it would deliver on the FAO's objectives of "Recognising Agency and Sustainability as Key Aspects of Food Security". Our Food System Pioneers are better placed to deliver this than our mainstream food system organisations. These objectives enable OLW to pursue its National Science Challenge objective "To enhance the production and productivity of New Zealand's primary sector while maintaining and improving the quality of the country's land and water for future generations". Adopting these recommendations would reinforce the "elevating food networks" workstream proposed through the *Mana Kai* initiative and *Fit for A Better World's* draft vision for "thriving local food systems. It also contributes to *Eat New Zealand's* work on a Local Grain Economy and the *Foundation of Arable Research's* goal to increase milling wheat production.

While there is not much evidence of Māori working within arable food systems, there has been historical evidence of their involvement. However, iwi and hapū have been enquiring with the *Foundation for Arable Research* about possible involvement in local grain systems to increase their food security and food sovereignty. Feedback through one of our interviews highlighted te ao Māori perspectives of kai and the increased agency or sovereignty Māori can bring back to their iwi or hapū, particularly by being involved in producing, processing, and distributing arable crops.

This research project has reinforced the view of *Eat New Zealand* and the *Foundation for Arable Research* that one of the keys to unlocking a local grain economy is removing barriers and enabling producers to take back responsibility for small-scale processing. This ensures they retain a role and share in the value chain while also growing the overall local grain economy, creating jobs and opportunities for local people and communities.



Figure 2. Wheat grain sample. Image Source: Heidi McLeod

How will this research improve the OLW's and NSC's objectives of creating different value chains?

The research project findings support the *National Science Challenge's* strategic objectives of creating different value chains by broadening the marketplace for agrifood producers of different scales and kaupapa. They distribute more value to farmers. Given the nature of arable crops, it is possible for farmers to utilise mixed farming systems that include a mosaic of land use. Bakers and farmers have told us that millers are not always providing good information to them, which means

they do not have good business information to base their decision-making on. Relationships and trust are variable along the supply chain. Increased transparency and closer relationships between farmers, processors, and eaters will provide clear direction to help farmers and growers transition to land use & management practices that better align with what customers are increasingly expecting with regard to environmental, social, and cultural outcomes. These Food System Pioneers are forging a pathway to a different relationship between farmer/fisher and eater. By doing so, customers' expectations for this type of relationship and transparency change.

Arable Industry in New Zealand

This section draws substantially from information available from *Federated Farmers* and the *Foundation for Arable Research*. Before deregulation, Aotearoa was self-sufficient in milling wheat (NZFMA). The Literature Review also outlines a long history of arable crop production and processing in New Zealand prior to the consolidation of mills.

New Zealand's arable farming is a diverse and resilient farming system where crop production is frequently combined with livestock. It has a low environmental footprint that contributes less than 1% of New Zealand's greenhouse gas emissions. Most arable farms are family-run, and many have been in the same family for generations.

Approximately 2,800 arable growers in Aotearoa are growing crops on 180,000 hectares of land. Irrigation is used on about 75,000 hectares. Most arable production is based in the Canterbury region, although significant production happens in Southland, the Wairarapa, Manawatu/Wanganui, Hawke's Bay, Gisborne, and Waikato. Generally, New Zealand produces 1,000,000 tonnes of grains each year. In terms of production for human consumption, grains and wheat are processed into the key products of flour, bread, pasta, baked goods, beer, seeds, oils, plant-based milk, plant protein, and animal feed.

Our small to medium food producers, such as many arable crop farmers, exist in an incredibly difficult environment. Covid disruption and lockdowns have taken their toll on hospitality and independent retailers, two of the biggest customers of arable crop businesses. Input costs have increased, and eaters find it increasingly difficult to justify paying a higher price for food as the cost of living/inflation increases. Transport and logistic woes in Aotearoa are also the bane of food businesses that sell online and rely on transportation⁴.

Retailers and manufacturers seek to maximise profits, impacting how much farmers and producers pay. Our supermarket system has reduced the diversity of offerings and increased 'homebrands', and the operating environment can be hostile for a smaller food brand.

The duopoly favours maximum profit for minimum effort. They want the cheapest products with the highest margin from as few suppliers as possible. They want suppliers who will work to their promotion calendar, stock their shelves, pay for shelf space and advertising and provide consistent, basic homogeneous products. Anonymous small food producer, Aotearoa.

Most of our small food producers are motivated by outcomes beyond just economic ones. Their innovation, entrepreneurship and diversity of offering are what allows us to tell a unique food story and practice connection and self-determination. It also contributes to increased food security through localising food production and less exposure to food supply disruptions. The level of

⁴ This article explains the problem well: <https://www.stuff.co.nz/business/farming/132275500/truck-driver-shortage-may-affect-fresh-produce-deliveries-especially-in-rural-areas>

transparency with small food producers often means they strive for better environmental outcomes and are closely connected to their customers' social and cultural needs.

We must imagine and enable access to new markets and customers for our small food producers beyond supermarkets. The most profound way to support these producers' endeavours is to help local food system transformation.

Aotearoa is well placed to provide a local grain economy in addition to its current production capacity:

Here in New Zealand, we are incredibly fortunate to have access to excellent soil and water. This gives New Zealand an advantage in global markets. We are smaller than many other grain-growing countries and can grow and change production relatively quickly. FAR website, 2023.

Today's cereal sector is mostly wheat and barley, maize, and oats. The latest *Arable Industry Marketing Initiative (AIMI)* survey reported the estimated size of the 2021 harvest of the six key cereal crops as of October 2022:

- Milling wheat: Total tonnage of 65,700 tonnes was down 36.6% compared to last year's harvest of 103,700 tonnes
- Feed wheat: Total tonnage of 333,000 tonnes was up 4.4% compared to 319,100 tonnes
- Feed barley: Total tonnage of 305,300 tonnes was up 15.5% compared to 264,200 tonnes
- Malting barley: Total tonnage of 38,500 tonnes was down by 36.7% compared to 60,800 tonnes
- Milling oats: Total tonnage of 14,400 tonnes was up by 8.7% compared to 13,300 tonnes
- Feed oats: Total tonnage of 10,000 tonnes was down by 13% compared to 11,500 tonnes

The total crop harvest tonnage in 2022 of 767,000 tonnes, and the total area under crop in 2022 was 94,800ha (*Arable Industry Marketing Initiative (AIMI)*, n.d.). New Zealand cereal and grain exports are now minimal (~ 3.6 kt), and approximately 22% of cereals produced domestically are used directly in food products, with the remaining 87% used for livestock feed (Soliman & Greenhalgh, 2020)

The table below provides an overview of production across the major cereal crops for the last year. It illustrates the ratios between milling (for human consumption) and feed cereals (for animal and poultry feed).

Table 1. Estimated NZ national figures for the 2022 harvest, plus sold and delivered tonnages, for six cereal crops as at October 10, 2022.

	Units	Milling wheat	Feed wheat	Malting barley	Feed barley	Milling oats	Feed oats	Total (all crops)
Number of farmers in the survey who harvested this crop in 2022	Units	41	88	21	101	12	23	128
2021 harvest								
Estimated NZ total hectares, 2021 harvest	ha	11,798	31,702	7,643	36,557	1,966	2,157	91,823
Estimated NZ total tonnes, 2021 harvest	tonnes	103,680	319,120	60,835	264,265	13,293	11,512	772,705
2022 harvest								
Estimated NZ total hectares, 2022 harvest	ha	7,694	33,950	5,618	43,418	2,429	1,747	94,857
Estimated NZ total tonnes, 2022 harvest	tonnes	65,752	333,028	38,512	305,270	14,455	10,017	767,034
Sold under pre-harvest contract and delivered by 10 October, 2022	tonnes	28,686	120,665	27,383	143,551	7,595	4,261	332,141
Pre-harvest contract grain stored on farm on 10 October, 2022	tonnes	7,836	67,008	1,797	34,122	3,832	2,636	117,231
Sold at spot/free price and delivered by 10 October, 2022	tonnes	14,747	91,858	1,159	83,248	484	1,550	193,045
Sold at spot/free price and stored on farm on 10 October, 2022	tonnes	5,475	35,013	0	17,420	981	255	59,144
(For milling or malting only) Sold for feed by 10 October, 2022	tonnes	7,086	-	1,718	-	0	-	8,805
(For feed only) Used on own farm by 10 October, 2022	tonnes	-	3,597	-	5,758	-	218	9,573
Unsold stocks on hand (2022 harvest only) on 10 October, 2022	tonnes	1,922	14,888	6,456	21,172	1,563	1,097	47,097
Sales channels (2022 harvest)								
Sold on pre-harvest contract (total) by 10 October, 2022	tonnes	36,521	187,673	29,180	177,673	11,427	6,897	449,371
Sold at spot/free price (total) by 10 October, 2022	tonnes	20,222	126,871	1,159	100,668	1,465	1,805	252,189
On farm storage (2022 harvest)								
Sold and delivered (total) by 10 October, 2022	tonnes	43,432	212,523	28,541	226,799	8,079	5,811	525,185
Sold and stored on farm (total) on 10 October, 2022	tonnes	13,311	102,020	1,797	51,542	4,813	2,892	176,374
Total sales (2022 harvest)								
Sold (grand total) by 10 October, 2022 (includes sold for feed & used on farm)	tonnes	63,830	318,140	32,057	284,098	12,892	8,920	719,937
Unsold stocks on hand (2022 harvest only) on 10 October, 2022	tonnes	1,922	14,888	6,456	21,172	1,563	1,097	47,097
Comparison of hectares and tonnes between last two harvests								
Estimated % change in hectares, 2021 to 2022 harvest	%	-35%	7%	-26%	19%	24%	-19%	3%
Estimated % change in tonnes, 2021 to 2022 harvest	%	-37%	4%	-37%	16%	9%	-13%	-1%
Comparison of yields (t/ha) between last two harvests								
NZ-wide estimated yield, 2021 harvest	t/ha	8.8	10.1	8.0	7.2	6.8	5.3	8.4
NZ-wide estimated yield, 2022 harvest	t/ha	8.5	9.8	6.9	7.0	6.0	5.7	8.1

Figure 3. AIMI Cereals Report to 10 October 2022 Image Source: FAR

FAR explains that for New Zealand's arable industry to improve, growers must produce high-specification products with specific end users in mind. FAR points out on its website that arable production plays a pivotal role in the meat, dairy and horticultural industries, which it says is a fact that is often disregarded. However, it needs to identify the role milling wheat, cereals and grains for human consumption could play in reducing reliance on overseas imports. This would increase food security in New Zealand and stimulate innovation and investment in human food products.

Currently, the loaves of bread we buy from the supermarket shelf, particularly in the North Island, are made from Australian flour. We have identified marketing claims of New Zealand ingredients in bread, but in reality, this is just a sprinkling of seeds or grains on top, which have been grown and processed here in Aotearoa.

A 2022 research report by the *Foundation for Arable Research* and AERU on New Zealander's willingness to pay for bread flour to be grown in Aotearoa noted that there is no country of origin labelling on bread loaves and an absence of market signals which makes it difficult to measure consumer values for New Zealand grown grain. Despite this, results indicate that many New Zealanders have significant positive preferences for New Zealand-grown grain as a source of flour ingredient in bread loaves. This trend has strengthened since the 2019 survey with NZ organic flour and water quality protection now significant factors. The results found that:

Group One is the largest, with a membership probability of 54%. The average member of this group is willing-to-pay \$0.56 more for a bread loaf that is made with New Zealand origin flour over one that is not. These members are also interested in Organic production, environmental management claims and Added Health Claims.

Group Three, with a 35% membership probability, has members on average willing-to-pay \$0.55 more for a bread loaf that is made with New Zealand origin flour over one that is not. They are also willing-to-pay for NZ Biodiversity Enhancement (\$0.39) and Added Health Claims (\$0.28).

Group Two is the smallest of the three with a membership probability of 11%. The average member of this group is willing-to-pay \$0.14 more for a bread loaf that is made with New Zealand origin flour over one that is not (Tait et al., 2022, p. viii).

Import and Export of Arables

Federated Farmers report that annual sales of arable products within New Zealand are approximately \$940 million, delivering a 43% increase over the last four years. In addition, the annual direct and indirect spending associated with the industry is \$2.5 billion. Each year Aotearoa exports approximately 45,000 tonnes of arable goods valued at \$290 million, as a key component in New Zealand's pastoral farming sector, worth more than \$29b in annual exports.

Arable Organisations

Many organisations represent the New Zealand arable, milling and baking sectors:

Foundation for Arable Research (FAR)

The Foundation is an applied research organisation responsible for New Zealand arable growers. FAR funds or contributes funding to research programmes, often in collaboration with government-funded organisations or universities for arable, maize research and technology transfer. It also produces sector data about the size of the harvest, sales channels, carry-over stocks, and sowing intentions for the upcoming season.

Plant and Food Research

Plant & Food Research is a New Zealand-based science company providing research and development that adds value to fruit, vegetable, crop and food products.

United Wheatgrowers NZ

A committee of wheat growers aligned with Federated Farmers of New Zealand. It administers a disaster relief insurance scheme funded through a compulsory levy on all grain sold. It also informs wheat growers about available grain contracts.

The New Zealand Grain and Seed Trade Association

The association promotes the development of new varieties, assists with the marketing, processing and distribution of seeds and grains, and provides advice and support to the industry. Membership ranges from sole traders to large corporations.

NZ Flour Millers Association

The NZFMA advocates for the interests of Flour Millers throughout New Zealand.

The Baking Industry Association of New Zealand (BIANZ)

This industry association supports and promotes the baking industry and its products. They seek to lead and grow the bakers and baking apprentices base in New Zealand.

Baking Industry Research Trust (BIRT)

This Trust is a New Zealand Baking Industry Association (BIANZ) sub-committee. Committed to research aimed at delivering medium-to-long-term benefits to the New Zealand bread-baking industry, and other flour users, BIRT has been instrumental in conducting a wide range of research on behalf of its members.

The New Zealand Institute of Food Science and Technology Inc

The New Zealand Institute of Food Science and Technology (NZIFST) is the country's leading professional association representing people working in the food industry or in related research and teaching that apply science, technology and engineering to food processing, manufacture and distribution.

Major Commercial New Zealand Mills⁵

Champion Flour Milling, Auckland, Mount Maunganui, and Canterbury

Champion produces over forty types of flour for national and international customers. These include high-performance bakers' flours to specialty grain, ethnic and wholemeal flours, specialty baking premixes, concentrates and food coatings. The Nisshin Seifun Group owns Champion Flour Milling.

NZ Flour Mill, Tirau

Around 90% of the flour they produce is purchased in bulk by large-scale commercial bakeries and companies.

Farmers Mill NZ Flour Mill, Washdyke, Timaru

All their flours are 100% grown and 100% milled in South Canterbury, New Zealand. Farmers Mill is the country's only independent grower-owned and operated flour producer. They provide traceability of their product from paddock to final product.

Mauri Mills, Auckland, Wellington, Christchurch

Founded in New Zealand, Mauri employs over 800 people across New Zealand and Australia.

⁵ As identified by the NZ Flour Association - <https://flourinfo.co.nz/about/our-mills-nz>.



Figure 4. Major commercial mills. Image source: <https://flourinfo.co.nz/about/our-mills-nz> (New Zealand Flour Millers Association, n.d.)

Independent New Zealand Mills⁶

1. Minchins Milling
2. Capitol
3. Weston Milling
4. New Zealand BioGrains Ltd
5. Flour Power Mills
6. Milmore Downs

⁶ This list is as accurate as possible from internet searches but may not include all mills.

4. Problems and Opportunities

The following section outlines considerations for a local grain economy and transitioning to more equitable value chains that prioritise New Zealand producers, processors, and eaters, environmental diversity and regeneration, cultural aspirations and practices, and reducing food insecurity.

Arable Farming

This section draws on information from the project team's arable farmers Hamish Glendenning of Ludlow Farm and Simon White of Woodbrook Farms. It reflects their experiences and insights into growing arable crops in Aotearoa. In their words:

It is unnecessary that NZ imports two-thirds of its milling wheat from Australia. In time, hyper-local, resilient, climate-positive food systems will be required as globalisation unwinds and countries look to prioritise feeding their people in a more sustainable and self-sufficient way.

New Zealand farming landscapes are dominated by pastoral farming. With climate policy meaning rural NZ will be less focused on animal-based production systems, there is an urgent need to explore scalable plant-based alternatives with a positive climate impact. It is essential that these alternatives give more control to the growers, who will become price shapers as opposed to price takers.

Why are bakers buying imported grown or milled flour? What are they offering that NZ is not? Does the customer or consumer care where their flour comes from, and would they pay a premium for this? What do bakers demand regarding product specification (spray-free, organic, regen, protein levels, gluten levels, or consistency)?

To enable arable farmers to develop processing initiatives to grow and support a local grain economy, these farmers need to have an appetite and motivation to invest off-farm or value add (such as Hopefield Hemp or NZ Buckwheat) through vertically integrated businesses. This creates a level of risk for them and a requirement for the market to adapt and prioritise local grains ahead of cheaper alternatives. For this to happen, investment is required to communicate the benefits of locally grown grain; at the same time, policy needs to incentivise a 'buy local' culture. Low farmer returns dictate what arable crops are planted on-farm and what investment is required in processing and manufacturing different grains.

Changing the balance of arable crop production for animal feed back to milling wheat largely relies on the price that goes back to the farmer. Until milling wheat offers a sustained premium versus animal feed wheat, farmers cannot be expected to risk crop changes. In addition, the criteria and specifications for feed wheat are much less, meaning less risk to the farmer. Also, there are generally higher yields for feed wheat, which means a higher return per hectare.

To improve the stake arable farmers can have in local food supply chains, collective investment and possible partnering with current stakeholders are needed to de-risk the transition to a local grain economy. This will also help to reduce duplication and unnecessary competition in the value chain as the market for local grains grows.

For arable farmers to transition to resilient and more prosperous futures in the arable sector, farmers need to be able to focus on what they are good at - growing high-quality, nutritious food and on-

farm processing. Other entities must generate customers, expand markets, stimulate local demand, and support or invest in infrastructure and processing. The Government has a role to play here. Farmers, ideally, would have the option to invest in these entities so they can share in the successes of the value chain and therefore be encouraged to produce various arable crops.

Changes and an emerging trend in the arable sector have occurred over the last decade. We now see plenty of diversity in crops grown, new regulations (emerging or required), licence to operate (emerging or required), and younger farmers trying new things in the last decade. It will be essential to see that continuation in diversity and farmers being more connected to eaters rather than processors and distributors.

New Zealand can grow different grains and operate its own mills, as is already being done on a small scale for niche purposes such as artisan bakers. However, growing a meaningful local grain economy that would help feed New Zealanders their daily bread would require scale at the milling stage, which cannot be achieved with on-farm mills.

The likelihood of large mills running specialist production runs of different grains or increasing mill numbers is probable if there is adequate Government and funding support to get these mills established or recommissioned. Current commercial roller mills require low input costs and high-volume throughput to stand a chance of being profitable. Thus, they are not suited for specialist production runs of different grains. Therefore, different types of mills are required, which requires significant capital outlay if they are going to be meaningful in size; funding would help progress this opportunity. It is a chicken-and-egg scenario, however. Local demand in the marketplace and value back to the farmer through the value chain must be achieved first. From a nutritional perspective, we continue to investigate different mill types; however, a stone mill is preferred to a roller mill. We have also been trialling flour made with a Zentofan mill with good results. Building or recommissioning mills operating outside the large-scale production mills and bakers in New Zealand will create scope to widen the market and increase demand for quality local arable crops.

The critical changes required to disrupt the current supply chain dynamics and create better opportunities in the arable sector are more localised cleaning and milling options in the north island; and cost-effective or creative domestic freight options for moving products around the country.

Arable Industry Perspective

The following section is drawn from feedback from Ivan Lawrie, *Foundation for Arable Research*, and information from *Federated Farmers*.

Production Capacity

Aotearoa produces around 60% wheat and slightly less barley, which fluctuates. The main uses of these crops are for domestic animal feed and around 100,000 tonnes of milling wheat for domestic use. One-third of New Zealand milled products are for local use, and two-thirds of New Zealand's flour and bread products come from imported Australian grain, despite the quality of New Zealand grain and the capacity to grow sufficient amounts for Aotearoa's requirements. New Zealand grain and growers miss out because Australia can grow much larger amounts of grain, reducing production costs. However, most significantly, it is cheaper to transport grain from Australia to North Island mills than it is to transport New Zealand grain from the South Island. This has also resulted in the gradual loss of infrastructure, and processing and storage capacity for arable crops, which is now a cost barrier to

those trying to reverse this situation. Freight costs are a significant factor in the cost of arable crops, which have yet, in the main part, been passed on to consumers. However, these costs are a barrier when expanding the market in new directions.

Problem	Transport costs between South Island and North Island.
Opportunity	New Zealand grows good quality milling grain and can produce enough for the country's needs.

Crop Type

Production of poultry feed is the primary use of our grain crops. In the North Island, maize and grain are the more popular crops for poultry feed and human food. Not much wheat is grown in the North Island. The maize that is grown for grain goes mainly into poultry and a minimal amount for human consumption. Barley is grown in the North Island, mostly for animal feed and a small amount for malting in Marton. Aotearoa is importantly recognised as the world leader in seed production. Currently, arable growers are paid more to produce grain to feed animals than to feed humans. Because the milling wheat price is linked to global wheat prices and feed wheat is determined by NZ's dairy milk prices, there are very few incentives for milling wheat. There is also a significant issue with infrastructure for the industry - regionally and nationally. This includes milling capacity for smaller diverse grain crops, grain cleaning facilities, silo storage and, of course, economical transportation from South to North Island.

Problem	It is more financially rewarding and reliable to produce feed wheat currently.
Opportunity	Milling wheat that does not meet higher quality requirements can be processed as feed wheat.
Problem	Lack of infrastructure for this section of the market.
Opportunity	Genuine interest from arable farmers and bakers to grow and utilise milling wheat, seeds and grains.

Environmental Considerations

Arable crops create less environmental impact than other crops or livestock, and Aotearoa provides the perfect growing climate for arables. While the agriculture sector battles herbicide resistance, the need to become more efficient with fertilisers and agricultural chemicals and optimise water use is increasingly important. There are definite advantages for small-scale growers of arables, who can be typified as regenerative and moving aggressively towards optimum soil health, no/low till, massively reduced use of chemical fertilisers, increased plant diversity, and reduced monocropping. Growing the size of the local grain economy would accelerate the agriculture industry's increase in positive environmental outcomes. The growing international interest in plant proteins to mitigate the extent of environmental impacts of animal diets creates opportunities for the development of niche products such as diverse and heritage grains.

Opportunity	Growth of a significantly more environmentally friendly agrifood sector, particularly at the small scale.
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Financial Considerations

Many arable crops return less than other land uses in New Zealand, and this can be connected back to infrastructure and transport limitations which make Australian wheat more competitive for bakers, particularly at the large scale and for the mass market. Conventional economic measures need to consider the positive attributes of what a local grain economy can provide to small-scale growers, New Zealand eaters, Aotearoa's environment, and the enhanced food security producing food within New Zealand can offer. The sector is smaller than other farming sectors, and there is a shortage of people entering the industry due to the current limited profitability of milling wheat. Factors such as increased fuel, freight and infrastructure costs, and the time and funds taken up by regulatory compliance for new or alternative production and processing are all disincentives or barriers to success for small to medium-scale growers. On a large scale, Aotearoa's reliance on multi-national organisations for milled wheat means New Zealand are price takers who cannot influence the market. This requires growth at the small end of the scale, where it is possible to introduce new higher-value crops into the arable rotation and where it is possible to maximise profitability with the lowest environmental impacts.

Problem	It is difficult to achieve and maintain the profitability of arable crops for milling or human consumption with the current sector constraints of infrastructure and transport costs.
Opportunity	Several small-scale growers are making it work, and this comes down to their ability to identify potential market openings and bypass normal supply chain dynamics to create new supply chain connections and take back parts of the processing functions to increase their equity in the supply chain.

Food Security

The local grain economy provides an achievable opportunity to reduce reliance on wheat imports to Aotearoa to provide the volume of wheat products New Zealanders consume. While a balance of imports and exports is desirable regarding food security strategies, there is significant scope for a local grain economy to participate alongside larger mainstream arable growers and processors. The encouragement of a local grain economy and the support of increasing infrastructure and on-farm processing or in-bakery milling encourages the growth of a diverse range of grains and wheat, including more heritage varieties. A local grain economy also meets the growing demand for access to food within local, regional areas.

Problem	Aotearoa is reliant on imported wheat or wheat products for 2/3 of its supply, exposing risks to our food security. The lack of local production has seen the loss of significant processing and milling infrastructure throughout New Zealand.
Opportunity	Aotearoa has a significant capacity to reduce its reliance on imported wheat and wheat products. Growing a local grain economy will improve opportunities for

arable growers, particularly at the small and medium scale. It would also increase the diversity of grains produced for New Zealand customers and eaters.

Bakery Sector Perspective

The information below is a response to questions posed by the project team about end market requirements – bakeries and New Zealand eaters. The purpose is to discuss how arable farmers create products for these bakeries and eaters by reflecting on Aotearoa's current food system position concerning grain. This includes feedback from an arable farmer after providing trial flours to several central city bakers of new varieties of North Island-grown and milled whole wheat flour raised the following comments:

- *Generally speaking, when New Zealand consumers purchase from a premium bakery or deli, they are not yet curious about where the wheat or flour was grown. Instead, the priority is whether the bread or product was made in-store.*
- *It is debatable whether consumers are willing to pay a premium for locally grown or milled flour. While prior research suggests yes (Tait et al., 2022), this intention may not often translate into action. This creates an increased risk for a bakery, especially in the current inflationary environment. If another bakery uses cheaper imported wheat to produce similar baked goods, that may not be easy to compete with.*
- *New Zealand-grown wheat and flour can have a higher cost. It can also have limited or inconsistent availability. As such, bakers have little choice but to mix local flour stocks with an Australian product. This process reduces the 'sourcing local' value proposition.*
- *The North Island is not yet set up to facilitate cleaning and milling of wheat at smaller scales, which, while meaningful, will not compete for space in large commercial mills, which are running 24-hour, 7-day-a-week operations supplying our supermarkets and other large baked goods outlets. I have canvassed the whole island to investigate grain cleaning options, but they are very limited. There is a significant requirement for investment to create this capacity, as it would assist the local grain economy to grow.*
- *In my opinion, the North Island is not currently producing wheat at the same scale or consistency as Canterbury, so this will take time to achieve.*
- *Currently, there is an impact of seasonal variation of grains*
- *I consider a mill at a bakery the least ideal model. Given the square footage cost in central city bakeries, what value is gained by a baker milling the wheat?*
- *Moving to small-scale mills or on-site milling is challenging because of the economies of scale of larger commercial mills. This includes the infrastructure they have, such as seed cleaning facilities. The problem is that these larger mills often do not have the capacity or ability to process small batches of grain.*

"I start with the grain, then I work out how to make the bread" Maia of Floret Bakery



Figure 5. Maia of Floret alongside her bags of Milmore Downs Flour.
Image Source: Angela Clifford.

The best opportunities, as I see them, are as follows:

- More people growing arable crops suitable for humans would help establish a local economy with internal demand. Support from the Government is needed to help de-risk investment in mills and cleaning plants and to support the sector to achieve meaningful growth.
- There is ample opportunity in the retail space to promote locally sourced flour and to create innovative packaging and product options.
- There is good volume to go after, especially in the white flour space. Bakers and customers are interested in purchasing more domestically grown wheat, not so much to tell a source story but to build resilience into supply chains and create protection from price shocks and weather events. Bakers are not always happy with the current service they are getting from some suppliers.
- A quality standard for New Zealand-grown milling wheat would be beneficial. I spent over \$1k getting my flour tested to prove that it contained no traces of glyphosate or AMPA (aminomethyl-phosphonic acid), but there is no quality mark to communicate this.

- Given the growing understanding that most of our produce goes offshore, a marketing campaign promoting New Zealand-grown milling wheat would resonate well - we are growing it for the people here in Aotearoa, not as another export product that our producers and processors get little value from in the supply chain.
- The goal must be to displace some of the large volumes of imported flour. This requires that the local alternative is of equal or better quality and priced at a level where the baker can still make their margins work. Achieving this is possible if internal transport freight costs can be addressed and more milling and processing infrastructure can be brought online for small to medium-arable crop growers and processors.

In conclusion...

The timing is right to develop a local grain economy. Eaters are ready to be more conscious about their food choices and how they impact the environment. Eaters need to be given these choices in the marketplace and informed of the benefits of a more diverse and readily accessible grain and wheat sector. As geopolitical and environmental challenges intensify, the importance of building domestic food security and resilience is becoming more apparent to consumers.

Extracting a significant premium for locally grown arable crops or milling wheat is difficult. In part, this is because they are often ingredients that are turned into something else by others. It needs to be packaged, branded and marketed well to attract a premium for locally grown grains. Currently, very little packaging or branding discusses provenance when you buy a loaf from a high-end bakery. Further, some brands use provenance claims when only a small percentage of the bread is locally grown.

Growing a local grain economy would assist with more stable pricing, depending on the pricing model you establish, and a chance to differentiate from competitors. There is an interest in and an ability to communicate more directly to the eater, and farmers are keener to tell their farming and provenance stories and to collaborate on crop varieties to grow or to meet certain specifications. A strengthened local grain economy also provides the ability to adapt quickly regarding varieties, taste, and climate restrictions.

4. Literature Review - History of Grain and Milling in Aotearoa

A brief literature review contextualises this research project within the New Zealand agrifood landscape.

Arable Farming

Arable farming refers to growing cereal grains and other vegetable crops in fields replanting yearly. New Zealand produces 70% of its cereal requirements and imports the remainder. Arable land is cultivated and prepared by ploughing, usually in autumn or spring, and the seed is planted or direct drilled into the ground. It matures through spring and summer and is harvested in late summer or autumn. The primary seed crops produced in New Zealand are cereals such as wheat, oats, barley and maize; pulses such as peas and lentils; brassicas such as oil-seed rape (or canola); as well as herbage, forage and vegetable crops such as ryegrass and white clover grown as annual crops for seed (Zydenbos, 2008). Most arable crops are explicitly grown as forage for grazing animals rather than for grain. These include cereals such as oats and maize and brassicas like swedes, turnips, rape and kale. Some arable crops, such as potatoes, carrots and broccoli, are grown as vegetables for human consumption (Zydenbos, 2008).

Grain and Seed Growing in New Zealand

The NZ Grain, Seed and Produce Merchants' Federation was founded in 1918 and is now known as the NZ Grain & Seed Trade Association (McKinnon, 2018). The Federation responded strenuously to several national issues, including introducing a chemicals bill in 1959. Early missionaries were the first to grow wheat and oats in New Zealand (Zydenbos, 2008). Maize growing is estimated to have begun around 1770, and missionary Samuel Marsden shared his experience and knowledge of English agriculture and wheat growing with Māori (McKinnon, 2018). For indigenous Māori, wheat was a new crop. However, a northern chief, Ruatara of Rangihoua, sowed and harvested his first wheat crop in 1813. He then got a hand-operated flour mill the following year and could grind his wheat for cooking (Tolerton, 2010). Ruatara was extremely effective at wheat-growing, barley, oats and maize, enabling him to establish these crops in his community (McKinnon, 2018). By the mid-19th century, some North Island Māori communities grew wheat sold to settlers, exported to Sydney, or used by themselves (Zydenbos, 2008).

Milling flour from wheat, primarily for breadmaking, was the most widespread industry in early colonial New Zealand times, and it remained one of the largest industries until the 19th century (Tolerton, 2010). In the late 1860s, cocksfoot was established and allowed a rapid increase in the pasture where there had previously been forest and bush. The cocksfoot became a valuable commodity in Australian, UK and US markets. By the mid-19th century, wheat was grown around the country, but in the 1870s, it had become concentrated in South Canterbury, North Otago and eastern Southland, where milling became an important industry (Tolerton, 2010).

Large-scale arable farming was made possible by evolving and locally produced machinery and technology (Zydenbos, 2008). Almost immediately, domestic distribution networks and exports of surplus were introduced. The seed trade also proliferated, with typical English varieties prospering here and creating superior seeds for trade back to England and Europe - mostly ryegrass, white clover seeds and peas (McKinnon, 2018). The establishment and viability of New Zealand-bred grain and seed indicate New Zealand's early export-focused production.

In the late 19th century, it took hundreds of workers to harvest a large wheat crop. Growing grain required horsepower to plough the land, and many growers bred their own horses and utilised as many as 100 working horses. Horses also worked in early threshing mills, but during the 1880s, these were replaced with portable steam threshing mills, and groups of 'threshers' operated the threshing mills in gangs on a contract basis (Walrond, 2008). Big estates like those in South Canterbury would engage around 300 men at harvest time. Nowadays, a combine harvester has replaced this workforce of horses and people.

In 1895 and again in 1917, rising problems with the functions of processing, distribution and marketing saw significant attempts to organise the trade of seed and grains through Terms of Sale (McKinnon, 2018), and following this, in 1918, the *NZ Grain, Seed and Produce Merchants' Federation* was founded. At this time, there was massive trade in oats and chaff. There was a noted history of conflict between the north and south islands. The coming together of the various members into the Federation allowed them to work in unison to lobby the Government, and in particular, the Railways, to ensure railway wagons were optimised for moving crops and also to oppose a government-proposed seed bill (McKinnon, 2018). McKinnon (2018) says that the Federation's proactive functioning and self-imposed terms can be regarded as a critical reason New Zealand today is one of only a few countries in the world without seed legislation. The terms are relatively unchanged from this time, and in 1925 were published in a handbook that set out standards, processes, sampling and grading systems. It was considered the 'bible' of the *Federation* (McKinnon, 2018).

Mills and the Milling Process

Small hand-operated machines were the first mills to be used in New Zealand. This was followed by larger water-powered flour mills established by the 1830s to process wheat into flour (McKinnon, 2018). Milling involves crushing grains to remove the tough outer husk from the flour using mill stones powered by wind, water or steam (Tolerton, 2010). Millstones were interlocking pieces of durable stone secured with iron bands (Tolerton, 2010). The 'bedstone' on the bottom remained fixed, while the 'runner' top stone rotated on the bedstone from a central shaft (Tolerton, 2010). A series of grooves in the stones with sharp edges ground the grain, and the centrifugal force sent freshly-ground flour out to the edges along the grooves (Tolerton, 2010). Mills needed to be tall buildings so that the grain could be lifted to the top floor and funnelled down to the eye of the millstone. When the flour emerged at the edges of the millstone, it then fell down a chute to a waiting sack below (Tolerton, 2010).

Māori quickly invested in water-powered mills, and in the mid-1840s, tribal groups in Waikato, Wellington, Taranaki and Whanganui had water-powered mills in operation to process their wheat (Tolerton, 2010). The first flour mills around Auckland were built in 1844, and by 1845 there were three mills sited at Wellington, Nelson and Akaroa (Tolerton, 2010). Then, between 1846 and 1860, 37 flour mills were built for Māori owners alone in Auckland (Tolerton, 2010). There is only one surviving water-powered flour mill in New Zealand. Known as Clarks Mill or as the Maheno Valley Roller Mills. Initially a grindstone mill powered by a water wheel, in the 1880s, it was converted to roller machinery powered by water turbines (Tolerton, 2010).

Milling was a significant industry in Canterbury and Otago, where wheat was widely grown (Tolerton, 2010). In 1867, South Canterbury sent a trial shipment of wheat and flour to England. The experiment successfully proved a market for New Zealand grain in Britain (Zydenbos, 2008). Ōamaru had huge grain storage buildings – such as the New Zealand Loan and Mercantile Company's three-storey, 100,000-sack-capacity warehouse built in 1882 and the New Zealand Elevator Company's grain elevator and grain store (later J & T Meek's Grain Store till the 1950s). These grain stores and mills left a legacy of many architecturally significant buildings reflecting the boom time of the grain economy in

the 1870s and 1880s (*Meeks Grain Elevator Building*, n.d.). Arable cropping increased in Canterbury and Otago when the price of wool declined in the 1870s, which coincided with technological improvements in ploughs and harvesting machinery (Zydenbos, 2008). Alongside these improvements, the development of roads and railways in the 1870s changed the geography of rural settlements. As soon as the mills spread throughout the country, the ability to transport flour to areas that did not have productive growing conditions meant these settlements no longer needed to rely on their crops and mills. Therefore, many mills closed through the 1880s (*New Zealand Flour Millers Association*, n.d.). Many remaining mills converted to the new roller system in the early 1890s, and the height of milling buildings increased and dominated town skylines (Tolerton, 2010). The colossal four-storey Northern Roller Milling Company building in Auckland's Fort Street was a prominent architectural feature of the central city from 1875.

The following significant change in milling came in the 1880s when rollers replaced millstones (Tolerton, 2010). The first mill in New Zealand to use rollers was the Timaru Milling Company's six-storey mill built in 1882, which finished milling in 2012 due to the centralisation of processing by the current mill owners (Tolerton, 2010; Williams, 2011). The iconic mill has a National Historic Places Trust category-one classification.

In 1888, the first fully automated roller mill, Firth's Eight Hours Roller Flour Mill, began processing in Auckland (Tolerton, 2010). Roller mills of the late 19th century worked by cleaning wheat of imperfect grains, chaff and dust, then passing the grain through steel break rollers from which bran was collected (Tolerton, 2010). Milled grain was then sieved, purified, and put through reduction rollers, after which wheat germ was collected. Another pass through a reduction roller produced the resulting fine flour. The by-products of this milling process, bran and pollard, were used as stock feed, and in 1944 the Northern Roller Milling Company started specifically making stock feed and, in 1954, added new machinery to make stock feed pellets (Tolerton, 2010). However, grain buildings were eventually converted to other uses when wheat growing decreased at the beginning of the First World War. By 1924, wheat for flour was mainly imported from Australia (Tolerton, 2010).

The New Zealand Wheat Board, a government marketing authority, controlled the wheat-milling industry from 1965 to 1987. However, after deregulation was introduced in 1987, many mills merged or closed, and import restrictions were liberalised, allowing mills to buy grain directly from growers (Tolerton, 2010). Most grains in the early 2000s were processed by Goodman Fielder's Champion Flour Mills, Weston Milling and Milligan's Food Group. These businesses operated flour and stock feed mills (Tolerton, 2010).

Grains in the Post-War Periods

During World War I, grain and seed productivity waned due to the substantial draw on nitrogen for seed production and a waning price for key exports of milk, meat, and wool. Additionally, during wartime, the Government incentivised food production on agricultural lands (McKinnon, 2018). Drought and conscription also impacted the sector, leading to substantial change. The role of an independent broker was essential from as early as the 1920s and focused on bringing sellers and buyers together and facilitating the most favourable deals between parties (McKinnon, 2018).

Grass seed underpinned the success of New Zealand's export economy, providing the pastures to feed increasing livestock numbers (McKinnon, 2018). However, grass seed contamination and reduced strength in grains, sometimes a result of overused arable farming systems that gave way to inferior grasses and weeds, was noted in the United Kingdom, and the selection of New Zealand seed showed similar vulnerabilities. In the 1920s, this focused on government and farming stakeholders

seeking premium seeds (McKinnon, 2018). In 1929, New Zealand launched what is recognised as the world's first quality control system - the New Zealand Seed Certification Scheme. Today several private laboratories continue this work (McKinnon, 2018). In 1968 New Zealand joined the international seed trading forum and the associated *Fédération Internationale du Commerce des Semences* in 1970 (McKinnon, 2018).

Over New Zealand's grain and seed history, production has shifted up and down freely based on demand (for example, as feed requirements have emerged or disappeared, communication and technological advances (from the advent of telephones and fax machines to the building of train networks or shipping routes), and to government direction (war efforts at food production for the armed forces and rationing public food), export changes, and weather events such as drought or flooding. These factors have seen the industry expand and contract quickly.

The Federation and now Association has actively and closely advocated and worked in its members' interests. They have sometimes lobbied aggressively against government initiatives such as price fixing or seed selection.

Production and selling mainly occurred in the South Island, with consumption and purchasing occurring in the North Island (McKinnon, 2018). The *Cook Strait Rail Ferry* service was a crucial component in transporting grain and seed between the South and North Islands, being quicker and more efficient than sea transportation (McKinnon, 2018). This inter-island ferry service began in 1962, providing a 'roll on roll off' service for freight that was competitive with coastal shipping. The service dramatically increased transport efficiencies since freight could stay in the same rail wagon for the entire journey, reducing time and money ('Interislander', 2023).

Cereal Grains and Food Security

Despite being a prosperous agriculture-producing country, New Zealanders consume large quantities of staple foods not grown here, e.g., sugar, wheat, maize, rice, and coffee. The foods we import come from only a few countries, putting the food supply at risk during disruption (Soliman & Greenhalgh, 2020). We are currently quite reliant on importing edible grains, mostly from Australia. "It is the lack of diversification in cereal supply that is one food security risk for New Zealand" (Soliman & Greenhalgh, 2020, p. 3).

A critical factor in Aotearoa, New Zealand's food security, is that arable farming has evolved into cereal cropping primarily for other production systems, mainly dairy feed. In addition, there is limited availability of agricultural land suitable for growing cereals. In the early colonial settlement period, New Zealand's cereal crops were of a low standard, and producing suitable milling grains was a struggle. Once shipping and rail connections improved, the importation and transportation of milling wheat solidified cereal crops as more beneficial for stock feed. Stock feed grew alongside Aotearoa's transition into lamb, beef and dairy farming. Despite significant improvement in the quality of milling grains in subsequent decades and interest in heritage and ancient grains for human consumption and niche bakery situations, the demand and supply of grains have remained focused on stock feed production.



Figure 6. The original grain storage building at Royalburn Station. Image Source: Heidi McLeod

In conclusion...

The literature review has canvassed a long history of grain production in New Zealand. It charts the industry's evolution through phases of colonisation, transport network development, technological advancements, and the gradual centralisation of production and processing.

5. Comparative Analysis Findings

The following case study is an Australian example.

Woodstock Flour Mill, Victoria, Australia

This family-run business produces a range of stoneground, organic, wholegrain flours freshly milled from grain grown on the farm. The mixed-system farm has been in the family for four generations and is certified organic. Courtney and Ian recognised that milling their own wheat was an opportunity to add value to the farm's production and diversify their income streams. They calculated that they could mill one tonne of grain a week, equating to what Woodstock Farm could reliably produce in "all but the toughest years for cereal crops" (Fernandez Arias et al., n.d., p. 54). Ian and Courtney also make sure they can cover each other's roles at Woodstock Flour while maintaining minimal roles in outside jobs, which can provide buffers if they cannot harvest crops.

Like many other Food System Pioneers interviewed, Ian and Courtney have a passion for the environment, enjoy food, and are particularly attuned to the niche market they can cater for. Courtney says, "We saw an opportunity in the market for small-scale, organic, farm-based flour milling and we jumped on it!" (Fernandez Arias et al., n.d., p. 48). They have taken the opportunity to connect directly with eaters and bakery customers to help them produce high quality and diverse wheat, flours and ultimately baked goods - "To us, it is important that we are not 'just farmers who mill flour' but farmers who have a solid understanding of and interest in baking" (Courtney cited in Fernandez Arias et al., n.d., p. 50).

This perspective allows them to offer a sustainable and meaningful business, which allows Ian and Courtney to lead their own healthy life connected to the land upon which they live. They also spent quite some time talking to bakers to work out the type of milled flour they preferred. In Woodstock's case, this meant opting for a New American Stone Mill rather than an often preferred Austrian Osti Roller to differentiate themselves from other millers in Australia. This attention to customer requirements represents the focus of Food System Pioneers.

This diversity of flours they produce, and interest in heritage varieties is helping to reduce monoculture cropping and reinvigorating heritage seed collections that are local to the area and appropriate for the local growing conditions. Like many food producers, Courtney and Ian cannot believe how successful regions are at producing food, yet it can be challenging for eaters to find locally grown, organic or healthy food within a region. They have worked proactively with bakers to provide information on the qualities of the different flours they produce. These grains do require different processing than that of larger mainstream commercial mills.

We want to see bakers promote their pastries or breads for the flour they have used, not because of the salted caramel or lemon curd. We have tried to frame flour in a similar way that you would talk about coffee and wine. (Fernandez Arias et al., n.d., p. 57).

Ian and Courtney are focused on regenerative agriculture practices on-farm, such as using biological stimulants or worm juice as fertilisers, no-till or as little as possible, high crop rotation interspersed with livestock grazing, and careful harvesting to ensure optimum soil health. They are, however, very rain dependent and retaining an appropriate level of soil moisture is a constant battle - something New Zealand farmers can avoid having to contend with to the same degree.

The benefit of producing such wheat and flour and using a stone flour mill is the creation of more nutritious flour with more flavour, which is appealing to more bakers. Typically, the large companies responsible for producing bulk flours for large commercial bakers are representative of 'Big Food' companies' requirements for foods to be fungible to create continuous economies of scale. Being fungible means any part of it is interchangeable, substitutable or switchable for any other part - wheat from one country is the same as wheat from another. With food, this means goods are grown and processed to create large volumes of ingredients or final food items that are shelf stable and can be exchanged as a commodity across the globe. In the case of milling wheat, the result is a stabilised, rather bland white flour that consumers have become used to eating.

This premium product does come at a relative price, however, and pitching a price that is accessible to local communities or encourages more bakers to use their product is challenging. It requires educating people about regenerative farming practices and the benefits of supporting food ingredients that are environmentally, socially, and culturally positive. Producing food this way costs more than what is produced for mainstream food systems. With rising food costs, it is difficult for producers like Ian and Courtney to advocate for their premium products.

Woodstock flours are local within 3 hours travel time (Melbourne bakery clients and specialist retail outlets). However, they are working hard to promote the local community supply in the Rutherglen area where they are located. They work proactively to connect with other producers, consumers, and the local community. Courtney is proactive on social media, focusing on marketing and retailing like the interviewed Food System Pioneers. Woodstock Flour are trying to interrupt the existing value supply chain, create additional and more equitable supply chains, and create niche, higher-value opportunities for their business.

Maintaining the viability of Woodstock Flour and the family farm enables alternative agrifood production systems, such as regenerative agriculture and permaculture, which returns positive environmental, social, and cultural outcomes. Courtney says, "Grains are often considered the last frontier of the farm-to-table movement", and indeed they are an essential ingredient of a healthy diet (Fernandez Arias et al., n.d., p. 53). Ensuring the supply of wheat and grains is a priority of food systems, and achieving a level of self-sufficiency, as a cornerstone of a diet, is invaluable.

However, Woodstock Flour did face challenges in getting their mill operative at optimum levels. There are essential equipment requirements to produce flour - harvesting equipment, grain cleaner, mill, air purifier, storage silos, and often something to lift to bags to feed the chute into the mill. Likewise, Courtney and Ian reckon it would be easier to enter into small-scale growing with a connection to an existing farming business due to the costs of setting up infrastructure or acquiring equipment. If this is possible, however, there is an opportunity to claim equity in a food supply chain.

We are part of a bigger movement working to build local grain economies throughout Australia, where the grain grown on family farms is processed and consumed locally (Fernandez Arias et al., n.d., p. 67).

Pointedly, Woodstock Flour acknowledges that milling your own grain is not a silver bullet to end "commodified, tasteless, and land degrading grain systems" (Fernandez Arias et al., n.d., p. 69). Therefore, it is essential to establish the correct level of independent grain growers and processors for Aotearoa.

In conclusion...

This Australian example outlines the same challenges as small to medium arable crop growers in Aotearoa. The investment in infrastructure is significant, the dedication to positive environmental and social outcomes is the same, and the attention to the market and the complete supply chain is paramount.

6. Thematic Analysis

This section discusses the findings of interviews and observations at on-site visits during this research process. Because we wanted to see if there were common themes for food producers, insight was also sought from farmers and fishers pioneering or creating ways to disrupt typical food system supply chains. These food producers, processors and harvesters have been motivated by the goal of creating value for their operations within a local food system. This provides an opportunity to increase the viability of their livelihoods, increase their products' nutritional and quality elements, and enhance the environments in which their food production occurs. There are also numerous cultural and social benefits that they are seeking to achieve at the same time.

Interviews

Carlos Bagrie, Royalburn Station

Carlos's family history has always been farming, and in 2019 Carlos and his wife, Nadia Lim, bought Royalburn Station in Arrowtown. Their shared background in food media and as co-founders of *My Food Bag* is now channelled into a diverse, regenerative and ethical farming operation focused on delivering the best quality lamb, chicken and crops. Essential to their success has been identifying the appropriate market and developing the perfect retail offering and distribution chains. Royalburn Station also brings as much processing on-farm to ensure they control every element of their food from paddock to plate.

Sam Ellis, Grizzly Baker

Sam has a long history of baking. In 2013 he began producing his bagels for sale at the Christchurch Farmers' Market. In 2018 Sam opened their flagship store, with an additional smaller location in 2019. The *Grizzly Baker*, 20-odd people strong, is constantly innovating and seeking to add more locally sourced ingredients.

Hamish Glendinning, Woodbrook Farm

Hamish has a background in innovative food commercialisation and looking at the potential of high-quality New Zealand-farmed products, including arable crops. Simon White actively farms Hamish's farm in Central Hawke's Bay.

Glen Herud, Happy Cow Milk

Glen's company has been crowdfunded from the early stages of trial, error, growth and redesign. This innovative milk processing and delivery system allows farmers to sell their milk in their communities. This has involved extensive supply chain analysis and design of processes and equipment to make a complete system that also incorporates required MPI reporting. Glen has created a complete supply chain for farmers that allows duplication of milk distribution and retailing anywhere in New Zealand.

Ivan Lawrie, General Manager - Business Operations, Foundation for Arable Research

Ivan works for the *Foundation for Arable Research*, which supports and liaises with arable farmers in Aotearoa by undertaking research, often in collaboration with government-funded organisations or Universities, to generate new knowledge, tools and technologies to support responsible and profitable farming. FAR liaises with everyone from the production stage through to consumption - the AFE Council (breeders, *Federated Farmers*, arable producers, limited grain merchants, millers and bakers, and facilitates biosecurity discussions, provides

education to its members through publications, and more frequently now, advocacy work on behalf of the industry. FAR collect a levy to undertake its work.

Nate Smith, Gravity Fishing Pod and App

Nate's pilot project, funded through the Sustainable Food and Fibre Fund, is a model based on localised sustainable harvesting of kai moana to order and availability. Fishers use a hook and line and then kill the fish using a humane Japanese method called Iki jimi. The app connects fishers to customers in real-time for ordering and delivery, and the pod provides a place for fishers to process the kai moana quickly and distribute it, with all certification and compliance handled through the app.

Martin Spear, Minchins Milling

Marty is the fourth family generation to farm in Sheffield, Canterbury, where he still farms a mixed system of livestock and rotations of arable crops. Marty was curious about ancient grains and began trialling different crops and then dabbling in milling those grains. He enjoys the reward of producing quality grains to process on-farm under the brand name of Minchins Milling.

Simon White, Ludlow Farm, Central Hawke's Bay

Simon farms in Central Hawke's Bay, where his family have run a mixed livestock and arable crop system for four decades. The farm has been GAP certified (Good Animal Practices)⁷ for 17 years. Like other younger farmers, he has experimented with more diverse arables. He trialled a crop of Hemp, which has been utilised by restaurants and processed into several retail products and continues to trail different varieties of grain and wheat.

OMGoodness Bakery and Mill, Hawke's Bay and Auckland

With an on-site mill, this bakery produces well-loved organic, gluten-free, dairy-free, refined sugar-free, paleo and vegan bread and bakery products. The milling of their grains is a crucial component of being able to produce their loaves of bread. Their loaves of bread include New Zealand-grown, organic wholemeal ground buckwheat.

⁷ See more information here: <https://www.nzgap.co.nz/>



Figure 7. Interviewing Nate from Gravity Fishing, Arrowtown. Image Source: Heidi McLeod

Food System Pioneers (FSP) are the people we interviewed that are innovating, disrupting the 'business-as-usual' mentality, and transitioning businesses to produce more equity and positive outcomes in our local food system. Key themes that emerged from our research were clustered around distribution, wellbeing-Hauora, scale, legacy, location, compliance, domestic/local food, innovation and entrepreneurialism, resilience, and barriers.

Distribution

The critical distribution element experienced by FSP is the cost barrier that emerges in New Zealand from moving freight throughout the country. In particular, transport across the Cook Strait between the South and North Islands is a significant cost driver. The South Island is the primary producer of arable crops and key grains, but the ability to provide products to the North Island can be cost-prohibitive. Currently, it is cheaper to source grain from Australia, which can deliver reliable, consistent quality products directly to North Island mills.

... for us to move grain from Canterbury to Tauranga, it's just about more expensive than if it came from Australia. So, there's not many transport options out there⁸. **Martin Spear.**

Distribution is a complex part of the business for growers, farmers, fishers, and millers to solve. Regarding the case studies undertaken, it became apparent that FSPs inherently understand how food supply or value supply chains operate. They understand the influence they need to have over how their product is distributed, marketed, and retailed. This is because their story is so significant, unique and intimately connected to themselves as a brand. Nate Smith takes the delivery of freshly caught fish seriously. When a local courier let him down, he personally delivered the fish to its intended restaurant to ensure it was received within the four-hour processing to customer timeline. Carlos Bagrie realised this as he developed his Royalburn Station operation. Carlos explains that they did not initially do their distribution. However, they quickly realised this meant they did not have the opportunity to maintain

⁸ Edited slightly for clarity.

relationships with their customers and to keep their story of provenance alive, which is a meaningful factor in the success of their business model:

It takes a lot to establish and maintain a brand in the market... there's so many parts to that, to make that activity work properly. **Carlos Bagrie.**

Becoming involved in different parts of the supply chain, such as distribution, enables FSP to inform customers of what is different about their products and practices and grow the marketplace and demand for their products. Glen Herud explained how challenging solving his milk's 'last mile delivery' was and how current New Zealand transport challenges⁹ are exacerbating FSP endeavours.



Figure 8. Royalburn produce for sale at their Farm Shop in Arrowtown. Image Source: Heidi McLeod

⁹ Transport challenges were discussed in this 2023 Stuff article: <https://www.stuff.co.nz/business/farming/132275500/truck-driver-shortage-may-affect-fresh-produce-deliveries-especially-in-rural-areas> (Uys, 2023).

Quality

The farmers, growers, fishers, millers and bakers we spoke to are committed to producing quality food that provides environmental, social and cultural justice. They are seeking outcomes such as healthy soil, high nutritional values, cultural self-determination, local food security, regeneration of the environment and restoring access for New Zealand eaters to New Zealand food.

We are so privileged in this country to have some of the best quality produce of anywhere else in the world, and we think it's a shame to just put it on a plane and send it somewhere else. **Carlos Bagrie.**

These FSPs are conscious of the nutritional value of healthy food and a healthy diet and are focused on producing consistently high-quality produce for eaters.

It's really empowering to have that hands-on stuff that we do as harvesters when we're out on the water. We're using our hands to iki jime the fish, to slurry it. It's a very intimate process, and if done correctly, it really shines through when it gets to the end user. It's in me and everyone who's adopting the model through Gravity. **Nate Smith.**

In all cases, this means transitioning from practices that are singularly focused on achieving the highest output volume. FSPs are creating food options in the marketplace that reduce the environmental impact, reinforce sustainability, and honour and respect land, animals, and people.

One of our values as a farm is to strive for low inputs and high outputs, both in terms of yield and quality¹⁰. **Martin Spear.**

Wellbeing-Hauora

There is a distinct attribute of well-being for the FSP, as their businesses offer numerous positive well-being outcomes. Firstly, they have increased personal satisfaction by controlling their business. They know the quality of their produce is higher, providing more nutritional value and physical well-being to those who eat it. Their food allows cultural and potentially medicinal properties to be a part of physical and spiritual well-being. It provides ways for Māori to express tino rangatiratanga over the food they produce, harvest, process and eat, as well as recognising Te ao Māori principles and the tikanga of honouring Papatūānuku and the whenua that supports our food system. Therefore, this approach to our food system is predicated on the requirement for sustainable production and, in many cases, regeneration of the environment.

I think it [the Gravity model] definitely contributes to the health and well-being of fishers... most of these guys have been fishing their whole lives, working under the quota management system and being encouraged to catch more fish because it's there to be caught on paper. It's a stressful thing. I have got down the line of 13-14 years as a commercial harvester. I started to feel down and out about it because you're seeing thousands of fish a year being taken out [of the sea], and you know the true value of it, but then it's not reflected in your business model – what you get paid... But if we didn't have to stress about money and knew we were doing things right by the environment... [If] we don't have to work long hours..., we're literally calling the shots about what comes out of the ocean – and that's empowering, really empowering for a harvester to live like that and stand by that. It's a lifelong thing.

¹⁰ Edited slightly for clarity.

There's a lot of mental health stress with the old model. The Gravity model cuts all that back. The physical demand is cut back too. **Nate Smith**

FSP take particular satisfaction from their focus on striving towards regenerative goals, high-quality products, and a better share of equity in supply chains. They are motivated to produce New Zealand food for New Zealand eaters as a priority and invest vast amounts of time, expertise, energy, and resources in making changes to our food system. They appreciate the diverse rewards that come from that - positive feedback from customers and their peers and professional recognition within the industry. The reward for their effort is a driving factor. Profit is not their sole motivator.

...the current commodity model – I didn't feel we were getting rewarded for what we're doing, and there's... no incentive or feedback for you to do your best job. You can't grow a crop, and it goes on a truck, and it's all see ya! That was it! There's just no reward... but it's quite satisfying when you get some feedback. Get a reward for what you've done, what you've put into it. **Martin Spear**

Scale

FSPs working in the arable sector, or other food initiatives of localised onsite processing or milling, are faced with the challenge of managing scale, efficiency and cost-effectiveness. This is not easy because the FSP are trying to achieve more for customers. They are choosing to face head-on conversations around environmental degradation, climate change, animal welfare, nutritional quality, food justice and well-being. There will often be cheaper options on the market because of economies of scale and externalities such as environmental degradation. The New Zealand food system also consolidates its wholesale and retail systems significantly.

If New Zealand wants food security, they are probably gonna have to pay a little bit more for NZ wheat. **Martin Spear**

The capability exists in the New Zealand agrifood sector to deliver increased capacity, and many farmers have proved this. The Australian Government's *Tasmanian Freight Equalisation Scheme*¹¹ shows how policy has increased and maintained economic trade and flows between Tasmania and mainland Australia. Such a policy for the Cook Strait of New Zealand could significantly change New Zealand-produced food market dynamics.

Most of our food system has seen a continual progression of centralisation and corporatisation of food businesses. While providing many efficiencies and conveniences, many negative externalities are created and embedded in our current food system. What needs to be better represented and provided for is 'lots of little' - small niche localised businesses that can work independently of the more extensive system to provide increased access and availability of food to New Zealand eaters.

Legacy

There was an apparent commitment from the site visit participants that they were committed to their businesses for the long term. They were not looking for quick opportunities to capitalise on an idea but wanted to build something sustainable with an enduring legacy based on their respective values for our food system.

¹¹ <https://www.servicesaustralia.gov.au/tasmanian-freight-equalisation-scheme> (Tasmanian Freight Equalisation Scheme, n.d.)

I wanted a business that fed communities but also had the ability to stand up on its own, so it didn't rely on me. I want the business and brand to outlive me. **Carlos Bagrie.**

... it's a long game we're going for. We haven't had any financial reward yet, but hopefully, that'll come one day. But we've had a lot of satisfaction which really keeps us going, which is awesome. So that's a real drive for us. **Martin Spear.**

Location

A feature of the FSP talked to was the importance of reflecting on location, whether hyper-local or national. Supporting localised food production for local eaters enables better seasonality, access to local specialities and ensures access to culturally significant food.

Everything we produce stays here in New Zealand. In fact, most of what we produce stays inside the Wakatipu Basin. So, I'd say 90-95% of what we...comes off this farm – doesn't go further than about 30km. **Carlos Bagrie.**

When farming for milling grains, consideration must be given to the fact that the South Island is a prime location for growing these arable crops, although there are also several suitable locations in the North Island. However, most of New Zealand's population lives near the top of the North Island, where most commercial bakeries and large mills are located. The North Island is not set up to facilitate the cleaning and milling of different wheat grains produced for specific purposes or in different ways, e.g. organic, regenerative, and heritage grains at smaller scales. Increasing infrastructure and capacity in the North Island would positively impact the competitiveness of locally produced flours shipped from Australia or the current large commercial mills based in New Zealand.

Compliance

An obvious critique by the FSP was the frustration with limitations of compliance and regulation in their businesses, especially in responding to innovations they were creating on-farm or in their businesses.

...the paperwork is a full-time person's role across the station. I spent about \$100k on compliance [over a year] ... [compliance officers] on the ground are really useful, they want to see what we're doing succeed, but when it comes to anything new or different, in terms of compliance, they don't know how to set up compliance for it, we've had to write the templates for them. **Carlos Bagrie.**

...what Happy Cow has really done is we've created a milk processing system and a retail system that we've built regulatory compliance all around it. And on top of that, we also have the marketing playbook that goes with it. **Glen Herud.**

However, these FSPs recognise the role of compliance and regulation policies and look at how they can integrate these requirements into their operations, mainly when processing occurs onsite at a farm or through a new initiative such as Glen Herud's milk processing, storage, and distribution system or Nate Smith's Gravity Fishing Pod and app.

Our system – the app takes care of all the paperwork/compliance you need to do here in New Zealand with MPI – we enter the data in once, and then it goes into the 5-6 different places it needs to go. **Nate Smith.**



Figure 9. Glen Herud of Happy Cow Milk Company has developed a technology system with built-in MPI regulation compliance for a complete supply chain approach to milk delivery at a small scale. Image Source: Heidi McLeod

Addressing compliance and regulation in these businesses is successfully diversifying and expanding New Zealand's food system and reducing reliance, or dependency, on conventional food supply chains and operators.

Domestic and Local Food

It is a frequent criticism that New Zealand is a land of plenty; however, New Zealand eaters don't necessarily have access to that or availability¹² is limited.

¹² The terms 'access' and 'availability' are utilised within their food security context, whereby access is considered the ability of eaters to access food, and availability refers to the availability of healthy food.

We're geared for export in this space - in fisheries, so that's where a huge percentage of our fish goes. It goes off-shore, and we're kinda left with the dregs, I suppose. And that's what we're hoping to fix with our model, to regain regional community access to good quality kai moana on a consistent weekly, daily basis – how it should be. **Nate Smith.**

Journalist and food activist, Jade Temepara, captures a question frequently asked in the media:

As a nation that is revered around the globe as a food basket, with the ability to feed 40 million people per year, it seems wrong that we are having issues distributing and making healthy kai accessible to all. **Jade Temepara.**

To the FSP, accessing the food we produce is an important goal.

So, someone can come into the Royalburn Farm Shop, take some of our lamb and they know that it's lamb only from one single place – it's from this farm...they know that we know everything about that lamb, and the farm shop's ten minutes away, you know like so the relationships really quite close. It's hyperlocal and that gives, I think, eaters an opportunity to actually experience what produce and food can taste like at that level. **Carlos Bagrie.**

I guess I always wanted to sell milk to our local community, so I started Happy Cow Milk in 2014 with just seven cows, and we were selling milk to local public around Christchurch, and everyone loved it, and we couldn't keep up with demand. **Glen Herud.**

New Zealand's food system must meet the needs of New Zealand eaters. We have a duty under Te Tiriti o Waitangi to ensure the rights of indigenous Māori to their customary kai, and all New Zealand eaters must have access to healthy food. However, the availability of this food is not guaranteed.

Kai moana is ingrained in us as New Zealanders; it's iconic. We grew up with it - fish and chips – but we don't have that access, so it's coming in from overseas. If we can't catch it ourselves, then trust and buy direct from our fishers – then you'll get that authentic product. **Nate Smith.**

Innovation and Entrepreneurialism

FSPs are just that - pioneers of our food system. They are entrepreneurs and innovators who have identified ways to do things differently and mitigate impacts created through our existing system. They are creating solutions and providing alternatives to how food is produced. They have taken risks and committed to various objectives that benefit the environment and our community in several ways. They effectively disrupt and transform the current food system to regenerate our environment and provide reconnection to New Zealand's foods. They see the opportunity and have fully invested in achieving something more than the status quo.

Yeah, I guess you do have to be a little bit entrepreneurial, and you'd like to build something...solving a technology or a distribution problem, it's perhaps not what all farmers think about when they get up in the morning... I like the idea of innovation and trying to do new things¹³. **Glen Herud.**

¹³ Edited slightly for clarity.

I've always been looking at other ideas, and I started... I went down the road of growing ancient grains – not grow – just playing with it, really, and I got some seeds and grew some corn [heritage species] and some spelt. Just always looking at different ideas really, and probably the reason for it is I'm just curious. **Martin Spear.**

Resilience

A food system consists of interconnecting long and short agrifood supply chains. This networked system includes all the inputs, activities and outcomes related to the production cycle, processing, distribution, retail, consumption, and food disposal. An essential aspect of functioning food systems is resilience. This recognises a requirement of our food system to respond well to supply chain disruptions, such as the interruptions caused by natural events such as earthquakes, flooding, and cyclones, as well as significant events such as the war in Ukraine or the impacts of Covid-19. In order to create a continuity of food supply to New Zealand eaters, it is necessary to consider how we ensure we are productively meeting these needs. This means ensuring our food systems are protected from interruption and can quickly adapt to change, such as climate change. Significantly, this means maintaining access and availability to food. Strengthening localised food production, processing, and distribution helps to achieve this.

We could make huge inroads if we had 10-15 packing facilities around our coastal regions. Regions that were once thriving and had an abundance of fish species could be that way again. If we fish different types of fish from season to season, we're not specifically targeting one species all year. I don't see that as sustainable¹⁴. **Nate Smith.**

Increased access and availability of local food encourages more small-scale operators, more diversity of food, and less reliance on imported or highly-processed foods. The FSPs are committed to showcasing local food, reflecting the provenance of their food, maintaining customary rights, and encouraging a connection between local communities and the food they eat.

So, it doesn't matter how big your operation is; you still are able to provide kai moana to your local community if that's what you want to do, and making it easy with the app is key to that. **Nate Smith.**

Barriers

As pioneers in our food system, these operators are innovating and experimenting with improving the quality of our food. They are working against the flow of the current highly industrialised food system. The positive outcomes of their efforts need to be encouraged and supported through funding or by de-risking their investment or projects. Access to capital through grants or funding is complicated.

We're working so hard to build better farming systems, and our inputs to date aren't recognised or won't fit the requirements for funding... I wish farmers working towards sustainability could be supported. There needs to be more carrots than sticks – we can move towards carbon zero easily... **Carlos Bagrie.**

¹⁴ Edited slightly for clarity.

The FSP feel they frequently face barriers as they work against the current model, thinking, policy and regulation.

I'd like to speed things up a little, so rather than waiting for us to [gather] data that proves that this is a more ethical, sustainable approach to harvesting kai moana here. **Nate Smith.**

It is also hard for these producers, millers and harvesters to compete at the retail end when customers and competitors do not recognise the costs involved in creating positive externalities, e.g. care of ecosystems, animal welfare, stimulating local economies, producing diverse foods, improving local availability of food. The negative externalities of much of our current food system, e.g., food miles, polluted waterways, and poor nutritional health, are not directly met by the producers or consumers and therefore have to be addressed through taxes. So, if customers are not prepared to pay more for food produced more positively, then it cannot be expected that food producers should subsidise that cost difference. They have to maintain their financial sustainability.

Farmers have got a lot of debt, and that's a pretty big driver for a lot of them... It needs to be driven from the consumer; if they want it and are happy to pay for it... the farmers can do it. **Martin Spear.**

Bakery Reflections and Expectations

*** This information has been provided in confidence; please consult author before distributing ***

Bakery A

- Uses 2,000kg of white flour per week and 50kg of whole wheat. Around 90% of their business is wholesale, even though they have a popular onsite café in a well-located city suburb.
- Baker was focused on organics, but after 15 years of trying to convince growers to convert to organics, supply was still not progressing. The Baker is now pro-regenerative & spray-free principles instead of organic.
- Sources flour from regeneratively-grown wheat through an ASP miller (Australian Sustainable Products Certified Company), *Wholegrain Milling*, is sent from Australia (*Wholegrain Milling*, n.d.) and supplied through a distributor.
- Finds NZ flour very variable. This is challenging as wholesale customers (90% of their business) require consistency.
- Wonders whether New Zealand has much smaller land areas planted; therefore, variability in quality is higher. Whereas, in Australia, they blend flour to standardise across much larger individual farms and soil types
- Most of their wholesale customers do not care about the origin of the flour currently.
- Manual handling of 25kg bags is problematic. In Australia, they provide 2MT bags, which can be put on hooks and amounts of flour weighed off as required.
- Have used NZ flour in the past (single-origin) and received no real positive or negative customer feedback.
- Need consistent supply at volumes to bake 2-300 loaves daily. *Farro* or *Commonsense Organics* cannot supply big enough volumes.
- Real issues about the variability of New Zealand flour create problems in the wholesale sector.
- Working with Massey University to develop a "Kiwi loaf" similar to *Vogel's* sourdough. Priced at a level Kiwis can afford. Created as a retail offering (via wholesale), so there is volume.

Bakery B

- This operation sits within an upmarket grocery/deli retail operation. A range of organic products is offered where possible. They have recently started a bakery to supply all the bread and pastries for the retail shop and are looking at supplying bread and baked goods to local wholesale customers.
- Main challenge is labour – cannot find staff to crank the bakery side of the operation due to unsociable hours and local competition from other work options paying up to \$45 an hour.
- Most of their flour is purchased through a local distributor or Icelandic Holdings. Currently buying a lot of Champion Flour direct, which is freighted directly to them.
- Customers have not asked about the origin of the flour but do care if it is organic and the availability of gluten-free options.
- Provenance could interest some of the vineyards around their location, which could be a factor when they start supplying them.

Bakery C

- A wholesale boutique bakery in two locations. They have traditionally been sourced through Farmers Mill New Zealand Flour (South Canterbury traceable wheat). However, they have had issues with the product - possibly moths, so they had to discard a pallet recently, and the supply is unreliable. So, have started using a 100% NZ-sourced Champion Flour.
- Purchase small volumes – about 100kg per week of white flour
- They do not need to worry about consistency, like those making loaves of bread. They can adjust ingredients easily depending on the flour qualities, whereas with bread, when you notice adjustments are required, it might take an extra 5 hours to bake. This can be disruptive to business.
- Coming from overseas, where they ran a restaurant using locally grown and milled flour, they understand this objective.



Figure 10. Buckwheat at OMG Goodness Bakery and Mill, Hawke's Bay. Image Source: Heidi McLeod

Bakery D

- Use 1 ½ tonne of Buckwheat, Tapioca flour, chia, linseed, kelp powder and seeds per week as a gluten-free, organic bakery.
- Focus is on providing high-value nutrition, gluten-free organic bread products.
- Produce 900 loaves per week and 300 units of their premix product.
- Purchase from Willowmere in the South Island, from Ceres Organics and are trialling some locally (central north island) produced buckwheat.
- We can mill 150kg per hour and ¼ of our bakery is dedicated to the mill. We are looking at getting a vacuum system to work with 1-tonne sacks.
- Feel that the grain/wheat sector is competing for land with dairy, which has substantial investment prioritised in it that is hard to get back. Local grain trials are essential to remove freight costs of supplies from the South Island.
- Beyond our gluten-free or coeliac customers, many people are eating our baked goods for flavour and nutrition - there is a market for it.

- Dehulling in New Zealand requires expensive machines, and different settings and requirements are needed for each grain
- What bread or baked goods New Zealand eaters get to eat is influenced by the dominance of dairy - that seems to be the nation's focus to the detriment of grain.
- Accountability and transparency of food labels is really important.
- People change their behaviour due to diet - we want people to understand the impact of climate change and food security and how that impacts what we eat. For example, in our bakery and cafe, we place a surcharge on cow milk and donate the surcharge to Forest & Bird.

Bakery E

- Purchases flour from Milmore Downs of about 15tonne to complement flour from the large New Zealand mills
- Over a year, uses about 120-140 tonnes - up from about 1 tonne 10 years ago
- "It doesn't appear there is any choice" - the offering seems very homogenous, says it's been milled in New Zealand, but not where the grain is from.
- You become more focused on where things come from. We are adding local grains to what we are already doing - that is less risky.
- Some bakers are ordering the grain to be grown explicitly for a specific purpose.
- Cognisant cannot charge for the premium local grains; therefore, using a 50% blend but would like to use 100% premium local grains.
- Bakers can see the difference in poor crops of grain/flour. Recently high ash content in their mainstream supply and miller resistance from the milling company to communicate about those differences or the vulnerability of certain crops frustrated the bakery. The main mills do not communicate or bother to build relationships with the Baker.
- Seems there is a lack of diversity in grain grown to mill in New Zealand to mitigate seasonality and climate differences.
- For individual artisanal bakers, there are not many options regarding grains and flours.
- See the value of a brand mark on grains and flours to identify provenance and quality.
- Feel the millers are controlling what is produced - ties into key customers of mills, e.g. bulk producer *Quality Bakers*, as well as the supermarkets
- Conscious of freight costs between the two islands and how this impacts the availability or viability of certain grains and flours.
- There is a basic need, however, for consistency of supply, a quality relationship between supplier and Baker, and good communication.
- Food is so expensive these days, there is a customer expectation that it should be cheaper, so it is hard to take on too much expense that may have to be passed on to the customer - we have absorbed it as much as possible so far.
- It is our goal is to have our own mill - to create a more resilient food system.

7. Local Grain Economy Pathways to Transition

The following section summarises important learnings and actions that can support a transition to growing a local grain economy. It describes the purpose and benefits of local supply/value chains and on-farming processing.

Mana-centred Local Food Systems

The following diagram is a synthesis of Angela Clifford's understanding of the potential of local food systems based on her work in them for the last twenty years. It considers a full plate of ingredients. Angela found that when people would talk about local food systems, the thinking was often limited to urban parameters and just fruit and vegetables. Seldom did the systems include meat, fish, grains, dairy and eggs, most of which are produced in rural areas and require some processing.

Our Food System Pioneers attempt to solve the problem of 'First Mile Aggregation'¹⁵ through on-farm mills, micro abattoirs, on-farm pasteurisation and community fishing hubs. In order to maximise value from these initiatives, there is an opportunity to re-design the rest of the 'Infrastructure of the Middle'. There has been much investment since Covid-19 into food rescue and distribution hubs, so Angela is considering whether these could be extended to become community food hubs.

These hubs could include food waste solutions, food rescue, and community composting. To be effective, they should consider the food waste hierarchy. There is likely tension between food waste mitigation and local food systems. As New Zealand is a high-quality, export-oriented food producer, second-grade or unharvested food contributes to food waste. Attempts to solve this issue could see small food producers needing help to compete in some areas. However, cleverly designed local food systems are the most viable solution for much of this food.

Several demand-driven activations can ignite mana-centred Local Food Systems. These include;

Local Procurement Policies: Hospitals, schools, aged care residences, local and regional councils, hospitality and tourism businesses and others can choose to source a percentage of their food locally.

Food Dollars with Local Incentive Programmes: Examples include the USA Farmers' Market Nutrition Programme. People can spend This amount of money in their local food systems to ensure good access to fresh food.

Green Prescriptions: Health professionals who can prescribe whole foods as a prescription which could be connected to the nutrition programme mentioned above.

Loss Attributing Qualifying Companies (LAQCs): The reinstatement of this status to farms that supply food to their local food systems would incentivise many more Food System Pioneers.

Supermarkets dominate Aotearoa's last-mile distribution. There is an opportunity to rethink this space for smaller food producers like our Food System Pioneers. We already have markets, including farmers' markets. There are still independent retailers, so ensuring regulations allow

¹⁵ See the discussion about this here: <https://theconversation.com/local-food-is-not-enough-we-need-a-sustainable-transition-in-the-food-system-201991> (Dale et al., 2023).

these alternatives to thrive would help our FSPs. However, this could also be extended to include places where people can gather to eat prepared meals, such as 'pay as you can' restaurants. It could also include community kitchens and learning spaces.

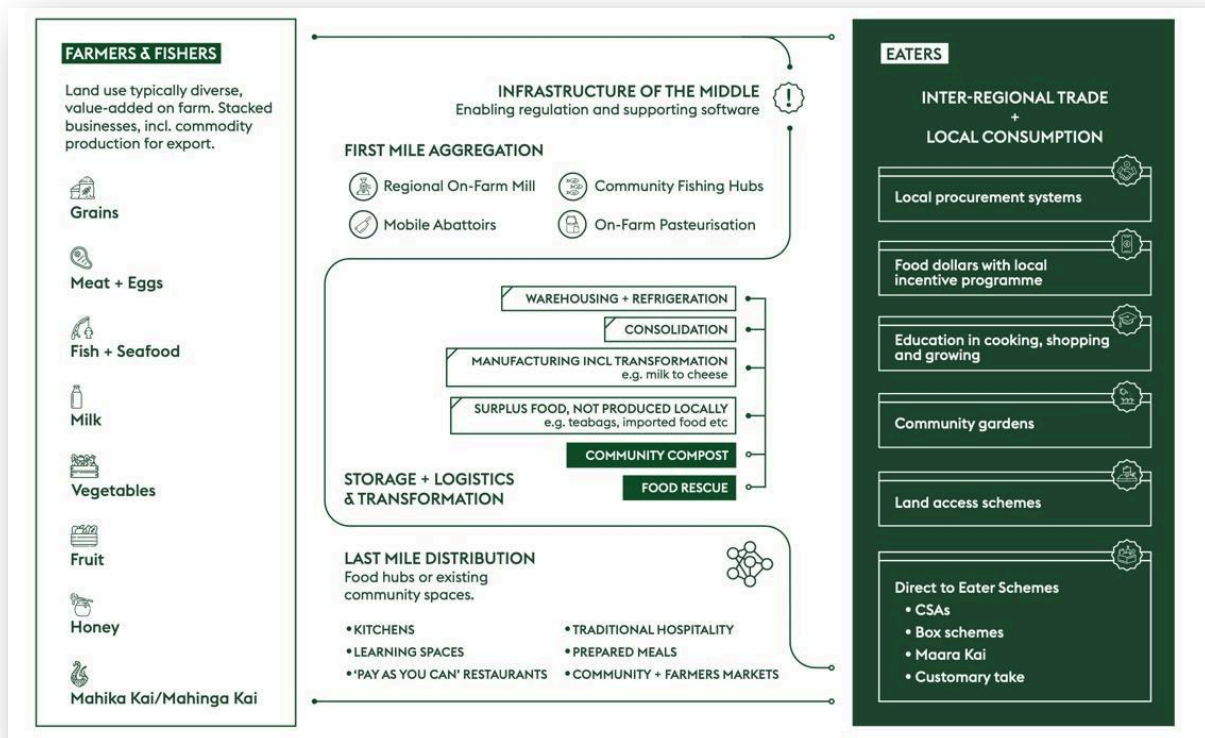


Figure 11. Image Source: Angela Clifford Eat New Zealand

Food Security

A significant driver for a Mana-Centred Local Food System could be food security. As there are major climate-related, geo-political and other stressors on our food system, this should see us place a higher value on locally produced grains, as an example. The growing focus on the connection between food and health has led to interest from the health sector in food systems. A culture of support for innovation and entrepreneurialism is essential for small food producers who want to supply their local food systems.

Food Sovereignty

Every community should be able to design their food system to serve their needs best (<https://www.zerohunger.org.nz/realising-food-secure-communities-aotearoa>). The outlined Mana-Centred Food System is offered simply as a suggestion and different communities will have different needs and priorities. It is imperative that we honour our treaty obligations in this respect.

Other Learnings

Number of On-Farm Mills

New Zealand is a relatively small market, so it will be necessary not to have so many on-farm mills that none are viable. Instead, collective or cooperative regional models will be most beneficial to ensure viable transitions. An example could be found in *Pure New Zealand Buckwheat*, where a mill or processing facility has significantly increased payments to buckwheat growers without them owning the processing or milling facility (*Pure New Zealand Buckwheat*, n.d.). Buckwheat is a 100-day crop, so it can be used as a rotation in a mixed farm business¹⁶. Stone and zentrofan mills tend to be favoured for the enhanced flavour and nutrition retained through this type of milling. Alongside mills, there must also be support services such as grain cleaning.

Milling Wheat vs. Feed wheat

Farmers will only grow milling wheat if there is an economic benefit. The feed wheat price can often be close to contract prices for milling wheat because of animal feed demand (including dairy). Feed wheat has lower quality parameters and higher yield and, as such, is a lower-risk option. How do we incentivise the growing of milling wheat and, if necessary, 'fall back' or downgrade to feed wheat in adverse weather events? Are there New Zealand food security imperatives that are useful here?

New Zealand Grown Grain Mark

There is no official mark indicating the percentage of New Zealand grains in a loaf of bread, as an example. This leads to claims of New Zealand-grown arable food when only a small percentage of the final product is New Zealand grown. By developing a mark, we can create a standard for the percentage of New Zealand-grown grains before a product can be labelled. There also needs to be a marketing campaign to support the development of this mark.

Consistency of Quality & Supply

How much research has been done into New Zealand milling wheat consistency? There is significant pushback from New Zealand bakers. Is it perceived or real? How is this communicated? There have also been some inconsistencies in supply. How can this collectively be addressed, understanding the impact this has on New Zealand milling wheat collectively?

Enabling Food Culture

There needs to be a wraparound food culture that celebrates, creates awareness of, and enables local food producers. This would allow more food system pioneers to thrive and not just survive. What activations can we encourage through media, local & regional government and other stakeholders that celebrate locally grown food?

¹⁶ Further information can be found here: <https://www.purenzbuckwheat.co.nz/> (*Pure New Zealand Buckwheat*, n.d.)



Figure 12. Carlos Bagrie shows the team through his meat processing facility with a mobile abattoir, butchery, and charcuterie processing section. Image Source: Heidi McLeod

These food system pioneers are small to medium in some respects, but they are commercial. This means they are not 'alternative' or hobby businesses. They are motivated to run profitable businesses, but they are also motivated by achieving high environmental standards and positive social outcomes.

8. Communicating the Transition

This section outlines how *Eat New Zealand* and *OLW* can collaborate to promote learning from this research to share with the wider rural profession and farming community. *Eat New Zealand* is involved full-time in the promotion and advocacy of food from field and sea to plate, as well as the livelihoods of those who grow, process, create and cook with it. *Eat New Zealand* is instrumental in shaping discussions around the production and consumption of food in Aotearoa, and communicating the findings of this project will become a key focus of their work around a local grain economy. *Eat New Zealand* will utilise the outputs of this research in its ongoing communication and advocacy work.

Eat New Zealand has been working on raising awareness about Aotearoa-grown grains through their local grain economy efforts, supported by the *Foundation for Arable Research*. This work has concluded that one of the keys to unlocking a local grain economy is removing barriers and enabling farmers to take back responsibility for small-scale processing. Doing so, they retain a role and share in the value chain. At the same time, they grow the overall local grain economy and create jobs and opportunities for local people and communities to benefit from or even be a part of their own food system.

Workstreams going forward

As well as communicating this research, several workstreams are going forward that will build from it:

Hamish and Simon's work to set up an on-farm mill.

Hamish Glendinning and Simon White continue their adventures towards an on-farm mill based in Hawkes Bay to service the upper North Island market.

Eat New Zealand's work on a New Zealand Grain mark with FAR.

Eat New Zealand and *Dirt Road Communications* are starting a project working towards a mark, indicating New Zealand-grown grains. This may include workshops for NZ bakers to improve their understanding and skills in working with NZ grains.

Eat New Zealand's work on regional food security strategies and mana-centred local food strategies.

Eat New Zealand continues to work with regions on food security strategies and mana-centred local food systems.

Academic connections

Eat New Zealand's researcher is actively utilising research findings in the academic arena to develop academic conference opportunities and to draft and submit a journal article to a high-ranking, peer-reviewed journal. Overall, the aim is to highlight the project undertaken in Aotearoa's critical agriculture sector. The outputs of the project will be publicised through Lincoln University and other relevant stakeholder groups, i.e. the *Food Transitions 2050 Joint Postgraduate School*, which is represented by Lincoln University, University of Canterbury, Plant & Food Research, Manaaki Whenua Landcare Research, and AgResearch. If appropriate, the research work may be extended into the student's PhD research.

Communication Plan

Objective:

This communications plan aims to promote the findings of our Rural Professional Fund research. The plan aims to create awareness, engage stakeholders, and overcome barriers to establishing a thriving local grain system and local food systems in general.

Target Audience:

- Farmers, growers, and rural professionals in the arable sector.
- Bakers, chefs, and food service professionals.
- Consumers and eaters interested in supporting local and sustainable food systems.
- Academic and research communities.

Objectives:

1. Raise awareness about the benefits of developing a local grain economy in New Zealand.
2. Communicate the findings of the research and the roadmap for enacting those findings.
3. Foster collaboration and engagement among farmers, processors, bakers, and consumers.
4. Promote regional food security strategies and mana-centred local food initiatives.
5. Establish Eat New Zealand as a trusted source of information and advocacy for the local grain economy.

Communication Channels and Tactics:

Stakeholder Engagement: Organise workshops, webinars or symposiums to bring together farmers, processors, bakers and other stakeholders to discuss the potential of a local grain economy. Seek opportunities to speak at conferences, industry events and webinars to share insights and promote the benefits of local grain economies and local food systems.

Collaboration with Tangata Whenua: Foster partnerships and collaborations with Māori organisations and communities to invite indigenous perspectives and practices into the development of the local grain economy, including awareness raising for traditional practices, including rēwena bread. Highlight the potential benefits of food sovereignty and increased agency for Māori through involvement in the production, processing and distribution of arable crops.

Social Media: Utilise Instagram, Threads and LinkedIn as platforms to share key messages, updates, and visual content related to the local grain economy. Incorporate relevant hashtags such as #EatNZGrains, #GrowFoodCommunities, and #LotsofLittle.

Newsletters: Send regular newsletters to subscribers, highlighting the research findings, progress in workstreams, upcoming events, and relevant news.

Media Content: Produce articles, press releases, and interviews to share the research findings, success stories, and the importance of a local grain economy. Target both industry-specific publications and mainstream media outlets.

Website: Create a dedicated section on the Eat New Zealand website under Food Systems, providing access to research documents, videos, and other valuable resources. Regularly update the website with new information and developments.

Academic Connections: Collaborate with researchers and academic institutions to present the research findings at conferences, submit articles to peer-reviewed journals, and potentially extend the research into PhD work. Engage with academic communities to amplify the impact of the research.

Activations: Plan and execute activations such as "The Shortest Meal," a campaign encouraging people to prepare meals with the shortest food miles on the shortest day of the year. Use these activations to generate awareness, engage the public, and highlight the benefits of local grains.

Communications Messages:

1. Highlight the key benefits of a local grain economy, including improved food security, more significant equity for farmers and growers, diversity in grain and seed production, increased opportunities for small-scale farmers, and transparency in food origins and practices.
2. Emphasise the positive environmental and social outcomes of small-scale farming and growing practices.
3. Promote the idea of growing food communities and supporting local producers.
4. Utilise hashtags like #EatNZGrains and #GrowFoodCommunities to create a cohesive online presence and facilitate engagement.

Communications Materials:

- Develop a concise 4-page public and sector overview document summarising the research findings and the pathway to transition.
- Create a collection of compelling images and videos to illustrate the research, showcase local grain production, and demonstrate the benefits of a local grain economy and mana-centred local food systems. Determine the appropriate platforms and channels to share these visual assets effectively.

Outcomes:

Facilitating a local grain economy can achieve five important things for New Zealand's agricultural sector and its consumers:

1. Provides increased self-sufficiency in Aotearoa's grain production, milling, and flour supply. This improves New Zealand's food security, which many other countries are doing following COVID-19.
2. It provides more opportunities for farmers and growers to take a more significant stake in the value chain, placing more equity in their hands.
3. Provides more diversity in grain and seed production and, therefore, more diversity in processed grains, milled flours and baked goods.
4. It provides more scope for small-scale farmers and processors to enter into the market space. This also increases the positive environmental and social outcomes prevalent among these farmers and growers.
5. It gives eaters increased transparency around food origins, farming and growing practices, and increased access to more diverse grain and seed products with health-giving benefits.
6. Encourages a diversity of land use by showing high-value pathways in arable farming.



Figure 13. Mill at OMG Goodness Bakery in Hawke's Bay. Image Source Heidi McLeod

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