



**KOI TŪ:
THE CENTRE FOR
INFORMED FUTURES**

'The Future is Now'
Conversation
Series

THE FUTURE OF FOOD & THE PRIMARY SECTOR: THE JOURNEY TO SUSTAINABILITY

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EXECUTIVE SUMMARY

This discussion paper has been developed by Koi Tū: The Centre for Informed Futures through a series of conversations with industry leaders, scientists and stakeholders. It seeks to further conversation on the issues confronting the future of New Zealand's agricultural and food production system. The use of the word 'system' as a singular unit is intentional. It conveys an approach to the food sector as an interconnected whole, encompassing agriculture, horticulture, aquaculture and fisheries and ranging from production through distribution, marketing, selling, consumption and disposal. This paper is one of a series focused on current issues intended to stimulate and inform dialogue about what kind of future we want. The paper does not attempt to provide prescriptive answers; rather, its purpose is to encourage the multidimensional discussion that is needed at a national level, recognising that the future of the food production system cannot be considered in isolation from our environmental, cultural, social and economic futures.

COVID-19 AND THE FOOD SECTOR

Along with its major social wellbeing implications, the COVID-19 pandemic is changing the economic shape of our country in profound ways. Although our robust tourism sector has been stopped in its tracks, fortuitously, our food industry is growing, and global demand remains buoyant. Our food production and processing industry remains a key part of our economic and environmental future.

As the rest of the world continues to struggle with the pandemic, New Zealand is now considered "COVID-free", and our global reputation has risen accordingly. There is an opportunity to leverage the mounting international interest in our unique national values and attributes and our status as a leading producer of elite primary products as the basis for the renewal of New Zealand's national brand. Farmers and producers are already shifting to position themselves for a future based on the values of sustainability, resilience and kaitiakitanga (guardianship).

THE FUTURE: A VALUES-BASED INDUSTRY

Over recent years, world consumer demand for high-quality food and food systems has been growing, accompanied by a resurgent interest in the values underlying the food's provenance. This includes "credence attributes", such as safety, nutritional value, animal welfare, carbon footprint and environmental protection. In the context of uncertainty created by the pandemic, discussion around the sustainable and safe food systems is taking greater prominence.

Alongside this, the commercial case for sustainability is becoming much more apparent, with a sustainable business model integral to success in uncertain times. Global financial markets are valuing these characteristics ever more highly, stimulating increased demand for reporting frameworks that measure all inputs into the production process, including monitoring the health of the natural resources that underpin the industry. A move from a linear to a more circular food system seems to be emerging.

Such moves towards sustainability are not new for our farmers and growers, but the journey already under way is being accelerated. In contrast to the more extractive, economically-orientated mindset that was common previously, farmers are increasingly focusing on the long-term health of their land, animals and people. Consideration of natural capital resources requires that the health of soil, waterways and biodiversity is protected and valued in every production and management decision.

CHALLENGES AHEAD: THE NEED FOR A STRATEGY

The opportunity for New Zealand's food and primary industries to leverage their rising reputation based on full commitment to environmental sustainability is not without challenges. There is a need to re-evaluate existing paradigms, business models and mindsets in many aspects of the food sector. Supporting this, there must be an integrated strategy with a common set of goals, based on a collective, cross-sectoral agreement that links economic, social and environmental aspirations.

Ultimately, our food production system will also need to become carbon neutral. Business-as-usual, incremental approaches will not lead to the necessary transformation. Addressing the underlying issues that could make the biggest impact, such as the determination of land use, water-access rights and water-quality issues, has continually been placed in the too-hard basket. Further, with the reality of climate change, our pastoral farming system must adapt to the changing weather patterns that could make some current practices and land uses untenable. Climate change will also heighten the risk of biosecurity incursions, which threaten plant production and animal health, as well as native biodiversity.

The common assertion that our food production is a mature industry is wrong. There are major opportunities, both terrestrial and aquatic, to advance the sector, but a more strategic approach to research and development is needed. Incentives in the New Zealand research system have a largely short-term focus, and significant changes are needed so that it addresses a clear set of strategic goals. To be strategic, the science system needs to fix its splintered nature and the misplaced incentives on which it is based. Further, the make-up of the private sector creates challenges, because most producers and manufacturers are small businesses.

Many different technologies, including sensors, big data and artificial intelligence, and the huge breakthroughs in the life sciences, such as gene editing, will dramatically change agriculture and food production systems around the globe. Non-animal-based foods, replacing meat and milk using advanced technologies, are rapidly emerging. Decisions will be needed as to which technologies New Zealand should exploit to sustain this sector. New food-processing systems, such as 3D printed foods and sustainable packaging, are also being developed in response to consumer needs. Indeed, consumer preferences in different markets are evolving rapidly. The necessary adaptations, investments and innovations will take time, but need to be planned for now. Metrics must be developed to enable and empower change across the sector.

Internationally, there are increasing calls for dramatic changes in food consumption patterns, in particular a move away from ruminant-based to plant-based foods to reduce the environmental impacts of production. This could significantly affect the acceptability of New Zealand's pastoral products in some markets. This challenge and the impact of reports such as EAT Lancet¹ in shaping public perceptions underlines the need to address the issues of providing evidence-based narratives around healthy and sustainable diets, adapted to local contexts.

A NEW NARRATIVE

In the rapidly changing post-COVID operating environment, there is a chance for a compelling and authentic narrative to be built with stakeholders both domestically and globally, leveraging the opportunity for New Zealand to become a "global thought leader" in sustainability across the entire food system. Taking a proactive approach to emphasising the qualities of sustainable, low-carbon dairy production, agriculture, horticulture, fisheries and aquaculture would be highly valuable to New Zealand. Examples already exist. The country's pasture-based, low-energy, grass-fed farming systems exemplify the highest standards of animal welfare with a relatively low carbon footprint per unit production. Likewise, our sustainable, well-managed fisheries are already well respected. But there is always room for improvement, and claims such as these must be supported by the evidence.

GOING FORWARD

It is critical that Government agencies take a coordinated partnership approach with scientists, producers and manufacturers to support and encourage the food and production industries' journey towards a resilient future. Required components are:

- Agreement on goals for sustainable and renewable pastoral farming, horticulture, fisheries and aquaculture.
- The development of a clear narrative around sustainable food production – development of a Sustainable New Zealand country brand, as the Irish did with their "Origin Green" positioning.
- Investment in the provision of accurate environmental data that will provide validation for the claims being made to global consumers. This may include certification and labelling systems where appropriate.
- Investment in the long-term and strategic research necessary to support an increasingly technologically-based sector facing rapid change as a result of the realities of climate change, environmental footprints, and different markets and consumer expectations. Barriers to exploring the potential of advanced life science technologies to assist our food system need to be periodically reassessed, given the rapid advances in knowledge related to their use.
- Investment in supporting producers to ensure food safety and provenance traceability, and in data sharing across the sector. Biosecurity must be paramount across all production systems.

- Investment in broadband connectivity within the rural sector, which will enhance productivity through best practice sharing and enable data transmission to inform decision-making.
- Increased efforts to protect our free-trade relationships and market access, in an environment of increasing protectionism globally.
- Attention to workforce requirements in the primary sector, including psychosocial needs of rural communities, upskilling of displaced workers, and training for future high-tech production methods.
- Clear and unequivocal endorsement to the nation of the central role of the primary industries and growers in wealth creation and jobs for New Zealand.
- Development of a national marine strategy that allows for innovative, sustainable aquaculture development and investment while supporting the preservation of marine ecosystems and biosecurity.

The advisory group for this report includes many of New Zealand's most senior and experienced leaders in our food system. They have contributed knowledge of all aspects of the industry, from the farm through to the consumer. They share a belief that the inflection point created by COVID-19 has presented us with an unparalleled opportunity to accelerate the transformation of our core export industry towards a more sustainable and profitable future, such that it will underpin the health of our nation.

This paper should be read in conjunction with its companion paper *The Environment is Now*,² which focuses on broader environmental issues. Both are to encourage critical thinking about New Zealand's future.

1 <https://www.thelancet.com/commissions/EAT>

2 <https://informedfutures.org/wp-content/uploads/The-Environment-is-Now.pdf>

INTRODUCTION

Koi Tū: The Centre for Informed Futures is a non-partisan, transdisciplinary think tank. Its report *The Future is Now: The Implications of COVID-19 for New Zealand*³ focused on the need for significant reflection on the country's direction as we recover from the pandemic, which represents a significant inflection point for all economies and brings wide-ranging social, economic and environmental impacts. Some contend the pandemic has mainly drawn attention to trends that were already emerging. But the size and scope of the global disruption have prompted considerable discussion on whether more substantive change is needed, and what is possible.

Crisis situations tend to inspire people to work together, with a singularity of purpose that is difficult to muster at other times. Will the experience of COVID-19 provide sufficient motivation for New Zealand to work collectively towards a common goal of resilience, to get us through the current period of ongoing disruption and better prepare us for future challenges? This would mean finding ways to adapt to changed circumstances and transform positively, seeking opportunities rather than focusing on impediments to progress.

New Zealand's admirable, cohesive early response to the COVID challenge has seen its reputation and visibility rise on the world stage. We have a chance to leverage this in developing a national brand that reflects our unique values and culture, our strength as a people, and our deep respect and affection for the environment.

As we emerge from the pandemic's acute phase, a number of factors are aligning to highlight the role of our food sector as a key component of our economic and environmental future. New Zealand pastoral businesses have had a powerful and attractive national brand in global markets – one that has arguably been significantly enhanced by our response to COVID-19. With tourism somewhat compromised for the next few years, the strength of food sector is critical to the economy. It is timely, then, that thought is given to what is required to ensure its sustainability.

CATALYSING THE CONVERSATION

The Future is Now highlighted the need to consider the broad strategic direction for our primary sector – one that fully integrates environmental, social and economic factors. Until now, the Government and other regulators have tended to see issues in a siloed manner rather than holistically, overlooking the interaction between the food system and the environment, tourism, health, social custom, and regional development. Indeed, current food-sector policies are based on fragmented objectives and, like food-sector science, tend to be driven and incentivised primarily by short-term goals. A fully integrated strategy is required, and this will be achieved by having a collective, cross-sectoral agreement on common goals for achieving environmental, social and economic sustainability.

In this regard, Koi Tū, as a broker and facilitator, has brought together different actors in the food sector to stimulate discussions. In parallel, a broad group of sector leaders convened to consider New Zealand's environmental future. Those conversations resulted in the companion report *The Environment is Now*. The reports were developed together with overlapping membership of the conversations, and early drafts of the two reports were shared. The contributors to this conversation and report are listed in the Acknowledgements.

This paper gives a brief overview of the range of issues at hand. Rather than prescribe solutions, it is intended to catalyse further engaged conversation and action. In doing so, it recognises and is complementary to current initiatives, such as those of the Primary Sector Council⁴ and Te Hono.⁵ Further discussion should be had by a broad, coordinated group of food industry stakeholders, including those engaged directly with consumers and global markets.

3 <https://informedfutures.org/wp-content/uploads/Koi-Tū-The-Future-is-Now.pdf>

4 <https://www.mpi.govt.nz/about-us/our-structure/government-advisory-groups/primary-sector-council/>

5 <https://www.tehono.co.nz>

CHALLENGES FOR FOOD PRODUCTION SYSTEMS

Global food production systems in their present form have been viewed as unsustainable in the face of climate change, biodiversity loss, ecological degradation, and an ever-increasing demand for food volumes.⁶ It is well understood that significant changes in food systems, encompassing production, distribution, marketing, selling, consumption and disposal, will be required if such threats are to be offset. The increasing concern about food system sustainability and global food security is highlighted in the objectives of the UN Food Systems Summit planned for 2021. The summit is expected to yield a political declaration outlining principles for sustainably transforming food systems, tied to the UN 2030 Agenda and the Sustainable Development Goals (SDGs). As the brief for that meeting states:

To make this happen, we need new ideas, strong partnerships, and global conversations to work through the tough decisions and trade-offs we inevitably face.⁷

From New Zealand's perspective, the ongoing global disruption and destabilisation resulting from the COVID-19 provide cause to rethink many of the interrelated aspects of the food system and how they relate to the global economy, including food security, trade and the environment. This interruption to 'business as usual' has opened up opportunities to reconsider what has been 'normal' practice. Under greatly changed circumstances, there is now the imperative to re-evaluate existing paradigms, business models and mindsets. The pressures have long existed, but action has generally been slow and uncoordinated. Now, the economy as a whole faces a reset as it confronts the pandemic's intermediate and long-term negative effects across many sectors.

FOOD AND THE ENVIRONMENT

Food production is resource intensive and can have wide-ranging effects on the environment. Given climate change and the broader environmental impacts, there is an expectation that our food systems must become more sustainable, and ultimately carbon neutral. Issues of land use are central to both global and local discussion on sustainability, and in New Zealand, water ownership and associated rights are an unresolved concern. These issues must be addressed.

Some considerations are particularly pertinent to our pastoral production style. Often, economically useful sheep and beef farming is found in relatively steep hill country that is unsuitable for any other productive purposes except forestry. Conversely, intensive dairying can occur in places where soil structure is too fragile and free draining to avoid ecosystem damage. Questions can be asked about past land-use zoning decisions and even some irrigation schemes. The rapid conversion of some areas to intensive dairy farming, such as the Mackenzie Basin, Canterbury and Southland, and extensive deforestation in the central North

Island for the same purpose, have brought short-term returns, but their environmental impacts have been large and persistent.

Agriculture's large contribution to our greenhouse gas emissions is a concern for the sector as a whole and is at the heart of New Zealand addressing its commitments to be carbon neutral by 2050. Multiple strategies for reducing emissions from agriculture are being developed, and current farm practices can be further improved. But the transformation may require changes in available forages (likely developed through new plant breeding techniques) and/or the use of chemical inhibitors of methane production, which are now moving from the laboratory to field testing, at least outside New Zealand.⁸ Such technological advances will require both regulatory developments and consumer acceptance in key markets, and from experience we know that sometimes they can be hard to achieve.

The reality is that our farming system will have to adapt over the next 30 years to cope with changing climate and weather patterns. Many dairy-intensive areas will become more arid. Without massive investment in appropriate water infrastructure, such regions will have to consider different land uses and forage systems. Such changes take time, so need to be planned for now. It is possible that New Zealand's pastoral ecosystems are now reaching the biophysical limits to growth and even sustainability. The recurring issues are well known and include:

- Land-use competition and inappropriate land use
- Soil degradation and loss
- Water rights and use
- Irrigation and water quality
- Excessive use of synthetic nitrogen and other fertilisers
- Biodiversity decline
- Pollution of aquatic ecosystems from ill-advised land use
- Climate change effects that will reduce productivity or force changes in types of activity
- Biosecurity failures resulting in incursion of weeds, pests and animal diseases
- Increased detection of pesticide residues (as a result of better technologies) in New Zealand's markets, possibly leading to the imposition of non-tariff barriers

This incomplete list is daunting. But if our vital primary production sector is to continue to thrive and support New Zealand's wellbeing, these challenges must be tackled through a coherent and collective strategy.

6 SAPEA Evidence Review Report no. 7 (2020). A Sustainable Food System for the European Union. SAPEA Berlin. ISBN 978-3-9820301-7-3; DOI 10.26356/sustainablefood

7 <https://www.un.org/sustainabledevelopment/food-systems-summit-2021/>

8 <https://www.pmcasa.org.nz/wp-content/uploads/Mitigating-agricultural-GHG-emissions-Strategies-for-meeting-NZs-goals.pdf>

A REFRESHED STRATEGY FOCUSED ON SUSTAINABILITY

New Zealand now has the strategic opportunity to commit strongly to a sustainability agenda across the food sector, extending well beyond pastoral agriculture to include arable production, horticulture, fisheries, and aquaculture. Consideration must also be given to our food manufacturing industries and their relationship with offshore consumer markets, which are becoming increasingly sophisticated. The sector needs a widely-accepted, overarching strategy for sustainability, in which all the components work together for the benefit of the whole.

We have a chance to develop and promote a values-based food system that will meet the expectations of global food investors and consumers in a post-COVID world. These include economic, labour, cultural, social, environmental, ecological, animal welfare, human health and safety values. We must also face the environmental and social realities of the future. We are already seeing political consumerism and activism for animal welfare, environmental sustainability and climate change demanding more and more sustainable food alternatives. Global financial markets are increasingly valuing sustainability and insisting on reporting frameworks that take into account the full product life cycle. Our producers want to meet these demands, but will succeed best if operating collectively.

However, the COVID-19 shock has also highlighted the parlous lack of cohesive decision making and long-term strategic thinking about what the future holds. New Zealand's vitally important primary sectors could be blindsided by consumer and international geopolitical trends post-COVID.⁹ In particular, the crisis has affected global supply chains and accentuated the potential issues New Zealand will face with its reliance on global trading. We are vulnerable to tariffs based on our current export markets looking for domestically produced food sources, to a general shortening of supply lines and a greater drive by some countries for food self-sufficiency. Conversely, there is opportunity for New Zealand, for example by advancing supply-line efficiency to be able to take advantage of e-commerce. There is also the potential to use our agricultural expertise commercially to rebuild capability in other countries.

CHALLENGES AND OPPORTUNITIES

Dairy farming in particular has been vilified over environmental concerns, in spite of concerted efforts by producers to mitigate the sector's impact. Adding to this, many commentaries and reports¹⁰ have crystallised calls for dramatic changes in food consumption patterns to reduce the environmental impact in ways that could significantly affect the acceptability of New Zealand's pastoral products. These developments have been used to argue for rapid moves away from ruminant farming and towards plant-based foods, such as industrially-produced meat substitutes. However, it must also be recognised that New Zealand ruminant farming is very different from intensive

grain-fed, barn-reared animal systems. Our grazing systems are very low energy, and produce low amounts of greenhouse gas per unit of production relative to pastoral systems elsewhere. Further, New Zealand could position itself well to meet more demanding future carbon-footprint requirements. Over time, new regulations will require all farmers to have a freshwater module in a farm plan, allowing reporting against water-quality measures. Animal welfare is generally of a high standard, but consumers expect ongoing reassurance, and international standards are continuously evolving. The provenance of products is always important, and this is an area New Zealand can continue to work on.

Generally, our exporting primary sectors have some grounds for optimism, as their productivity levels have not been severely disrupted by COVID-19, unlike other parts of the economy. However, flattened consumer demand offshore may affect prices for some time. However, under the very changed conditions, broad agreement exists across the food industries to move determinedly and coherently to ensure long-term sustainability and resilience of these all-important sectors. In particular there are calls to move beyond large-scale, commodity-driven primary production to offer high-value products and a greater diversity of products with lower environmental footprints. The challenge is how to achieve this. It cannot be done without systems thinking and an understanding of the complex dynamics of the interplay of food production with virtually every aspect of New Zealand economic, social, cultural and environmental life.

Māori have particular relationships with our land, rivers and the sea. They are significant actors in the Aotearoa-New Zealand food system, and they think intergenerationally. The Māori approach to farming assumes the land will remain in their collective ownership for centuries. Some non-Māori farmers also see their link to the land passing through generations, but many others also look as much to capital gain as to income. These very different cultural strategies must be understood as we mutually explore changes in our food systems.

Many of these issues have arisen from a long-time lack of high-level national strategic planning for the whole of the primary industry sector. For at least the last 20 years, prevailing sentiment has been to let the market decide. This has led to splintered, incoherent and short-term decision-making both in the private and government sectors.

FRAGMENTED SCIENCE

In keeping with this, primary-sector science has been similarly confined to rather short-term research. Scientific research has increasingly been referred to simply as "innovation". This is a misnomer and it has precluded the long-term monitoring of the agro-ecosystems that is essential if we want to start answering the questions above. The long-term issues, such as soil loss and rainfall distribution changes, are well known, but the national

⁹ <https://informedfutures.org/new-zealands-place-in-the-world/>

¹⁰ <https://www.thelancet.com/commissions/EAT>

research system is not focused on undertaking that research for the types of farming will be needed in the future (with the possible exceptions of arable horticulture and aquaculture).

Similarly, our food production research is relatively short-term and lacks a holistic strategy. In part, this reflects the company base in New Zealand, which is dominated by small producers who may not be well aligned. In the dairy sector, the undercapitalised nature of food research relative to supporting commodity exports holds New Zealand back, compared with similar food producers such as Denmark and Ireland. This contrasts markedly with the substantial and strategically based government investment in advanced foods and food safety by countries such as Singapore. Even agreeing on standards has at times proved difficult and divisive, as exemplified by the issues surrounding manuka honey.

A CRITICAL NEED FOR ACCESSIBLE DATA

It is critical to have access to better and more complete data to support decision making across the primary industries. Although datasets exist (e.g., soil type maps and predicted rainfall patterns and water catchment information), they are not readily accessible, in part because of data sharing and IP issues. Further, the information may not be in a form that farmers or farm advisors can use to make informed decisions at an individual farm level. Such gaps reflect a lack of coordinated research and vision for what is needed on a practical level to make long-term sustainable choices on land use, as well as to inform best practices to arrest further damage and restore ecosystems. Rural broadband has connected farmers and producers to information and also socially. This is very important, but it is far from universal, and bandwidth is limiting.

FOCUS ON BIOSECURITY

Biosecurity is of huge importance to our food and primary sector. Border biosecurity is particularly critical in preventing incursion and establishment of exotic organisms, often insect pests and plant diseases that threaten food production. New Zealand must continue to excel at keeping out such threats, as the devastating effects of invasive species on our primary industries are well known.

Associated with this is an immediate trade dimension. New Zealand has had a major influence on setting up international phytosanitary agreements that guarantee trading partners follow high standards of biosecurity compliance. Under the rules, refusing imports on the basis of biosecurity concerns can be justified only when there is scientific evidence. This precludes biosecurity being used by stealth for what are effectively non-tariff barriers.

New Zealand needs to be recognised as exporting products that are pest and disease free. Maintaining a high level of biosecurity is critical, as we simply cannot accommodate more exotic invasive species if we are to sustain our productive ecosystems. These considerations will become more important with climate change affecting biosecurity threat diversity, and diversifying trade patterns, and are therefore critical to any future-focused strategy.

AGRICULTURAL AND FOOD TECHNOLOGY

Innovation must focus on finding new, more sustainable production methods, improving supply-chain efficiencies, and incorporating innovations from other industries, such as the use of drones and artificial intelligence (AI). The future of all forms of food production will rely increasingly on technology and data and, in particular, on information provided by sensors and advanced analytics. Such technologies will depend on farmers and growers being completely digitally connected, with access to sufficient bandwidth to use it effectively and efficiently. This infrastructure will be as critical in rural New Zealand as it is in urban areas.

Horticulture is well placed to adopt precision technologies, with data and sensors to manage resource inputs. Robotics are being developed for harvesting and processing. Recently, interest in vertical, hydroponic and intensive production of plant-based food (e.g., lettuces) has been growing. In the wake of the pandemic, it is likely the growth of these vertical farming operations will increase further as the world's major cities seek to improve food security and shorten supply chains. Is there an opportunity for New Zealand to incorporate cultivars other than lettuce and leafy greens into these systems, or to develop our own systems?

There is significant convergence in technology and food production, particularly as personalised nutrition develops. The biology of nutrition is changing, with a far greater focus on the reality that what we eat is not necessarily what we absorb. The gut microbiota act as intermediaries, and advanced food research is increasingly taking this into account. Developments in food manufacturing, such as 3D printing, are being explored to deliver foods with greater potential to advance healthy nutrition. Increasingly, major food companies are looking, especially in Asia, to link food composition and presentation to health promotion. If New Zealand is to move from commodity-weighted food exports towards high-value food exports, it will have to embrace and engage with these technologies.

The move in many countries to plant-based foods includes the use of fermentation technologies, often involving genetic manipulation. Already, plant-based and technology-based equivalents to meat and milk are rapidly finding market shares in advanced markets globally. As the technologies progress and production costs fall, and depending on consumer acceptance, these may become real challenges to commodity-based milk and meat production systems. They are not an immediate threat to our pastoral farming, but they could become so in the next decade. The pastoral sector will need to protect its position through high-value products and by diversification.

New Zealand may need to explore whether it, too, has advantages in advancing synthetic food production. If the market for plant-based meat substitutes continues to grow as projected, these factories will have to source large amounts of nitrogenous (legume) plant material, such as lucerne, and various leguminous grains for manufacture. This is an opportunity for the New Zealand primary sector to consider. These ingredients, which may be based on precision irrigation, must be pesticide free and also free of fungal species, some

of which can seriously affect human health. Also, plant-based foods produced through new breeding technologies such as gene-editing would allow the development of precision foods designed for specific market needs, including health and medicine. For example, there is the potential to reduce the glycemic loads in ways that could be very useful for the management of diabetes – an enormous potential high-value market for this exists in Asia. Significantly, though, this type of approach would require research investment combined with industrial partnerships at a level not yet seen in New Zealand. Here, the issue is whether new molecular-based plant-breeding techniques should be applied in New Zealand food systems. Much of the world is already doing this, especially in the production of feedstock for cattle, pigs and chickens, and in the production of key ingredients such as rennet used in cheese production. Consumer attitudes are, at best, mixed. As food-security and environmental concerns inevitably rise, consumer attitudes to these technologies is likely to change. In part, this is because concerns expressed when earlier versions of these techniques emerged 30 years ago have now been empirically addressed. There is recognition of their increasingly widespread use internationally, and their potential as a tool in addressing difficult agro-environmental issues. As yet, it is unknown whether the use of forages being developed by such techniques will reduce methane and other environmental footprints in this country. The reason is simply that they cannot be tested in our environment because of our highly precautionary regulatory regime. The question is, would they put land use on a more sustainable footing while helping to secure the rural economy? Right now, we simply don't know because of the lack of empirical data and the inability to obtain it.

Biosecurity scientists are exploring how genetic technologies can be used to enhance resistance to invasive pests and diseases. These technologies can also be used to better understand soil microbiology and thereby enhance soil quality. Also, important progress is being made in our understanding of the complex microbiology of the rumen, to reduce greenhouse-gas emissions and increase productivity. The technologies for advancing such questions are being developed in different ways in New Zealand and beyond.

Some consumer groups remain uncomfortable with the application of genetic technologies, but there are ways for organic-type farming systems to exist alongside such technologies, as they do in other countries. This applies particularly if the plant species involved do not have promiscuous gametes or at least the dispersal of pollen can be controlled. New Zealand will definitely have a more limited suite of options in the food and agriculture sector if advanced biological technologies remain off limits. The history of technology adoption in general suggests that continuing to avoid domestic evaluation of these new technologies is a high-risk strategy.

Another area of critical long-term importance to our export sector is that of advances in food packaging. New approaches and technologies will be needed to meet consumer expectations and environmental obligations. Traceability and food safety are related matters that must continue to be emphasised. Complacency around food-safety measures would create huge risk. At the same time as detection mechanisms become more sensitive as a result of technological advances, continued attention must be paid to preemptive interactions between producers, manufacturers and regulators: the latter both domestically and internationally.



MOVING FORWARD: TRANSFORMATIONS NEEDED

Transforming the food system to fulfil rapidly evolving market and societal demands will require a number of fundamental changes. This will certainly require the balancing of all impacts, with considerations for health, cultural factors, the environment, consumer attitudes and economic aspects.

The underpinning sustainability goals are to:

- Implement climate-resilient agricultural practices
- Ensure healthy food for all New Zealanders
- Overcome social and economic inequalities
- Protect our environment and native biodiversity
- Minimise greenhouse gas emissions
- Sustain the aesthetics of our landscapes

Achieving these goals will involve:

- Using our land types more appropriately
- Managing yields while decreasing the environmental burden (biodiversity loss, soil erosion, water shortages and pollutions, emissions)
- Improving resilience through land-use diversification
- Finding ways to move exports up the food-value chain
- Reducing food loss and waste
- Stimulating changes towards healthier, more sustainable diets
- Responding to consumer preferences and market demand
- Accommodating issues relating to food sovereignty and healthy food access

A more strategic approach to scientific (including natural, data and social sciences) and technological developments will be necessary to support these objectives.

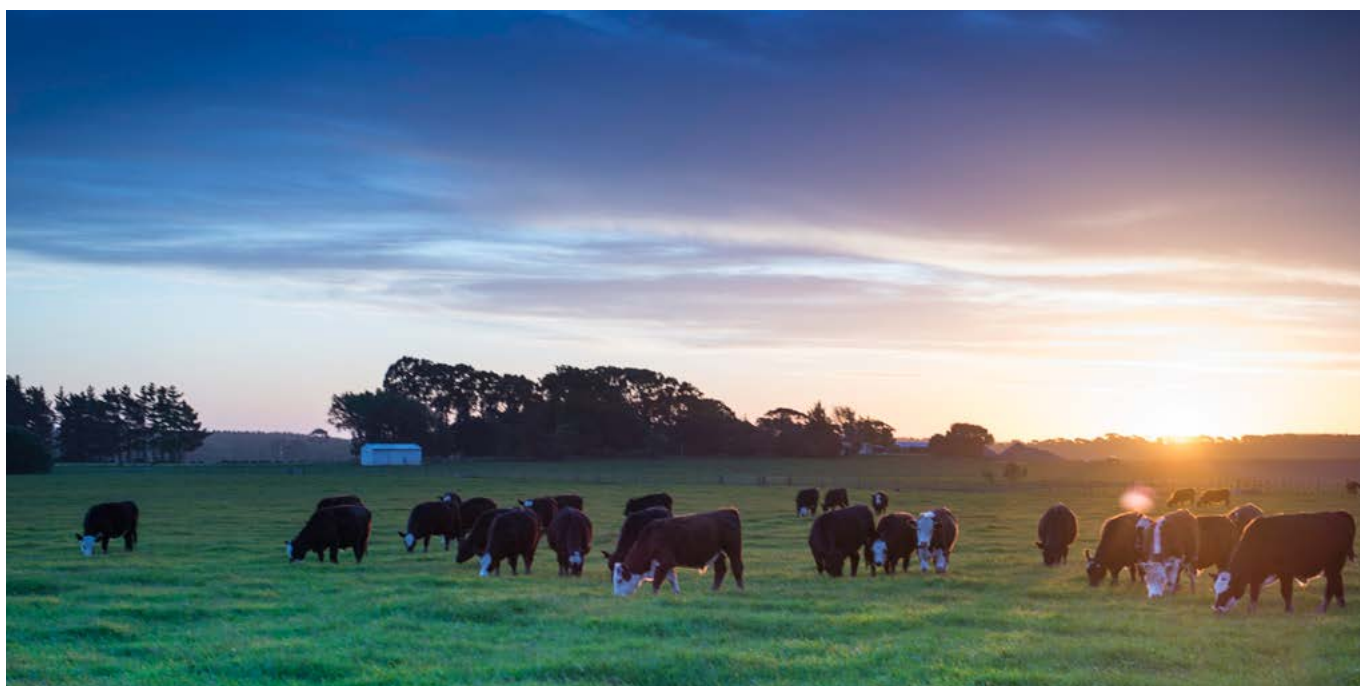
For the land-based primary sectors more specifically, there is a big opportunity for more beneficial and effective land and

water use. Water harvesting needs to be optimised based on sound science and local knowledge, and its use in irrigation carefully targeted for environmentally sympathetic production intensity and increased product value. A lot of flat land with suitable access to water is amenable to arable cultivation and the development of high-value horticultural crops.

Such a move, combined with suitable precision, will create a mosaic of land uses, increased employment, ecosystem stability and a hedge against some of the effects of climate change. Conversely, using such irrigated flat land with good soils for extensive ruminant grazing may not be optimal, and is often polluting. Ruminant grazing such as dairying is better suited elsewhere, and a significant amount of steep hill country (notwithstanding erosion-prone areas) provides an optimal opportunity for sheep farming without the need for cultivation. In all cases, such land uses have to be underpinned by accurate understanding and continuous monitoring of the associated biophysical environments.

Any shifts in land use have social and political implications and raise questions of how they should be determined. As it is, innovative farmers are already diversifying their land use, achieving emissions reductions and reducing pest and disease effects. Traditionally, changes in farm systems are believed to take about a generation, but the urgency created by the pandemic and new opportunities to create jobs and wealth may make faster progress possible. This has already been demonstrated by changes in land used for dryland sheep production to vineyards. But this still takes time and capital and, depending on the type and rate of change, it can be associated with considerable social disruption.

Seafood is likely to become a greater part of people's diet, but it will increasingly be farmed fish. That said, pastoral agriculture must be adjusted so that it does not pollute waterways and contaminate fish and mollusc farms.



THE RESET: COMPLEX CONSIDERATIONS

BORDER CLOSURES, INTERNATIONAL TRADE ISSUES AND SUPPLY CHAINS

The economic downturn will affect the top-end food market both in New Zealand and abroad, but it is unclear whether any permanent change will occur. COVID-19 has pushed more consumers to buy online, and this is likely to continue. The food sector needs to make sure it is well aligned with e-commerce purchasing options. Packaging and food safety issues are key to this.

The loss of the international tourist sector will be challenging for New Zealand, at least for a while. Managed recovery may involve pursuit of more 'high-value tourism', or tourism focused on uniquely Aotearoa values based on a respect for the natural environment and the food it allows us to produce. The food sector will need to consider changing dynamics of tourism, for example the extent of epicurean experiences for tourists.

COVID-19 has affected global supply chains and highlighted potential issues for New Zealand, with its reliance on global trading.¹¹ Indeed, the pandemic is likely to accelerate a move towards shorter supply lines and increasing self-reliance and localisation by our trading partners. Therefore, we need to prepare for changes in global trade patterns, as protectionism and subsidisation are likely to increase in a post-COVID world. The question is, then, will New Zealand be able to improve its resilience to such market fluctuations by further diversifying its outputs and possibly its markets?

Is it possible that over time New Zealand may seek to increase its own self-reliance for a complete production, processing, distribution and consumption chain? We are mostly self sufficient, except for a few things, such as wheat and rice. However, these carbohydrate production systems are probably ripe for disruption by fermentation-produced material.

WORKFORCE

The primary sector faces both short-term and long-term workforce issues. The need for workers to help with harvesting has been aggravated by travel restrictions, but they will ease when the Pacific-Australian travel bubble opens. The transient shortage may be partially addressed by redeployment of those who lost their jobs following the downturn. But the longer-term issues still need to be addressed.

Food production is becoming increasingly technology based. This requires a trained and technologically savvy workforce. If transient employment schemes are developed for New Zealanders to address the post-COVID unemployment surge, then they should include appropriate induction and training suitable for ongoing contribution to land-based industries. Indeed, in the last decade, farming as a career has become less attractive for multiple reasons, many of which are described elsewhere in this report. The consequences over the long term could be problematic. Could the emerging unemployment threats in other sectors lead to interest in learning the skills of sustainable food production, now seen as a trendy professional career for the young in digitised rural environments? Creating

a positive strategy for the sector, supporting agricultural higher education, including technology-oriented training, and promoting technology adoption are all part of the remedy.

CONSUMER PERSPECTIVES

Do we understand enough about food trends and how they will change? Are we making global consumers' preferences visible to our farmers and governments? How might we improve that visibility? Which medium-term challenges and opportunities do we need to consider? Consumers in offshore markets may have very different preferences to those of New Zealand consumers, and offshore market preferences will clearly vary.

Internationally, we are seeing a preference for local food sources (hence the proliferation of farmers' markets), which aligns with general pressures to bring sourcing closer to end markets (food miles). However, the total volume of our primary industries' production is minute compared with international amounts. Consequently, even with shifts in market preferences, New Zealand is very much a niche food and beverage provider, hence the critical importance of branding and marketing and the focus on higher-value products.

In light of heightened awareness of health risks from diseases of animal origin, New Zealand needs to be even more certain about guaranteeing provenance of our foods and linking products to narratives of our people in harmony with their land and sea. The claim that food production in New Zealand is a sunset industry with no future simply does not hold, and never has.

BUSINESS MODELS

New Zealand has always primarily been a commodity food producer and trader, despite a long-time focus on high-value added products. Milk powder and beef are obvious examples, and such commodities definitely have their place. For example, New Zealand is providing huge amounts of animal protein to China, which is dealing with a huge loss of its pigs because of African Swine Fever. With regard to the value-added dimension, our land-based primary industries should be pursuing products that people want to eat, rather than have to eat. A "commodity only" narrative is potentially damaging to the New Zealand brand, and our export product mix is changing rapidly.

New Zealand has a limited number of large companies that turn our primary products into value-added food items. These companies are very good at responding to changes in consumer preferences, with innovations including packaging, new fruit varieties, new dairy products such as specialised cheeses, highly specialised paediatric products, sports nutrition products and other high-tech food-service products, particularly ingredients. Aside from those companies, the sector is dominated by small and medium enterprises, many of which are not of a scale that could rapidly take consumer preferences and turn them into food solutions for new consumers. Therefore the sector could do more to collaborate with each other and with other countries' research systems as well as partner with other larger food manufacturers.

¹¹ <https://informedfutures.org/new-zealands-place-in-the-world/>

The exception here is the dairy cooperative Fonterra, but even that is struggling to combine its role as a buyer of milk from dairy farmers and the raw material conversion into commodity exports with its ambition as a product-focused company. There is a need for capital investment and research at a scale that is probably not commensurate with a cooperative model. Irrespective, though, Fonterra has taken dairy marketing to scale, something not achieved in the meat-processing sector. The horticulture sector, however, has embraced collaboration and developed effective marketing structures to improve returns across the sector.

As the agricultural sector looks to the future, it is important to consider that, with the exception of Māori holdings, New Zealand's farming model has been increasingly based on eventual capital gain from smaller farms. Only by aggregation into larger units can farming operate on an income-based model. One result of the status quo is that many farmers are overcapitalised, especially those who have gone through dairy conversion. This makes them reluctant to think about diversification. These issues cannot be ignored in any rebuild of the primary sector.

MĀORI PERSPECTIVES

Can we learn from the long-term perspective taken by Māori? Māori worldviews place the environment at the heart of all conversations about living in Aotearoa, emphasising that land, food and environment all interact to sustain human wellbeing. Māori maintain long-term, collective land holdings, from which they feed themselves and generate profit, including through food exporting. Many consumers overseas resonate with the stories and concepts around how the food is produced and the values of the people producing it, and this could be further built on. But there is also Māori land that is not currently used to best effect. What conversations are needed to enhance the diversity of production on such Māori land that is focused on long-term sustainability and cultural and societal wellbeing? How can this perspective be incorporated into national branding?

In terms of food systems, the Māori focus has long been on food security, food supply and food sovereignty. Food sovereignty means ensuring the right to healthy and culturally appropriate food produced through ecologically sound and sustainable methods – and a right to define one's own food and agricultural systems. There is impressive momentum in the Māori community around self-sufficiency and co-determination of their futures in the face of the COVID crises. How can this be supported, and what can it tell us for broader action around food security (see below) as well as sustainable food systems?

The Māori response to the pandemic was to immediately take a community-based approach, focusing on elders and children with a message of aroha, and apply their intergenerational bonds and distinctive connection to Aotearoa that boosts their resilience. There is strength in this story that reflects the values we want to present to the world.

THE IMAGE OF FARMERS AND AGRICULTURE

Agriculture has unfortunately suffered reputational issues within New Zealand over recent years, driven partly by incentives

including bank lending policies supporting rapid intensification, and the difficulty in reversing key issues related to water quality. There is also a serious lack of government strategy for land use. Issues of water rights and ownership remain unresolved. The abiding environmental and water-quality issues, as well as the reality that about half New Zealand's greenhouse emissions are derived from food production, especially ruminant farming, have given farmers a bad name in recent years. By demonising farmers as the enemies of climate change, their wellbeing and morale have been badly hit. Within its capacities, farming has been progressively investing heavily to respond to such issues, while sustaining the economy. However, these capacities have been limited by a number of knowledge gaps and policy uncertainties, including the political debates over how agricultural emissions should be handled in climate change regulations.

As a rule, farmers and food producers are far more entrepreneurial, innovative and proactive in adopting green solutions within their businesses than their image suggests. Traditionally, farmers have been highly adaptive, flexible and resilient, especially with respect to land-use changes. Given the right information, incentives and encouragement, this trend will likely continue. Food production will remain a mainstay of our economy and partnerships rather than discord will be needed to navigate the major changes ahead. It is impossible to look at farming and food production in isolation from the environmental, economic, cultural and social implications associated with change.

Farmers' mental health has given cause for concern in recent years, and rural support networks have been critical. But the gestalt under which they operate has been difficult. It is essential that our primary producers are seen and engaged as indispensable and constructive players in setting New Zealand's path ahead.

BRAND NEW ZEALAND

New Zealand has a very favourable global profile, which has been reinforced over the last 12 months. Our national product branding needs to be refreshed and not just seen as a slogan. Instead, it needs to be linked to measurable progress on key indicators of value to consumers. These are likely to be both origin and environmentally linked. British consumers, for example, clearly trust food produced by Māori enterprises, and are willing to pay a premium price.¹² A cohesive strategy needs to be developed and connected to quality assurance if high value is to be sustained.

Consumers in high-value markets want to know the provenance of their food, increasingly down to the individual farm. Traceability and origin marketing are becoming important. Ireland has shown the value of environmental labelling with its "Origin Green" strategy.¹³ New Zealand needs to develop and market a national accreditation scheme that reflects the nature of our future food production and is evidence-based. We also need to consider how to better link our brand to the unique cultural identity of Aotearoa and promote our aspirational social, cultural and environmental values.

¹² Saunders, C. and Goldson, S. NZ has a massive trade advantage and needs to protect it. *New Zealand Herald*, 5 Jun 2020

¹³ <https://www.origingreen.ie>

SUPPORTING A PLATFORM FOR CHANGE

The challenges and opportunities discussed above illustrate the need for traction on critical issues about New Zealand's future in the food and agriculture domain. Meaningful progress will only occur if the challenge is approached in a coordinated manner. It is therefore critical that New Zealand Government agencies support and encourage the industry's journey towards a sustainable future, by:

- Establishing agreed goals for sustainable and renewable pastoral farming, horticulture, fisheries and aquaculture.
 - Facilitating the development of a clear narrative around sustainable food production – development of a Sustainable New Zealand country brand, as the Irish have done with their Origin Green positioning.
 - Investing in the provision of accurate environmental data that will provide validation for the claims being made to global consumers, including certification systems where appropriate.
 - Investing in the long-term research necessary to support an increasingly technology-based sector facing rapid change in both the realities of climate change and markets and consumer expectations. Barriers to exploring the potential of advanced life science technologies to assist the New Zealand food system need to be periodically reassessed.
- Investing in supporting producers to ensure food safety and provenance traceability, and by taking a lead in data sharing across the sector.
 - Investing in broadband connectivity within the rural sector to enhance productivity by informing decision-making and enabling data transmission and best practice sharing.
 - Increasing efforts to protect our free trade relationships and market access in an environment of increasing protectionism globally.
 - Giving clear and unequivocal endorsement to our nation of the central role our agriculture industry and our farmers are playing in the generation of wealth and jobs.
 - Creating a national marine strategy that allows for innovative sustainable aquaculture development and supports the preservation of marine ecosystems and biosecurity.
 - Ensuring complete government and industry collaborative efforts to maintain biosecurity.



WHERE TO FROM HERE? EXTENDING THE CONVERSATION

The discussions that inform this paper should be seen as just the beginning of an iterative process that aims to spark further inclusive conversation and action. There is a need to focus on those core issues that require urgent attention from a cross-sectoral perspective. In discussion to date, the role of a neutral convenor and broker, which is neither government nor a sector component, has come to be seen as desirable. Such conversations can promote a convergence of existing strategies that interplay, and identify barriers in the system, so that more cohesive strategies for the food sector as a whole can be achieved.

There is the need to encourage aspirational leadership and strategic thinking. A fully integrated strategy can only arise from a common set of goals for achieving environmental, social and economic sustainability.¹⁴ How can we facilitate more cross-sectoral discussion and linked-up conversations between private sector, researchers and Government? What is the overall vision for sustainable and renewable pastoral farming, horticulture, silviculture and aquaculture and what intermediate steps will be necessary? Can we form a 'coalition of the willing' to draw together themes and align work programmes?

TAKING RESEARCH SERIOUSLY

We need to apply a long-term strategic lens to our research sector, so that some of the critical questions can start to be addressed. Many of the issues require long-term research investments against a clear, nationally-owned strategic plan. Yet the current research system is driven by a series of mostly short-term projects disconnected from each other; as a package they in no way indicate how the food sector should progress over coming decades. The incentives on the five relevant CRIs (AgResearch, Plant and Food Research, Manaaki Whenua – Landcare Research, Scion, and NIWA) are dominated by the need for short-term fiscal returns, resulting in their focus being locked on income flows and immediate exploitable outcomes. This cannot lead to a dynamic, forward-looking food-production sector. The food- and production-focused universities are also in very constrained positions, which raises fundamental questions about the shape and incentives operating in the public science system. Given the long-term nature of the research needed, its overlap with other objectives, and the international competitive landscape, the Crown must look to a more effective partnership with stakeholders well beyond the cautious incrementalism that currently exists.

OPPORTUNITIES FOR AGRITECH AND INNOVATION

Sustainability and resilience require adaptiveness and innovation in the face of change, including those driven by changing consumer attitudes, economic imperatives, geostrategic

pressures, and, of course, climate change. Ultimately, technological developments will assist transitions to more efficient and sustainable land use and management. Adoption of new, and in some cases disruptive technologies has the potential to reduce greenhouse gas emissions, including methane and nitrous oxide, in farming systems. How will New Zealand approach this? If technological innovation and adaptiveness are the key to protecting our environment and food systems for future generations, can this sit comfortably within the Brand New Zealand marketing story?

Globally, innovation depends on major companies, which spend about 70% of global R&D. The investment in advanced foods made by such companies is immense. New Zealand misses out on the advantage of such research because its companies are not sufficiently configured to attract significant investment and research activity here. The New Zealand food space, dominated by SMEs, cannot compete against extensive offshore activity that is increasingly technologically based. Solutions are possible through combined government and industry investment and through strategic partnerships.

REGENERATIVE AGRICULTURE

More research is needed into the potential of the widely promulgated concept of 'regenerative agriculture', which is gaining support as an answer to the sustainability conundrum. However, while its broader intention is well understood,¹⁵ this term can also imply some specific approaches or be interpreted in different ways by different groups. In essence it reflects a desire to see farm systems move to a much more sustainable set of agricultural practices.

Broadly speaking, many of the principles and practices linked to sustainable or regenerative agriculture already form much of the basis of the well-performing components of our pastoral agriculture, which, undoubtedly, always bears improvement through research and development and its application. Overall, we need ongoing, systematic research into the specific aims of, and the suggested approaches to regenerative agricultural practices and their cumulative effects and scalability in the context of different New Zealand food production systems. This enquiry must be based on robust scientific understandings of such farming approaches in the New Zealand context in order to determine what gains are possible and what the production characteristics of taking it to scale might be. Such a contribution will clarify choices for both farmers and consumers.

14 Other Kōi Tū conversations are also addressing these issues – for example <https://informedfutures.org/the-environment-is-now/>

15 The concepts of regenerative agriculture as generally understood to include activities like rotational grazing in a closed system that minimises extractive practices, replacing soil nutrients that are removed through harvesting, and sometimes the use of seaweed as a topical dressing. Some definitions of regenerative agriculture include increasing soil carbon sequestration by enriching soil's organic matter content. However, the carbon levels in New Zealand soils are already high. Likewise, there are initiatives such as incorporating green leguminous matter through animal grazing of tall stands and trampling some of the material to improve soil structure and nitrogen levels. Conversely, this can lead to higher levels of methane production.

THE MARINE SPACE AND OPPORTUNITIES FOR AQUACULTURE

Aotearoa-New Zealand is a maritime nation, with 96% of its territory being ocean, and yet we have no strategy for marine sustainability. Within this, Māori fisheries make up 20% of the \$1.6 billion in export earnings. Currently, New Zealand has one of the cleanest growing environments for aquaculture. A far more entrepreneurial attitude to new technologies and products (seaweeds, salmon, mussels) using ocean farming as well as inshore farming is overdue. Planning issues and inconsistent approaches between Regional Councils and Central Government constrain entrepreneurial innovation and investments. More focus needs to be given to biosecurity in the marine and freshwater systems. This is of particular importance to Māori for both cultural and economic reasons.

FOOD WASTE AND THE CIRCULAR ECONOMY

Circular economy principles focus on reducing waste and maintaining materials for long-term use and reuse and regenerating natural systems rather than simply extracting from them. The drive to promote a more circular economy will mean reducing the environmental footprint across the entire food supply chain. Currently, our post-harvest supply chains use a lot of power, both for transport and for cooling, and food waste is a big issue, particularly for fruit. We need to explore co-product development so that no potential products are wasted, while also curbing overproduction and overstocking, and improving supply-chain efficiency. There are opportunities to use new technologies including AI to “design out” food waste from our production systems, from production methods to processing, logistics and consumption.

Significant food waste occurs in consumer households. Encouraging behaviour change, developing consumer awareness about smart eating, and developing innovations that reduce food waste at home will also be important. Change in the food system presupposes responsive consumers.

FOCUS ON FOOD SECURITY AND NUTRITIONAL QUALITY

Beyond the core issues of environmental sustainability, we need serious conversations about how we feed ourselves. New Zealand produces food for the world, yet sadly food insecurity exists within our borders. Indeed, many in New Zealand have poor diets because of lack of access to, and the high cost of nutritious food. Further, the difficulty in finding reliable information on nutrition in the face of marketing campaigns for cheap fast foods and high sugar beverages plays a major role in the health burden of non-communicable disease that the country faces. The lack of appropriate nutritional decision-making by many in the community was recently evidenced by the rush for fast foods after the Level 4 lockdown ended. The nation’s fast-food habit has been driven in part by cost factors, but also by deficient nutritional education and the failure to limit marketing to children. The latter has been despite New Zealand being a party to a WHO convention on such activity. In short, there remains a failure of coherent public health messaging.¹⁶

The high rates of non-communicable disease in disadvantaged communities are linked to the above issues. How do we support citizens to make healthy and sustainable food choices? Children are particularly affected by poor nutrition as it compromises their learning. Regrettably, the lack of an effective health education and a public health body distinguishes New Zealand from many other advanced nations.

Serious questions need to be asked about the quality, availability and cost of food for New Zealanders, some of whom have limited disposable income. Most consumers want to do the right thing, but many cannot afford to do so. How to promote equitable nutrition, health, environmental and food sovereignty values in our food system is a critical topic for further conversation with a wide range of stakeholders.



¹⁶ <https://www.who.int/end-childhood-obesity/en/>

FINAL COMMENTS

There is plenty of reason to believe that New Zealand can approach these challenges with confidence. Our primary sector produces the highest quality protein meat, dairy and fruit products with a low carbon footprint relative to its competitors, and New Zealand already has a strong brand image. For that reason, New Zealand is expected to retain or grow market share even as other countries may focus inwardly. In the short to medium term, the experience of New Zealand's leading food companies in marketing products to the world and the strength of the New Zealand reputation and international relationships should support significant growth for our country. While individual brands may be strong, New Zealand definitely needs to consider how it now promotes itself. In short, New Zealand is a country with high social and environmental values that produces safe, healthy food with a relatively low carbon footprint.

The questions raised and the issues addressed in this paper need to be advanced in further stakeholder conversations. The Government needs to be a partner in such discussions, which must be cross-sectoral but also allow bottom-up ideas to surface. Urgent action is needed in some areas, such as the development of a clear national strategy for the primary sectors. Long-standing issues over water and land use need to be tackled, as well as emergent issues such as the pursuit of accelerated partnerships to address sustainability and branding. Beyond the immediate shocks of the pandemic, it is the commonality of most of our basic values that will keep us at the table, envisioning our Aotearoa food futures.

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