

THE GREEN PROTEIN REPORT:

MEETING NEW ZEALAND'S CLIMATE
CHANGE TARGETS BY 2030
THROUGH REDUCED RELIANCE
ON ANIMAL AGRICULTURE



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ABOUT THE VEGAN SOCIETY AOTEAROA NEW ZEALAND

The Vegan Society of Aotearoa New Zealand supports and helps to facilitate a vegan lifestyle and plant-based eating. We do this by creating a vibrant, visible and influential community, and by providing resources and information. As a national charity we are the voice of veganism in New Zealand, with a strong media and social media presence. Our goal is to grow veganism in New Zealand by making it easy and desirable.

We educate Kiwis about veganism and promote vegan education elsewhere. We encourage the availability of vegan options in institutions such as schools, hospitals and other public facilities throughout the country. We are increasing and supporting business activity around veganism with our Business Membership Scheme, the introduction of New Zealand Vegan Certification and through our Vegan Food Awards, which recognise excellence in the vegan food industry. We also provide a nationwide community support network for vegans and those progressing toward veganism. Our resources include a 21 day *Easy Vegan Challenge* to help people choose plant-based meals as often as possible (www.tryvegan.org.nz).

We are pleased to publish this report, which clearly shows the potential for New Zealand to compete on the global stage in the production of plant based food sources. The planet can no longer sustain a food system dependent on animal agriculture. We can, and must, apply our efforts to a successful transition to horticulturally-based food production.

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Jasmijn de Boo is a professional animal advocate and educator with over 20 years experience in global leadership positions. Jasmijn is currently International Director at ProVeg International and has previously worked in a range of international animal protection organisations, including as a CEO of both SAFE NZ, and the UK Vegan Society, and as a researcher, global education manager, lecturer, and programme adviser. In that time she has amassed a wealth of knowledge and understanding of the impacts of the Anthropocene on animals, our planet and humankind.

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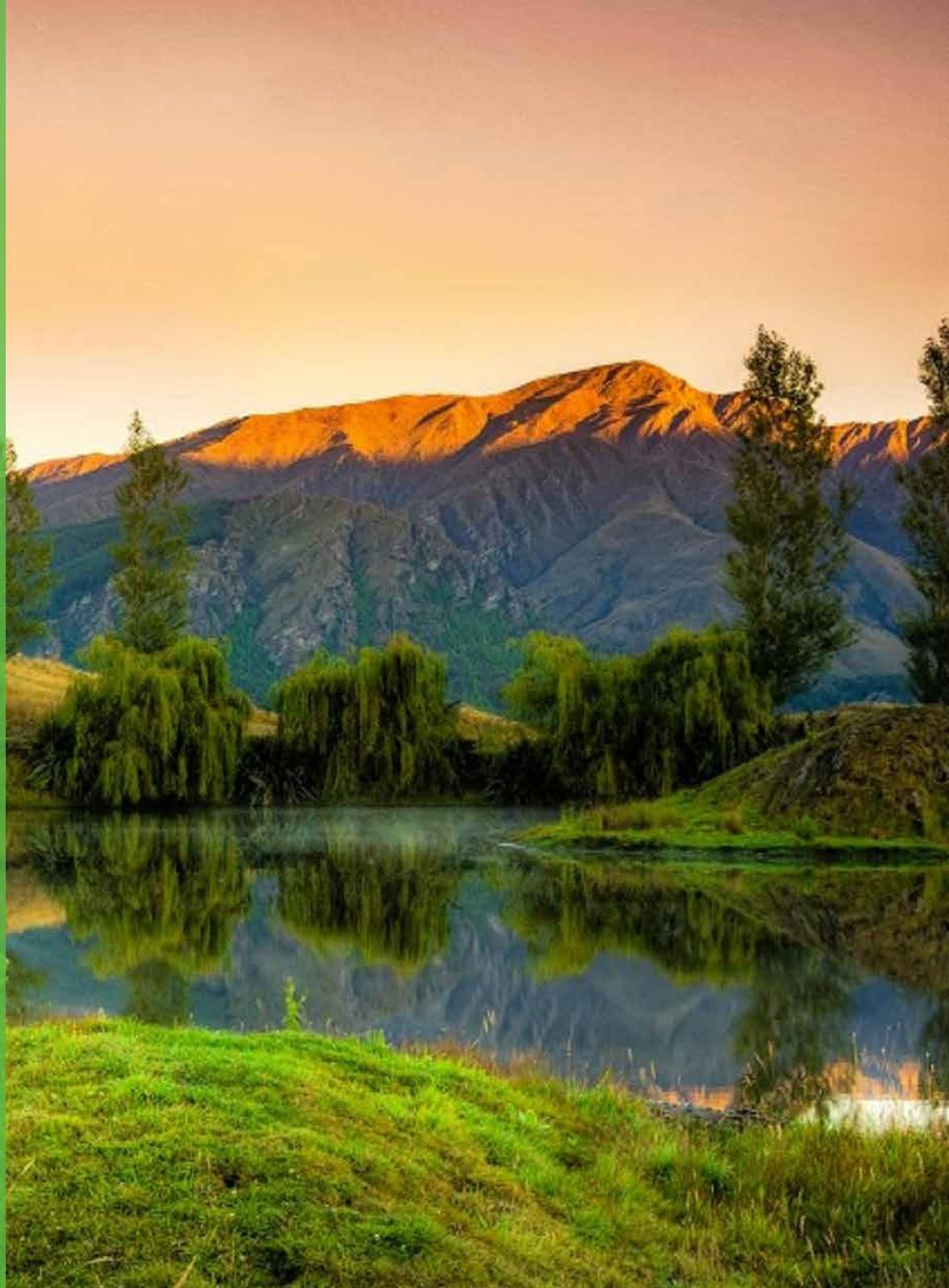
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**NEW ZEALAND
HAS AN OPPORTUNITY
TO LEAD THE WORLD
IN ACHIEVING A
TRULY GREEN,
CLEAN AND SOCIALLY
JUST SOCIETY**



EXECUTIVE SUMMARY

New Zealand's internationally famous 'clean, green' image has been threatened in recent decades by its agricultural practices. Greenhouse gas emissions, polluted waterways, soil erosion and compaction, deforestation, and habitat and biodiversity loss are some of the main problems caused by livestock farming.

New Zealand has one of the highest methane emissions per capita in the world, due to the sheer number of cattle and sheep that emit methane via rumination and enteric (intestinal) fermentation. Methane is a significantly more potent greenhouse warming gas than CO₂.

Instead of 'borrowing from the future', food security and economic development need to respect planetary boundaries. This is a concept now widely acknowledged by the UN and other global bodies, to ensure a sustainable world in which everyone has enough to eat. The use of energy, land and water to grow crops to feed animals is significantly less efficient than growing crops for human consumption directly. Omnivorous diets have a much larger ecological footprint than vegan diets, and adopting a plant-based diet is among the four most impactful actions one can take to reduce greenhouse gas emissions.¹

New Zealand's economy, and particularly its exports, rely heavily on animal farming. While globalisation has provided trade opportunities for New Zealand, global markets and consumer demand are changing; climate change targets will need to be met; and society is increasingly becoming less tolerant of environmental degradation and animal suffering.

In the interest of global food justice, and preventing cruelty to and minimising suffering of 160 million farmed animals per year, New Zealand must initiate a transition toward a predominantly plant-based agricultural system. The unfettered growth in animal farming has had substantial costs, most notably to the animals directly, but also to the environment and human health. Any significant reduction in farmed animal populations (particularly in broiler chickens, dairy cows and sheep) will immediately reduce total suffering and death.

ADOPTING A PLANT-BASED DIET IS AMONG THE FOUR MOST IMPACTFUL ACTIONS ONE CAN TAKE TO REDUCE GREENHOUSE GAS EMISSIONS

A global trend towards protein crops, which are used in innovative meat, dairy and egg substitutes, is starting to disrupt and displace the traditional meat market. Whether for health, environmental, ethical or other reasons, an increasing number of people are becoming 'flexitarians' (individuals actively reducing meat consumption) or are cutting out animal products from their diets. Their interest in tasty, nutritious and convenient meat substitutes has led to new food technology start-ups that have grown substantially. Increasing examples

of mergers and takeovers have demonstrated that this is now a multi-billion dollar business, set to grow further.

For the benefit of animals, the environment, public health, and diversification of the economy - and in line with the recent EAT-Lancet report² - this report calls for a change in national, and indeed, global, agricultural strategy. Farmers will need to be supported by Government and industry sectors to transition away from animal farming. They will need support to develop sustainable and financially viable horticultural, agro-forestry, and other rural livelihood opportunities. Such a move away from animal farming will have important positive impacts beyond saving animal lives. It will greatly help New Zealand to meet its climate change targets, and its public health may substantially improve.

Recent corporate developments, including more vegan products available in supermarkets, a marae that went vegan to improve community health,³ and a day care centre offering a vegan menu⁴ demonstrate that New Zealand has an opportunity to lead the world in achieving a truly green, clean and socially just society. This report provides a rationale and 'greenprint' for achieving this.

RECOMMENDATIONS

The Government and all relevant stakeholders will need to take bold measures. The following recommendations provide a starting point with a view to full stakeholder dialogue and development of an action plan in the coming months.



RESEARCH AND DEVELOPMENT

1. Redirect funding away from research that leads only to marginally reduced GHG emissions to increased funding for:

- Applied research to study the suitability of various crops grown in different New Zealand geographical, climatic and other conditions. Examples could include quinoa,⁵ oats,⁶ hemp,⁷ peas,⁸ fava beans (also known as broad beans), lupins and other pulses and legumes, and other nourishing grains, fruits and vegetables for the domestic and international market, which is growing.⁹

Data collection on growing and consumption of pulses should be part of the wider research and development strategy. Regular consumption of pulses substantially benefits health thanks to high fibre and protein content; they increase longevity and help reduce the risk of obesity and certain diseases.

- Identifying suitable land use, and land use change, for a variety of protein crops that are sustainable and provide good return on investment across New Zealand.

Where possible, arable farming should be organic or vegan-organic¹⁰ ('stockfree' using green manures, and no animal inputs). In addition, the planting of crops such as hemp and legumes

requires less fertiliser, and they naturally fix nitrogen in the soil, which helps mitigate climate change.

- Research into, and development of, value-added plant-based products and technology required (the 'post-farmgate infrastructure') within New Zealand to upscale new markets.
2. The economic and marketing position of horticulture and agroecology within New Zealand will need to be strengthened. The dairy industry, in particular, and beef and lamb, egg, and meat chicken industries, have disproportionate lobbying power, at the expense of other farmers, sectors and communities affected by animal farming.
3. To boost consumer knowledge, interest and consumption, the horticultural sector should investigate ways to improve marketing of plant-based products.



POLICY

1. The New Zealand Government and agricultural sector should provide direct funding for transitioning from animal to protein crop farms through:

- A direct payment support scheme for trial farms, and farmers growing protein crops
- A young farmers' protein crop start-up grant scheme to address the ageing population among farmers¹¹
- Considering introducing a sustainability charge on animal products, to account for externalities in animal farming.

2. The government, agricultural sector and researchers should set up a multidisciplinary think tank and establish an action plan to:

- Develop an integrated agricultural roadmap fit for the future. This will need to consider animal welfare, environmental and public health impacts. It should include the promotion of sustainable farming methods, binding climate emission targets, reduction targets for the national cattle and sheep herds, and practical support for farmers interested in transitioning from dairy and other animal-based farms to crop farms and other non-animal based agricultural and forestry enterprises. Expansion of animal industries should be halted, while non-animal-based sectors should be increased.

- Identify and prepare knowledge exchange and knowledge transfer opportunities for (young) farmers and anyone interested in growing protein crops.

EXPANSION OF ANIMAL INDUSTRIES SHOULD BE HALTED, WHILE NON-ANIMAL-BASED SECTORS SHOULD BE INCREASED

3. Discontinuation of the Crown Irrigation Investment fund for dairy farm irrigation projects. Public funding for large-scale irrigation projects has already started to wind down.¹² A water use tax should be investigated, according to the overall environmental impact of production methods ('polluter pays' principle¹³).
4. Inclusion of agriculture within the Emissions Trading Scheme (ETS).
5. Given the conflict of interest within the Ministry of Primary Industries (which is focused on increased production and the economy), the Government should establish a separate government body responsible for animal welfare policy and enforcement. MPI will require further resourcing to better support horticulture and agroforestry, particularly when dairy farmers start transitioning to other types of farming.

PUBLIC AND CORPORATE PRACTICE

1. Public procurement for canteens and restaurants in schools, hospitals and government and council venues, as well as within the private hospitality sector, should increase the number of plant-based dishes and pulse- and legume-based cuisine. Customers may not always express a demand for alternatives to meat. Therefore, an increase in what is on offer will need to be proactively stimulated. For example, if plant-based meals were the norm,¹⁴ not the exception, especially for institutional meals where health, economy and environmental impact should be considered, significant and lasting change could be achieved at a national level.
2. Retailers should take a lead in offering sustainable, healthy and affordable plant-based products that are appealing to their customers. Supermarkets in Europe and North America are already transforming in this direction.
3. A conference for medical practitioners about plant-based nutrition and health could provide continuous education on the role of wholesome nutrition and health. Such events have been successfully held for a number of years in the USA and in Germany,¹⁵ and a similar New Zealand symposium was held in Gisborne in January 2018.¹⁶ Medical degrees should include more lectures on plant-based nutrition and health within curricula.

**WE NEED TO INVEST
IN A TRANSITION
TOWARD A
SUSTAINABLE,
COMPASSIONATE
AND HEALTHY
FOOD SYSTEM**



1. INTRODUCTION

Until recently, Aotearoa/New Zealand enjoyed a worldwide reputation as a clean, green country with a relatively pristine environment. Environmental degradation—including by dairy farming—is increasingly a major national concern. Scientists agree that the increasing greenhouse gas emissions, polluted waters, deforestation, overreliance on fertilisers, soil erosion, biodiversity loss, and the rapidly developing livestock sector in New Zealand are unsustainable. Change is inevitable if the climate change goals set for 2030 and beyond are to be met.

Driven by economics, the large-scale growth of the livestock industry in general, and the dairy sector in particular, have created serious environmental, public health and animal welfare concerns at the national level, that need to be addressed holistically.

Animal farming causes substantial suffering and death. Due to the large number of animals produced and consumed, New Zealand has been ranked 30th out of 50 countries surveyed in an Animal Cruelty Index.¹⁷ These 50 countries are responsible for 80% of the animals farmed for food globally, most of which are kept in intensive farming systems that compromise animal welfare in various ways.

In addition, New Zealand's public health is at risk, as diets heavy in animal protein increase the likelihood of developing a range of so-called lifestyle diseases. New Zealand is among the ten highest consumers of animal products internationally.

Studies indicate that plant-strong diets are better for health and reduce many of the risks associated with animal product consumption. The EAT-Lancet Commission

on Food, Planet, Health has published the first full scientific review of what constitutes a healthy diet from a sustainable food system, and which actions can support and speed up food system transformation.

1.1 OPPORTUNITIES FOR CHANGE

The New Zealand Government, environmental scientists, agricultural experts, food manufacturing and retail industries, health professionals and other leaders, now have an opportunity to change track.

We need to invest in a transition toward a sustainable, compassionate and healthy food system that puts people's health, animals, and the environment ahead of short-term profit, animal suffering, and environmental degradation.

The Labour-NZ First-Greens coalition government of 2017 has proposed to take more urgent action on climate change and protection of waterways, including setting up an independent Climate Commission. Root causes will be examined and addressed, including phasing out fossil fuel subsidies and planting trees on marginal land.

Unfortunately, NZ First has negotiated that farming will be excluded from the Emissions Trading Scheme (ETS) for this parliamentary term. However, the new Climate Commission will be determining how to bring agriculture into the scheme.¹⁸ The Rt Hon. Jacinda Ardern added in an interview¹⁹ that governments may be limited in the impact they can have without bringing society on board.

As society's values and systems are changing, food production-related climate change solutions must be implemented at the local and national level. New Zealanders care about the environment, and we are also a nation of animal lovers, particularly when it comes to the millions of animal companions with whom we share our homes. Cruel farming practices, such as prolonged, close confinement within sow stalls, battery and colony cages for laying hens, and mistreatment of calves, have been rejected by a majority of concerned citizens. These concerns have resulted in changes in law, such as a ban on sow (gestation) crates, and in practical changes, such as supermarkets committing to supplying only cage-free eggs. (Similar consumer changes in attitude have led to bans on the sale of microbeads by some retailers, and to the phasing out of plastic bags in supermarkets.)

Land exploitation in New Zealand affects all communities, particularly in areas such as Taranaki. In a recent guide developed to help environmental management decisions, Taranaki iwi spoke out against intensive farming practices.²⁰ In Northland, a marae took a stand against a new and massive chicken farm proposed by Tegel Foods.²¹ Whether for ethical, health or environmental reasons, an increasing number of people are choosing to eat more plant-based products.

The largest demand for the meat substitutes and dairy alternative market is being created by 'reducetarians' and 'flexitarians' – people who eat less meat or have cut back on dairy or other animal products. Lactose intolerance, religious or spiritual beliefs, and the cost of food are some of the other reasons why people are reducing their consumption of animal products.

Worldwide, a surge in interest in plant-based diets, investments in cultivated ('clean') meat, and in meat, dairy and egg substitutes, is emerging in retail and hospitality sectors. Industry publications, news stories, marketing reports and start-up organisations are reporting exponential growth in this area.²² These trends are becoming industry disruptors, forcing established manufacturers to rethink their strategies. Science, technology and pragmatic solutions to tackle environmental and animal issues associated with livestock farming are converging, and these initiatives have attracted substantial funds from wealthy technology leaders and well-known celebrities.

A report by Rabobank²³ documented strong growth in the alternative protein products sector. Given strong and persistent drivers of growth, this market is expected

to grow at a compound annual rate of 8% within the European Union (EU), and 6% within the United States of America (USA) and Canada. It is important for New Zealand's economic future that New Zealand is able to capitalise on such growth, rather than being left behind.

To remain at the forefront of economic development, business and agricultural experts—including those from

WHETHER FOR ETHICAL, HEALTH OR ENVIRONMENTAL REASONS, AN INCREASING NUMBER OF PEOPLE ARE CHOOSING TO EAT MORE PLANT-BASED PRODUCTS

animal farming industries and the financial sector that supports them—have started discussing the new direction New Zealand needs to take, to avoid trailing behind European and American trends and innovations in food production.

1.2 PURPOSE OF THIS REPORT

Capitalising on recent trends and acting on concerns for animals and the environment, this report aims to set out the case for a different agricultural vision for New Zealand that is less economically reliant on farming animals for food generally, and on dairy, sheep and meat chicken farming in particular. It provides an overview of the scale of existing environmental, health and animal welfare problems, and provides suggestions to facilitate a transition from animal-based farming to crop growing and horticultural expansion. Farmers' livelihoods are important, as are export and trade opportunities, but neither can continue unchanged given existing and projected impacts on the environment, public health and animal welfare.

First, this report reviews New Zealand's agricultural developments in recent decades, its trade and export, and its national dietary habits. This is followed by an overview of the welfare of various farmed animal species. Then, the environmental impact of the livestock sector in general, and of dairy farming in particular, as well as the environmental impact of plant-based diets, are subsequently explored. The global 'green protein' revolution—a trend shifting demand away from animal products in favour of more plant-based products—is discussed next, followed by opportunities for a sustainable New Zealand, including policy recommendations.

The Economist²⁴ declared that 2019 would be the 'year of the vegan', and the year embracing a plant-based lifestyle will go mainstream, respectively. Looking back, it heralded the beginning of a paradigm shift for the benefit of the environment, people and all the animals with whom we share the planet. All relevant stakeholders should be brought into this dialogue to effectively develop strategies for a more sustainable future for all.





2. FOOD CONSUMPTION, AGRICULTURAL PRODUCTION, AND THE NEW ZEALAND ECONOMY

As recently as around 800 years ago, Aotearoa/New Zealand was one of the few places, let alone entire regions, on Earth, to be free from human settlement. Except for the high alpine and volcanic regions, approximately 80% of the islands were covered in forest.²⁵ New Zealand's rich geographical history and biodiversity was unique. Prior to human settlement, New Zealand was home to only two mammal species, (two species of bats), while bird, plant and marine life was abundant. Human settlement, initially by Polynesians who established the Māori culture in Aotearoa / New Zealand, was followed by Europeans (Pākehā) in the 17th and 18th centuries.

New Zealand's modern economy grew around pastoral farming, which altered New Zealand's land, freshwater and marine areas substantially. Many species were decimated, and environments polluted, with most of the damage caused in the past 50 to 150 years.

In 2009, nearly half of New Zealand's export income was reportedly derived from farmed animals and their products.²⁶ By 2017, New Zealand was the world's 12th largest agricultural exporter (by value), the number 1 exporter of sheep meat and dairy products, and the number 2 exporter of wool.²⁷

This chapter provides a brief overview of some of the current and recent developments in New Zealand's demographics, food consumption and production, and the contribution of animal farming to its economy.

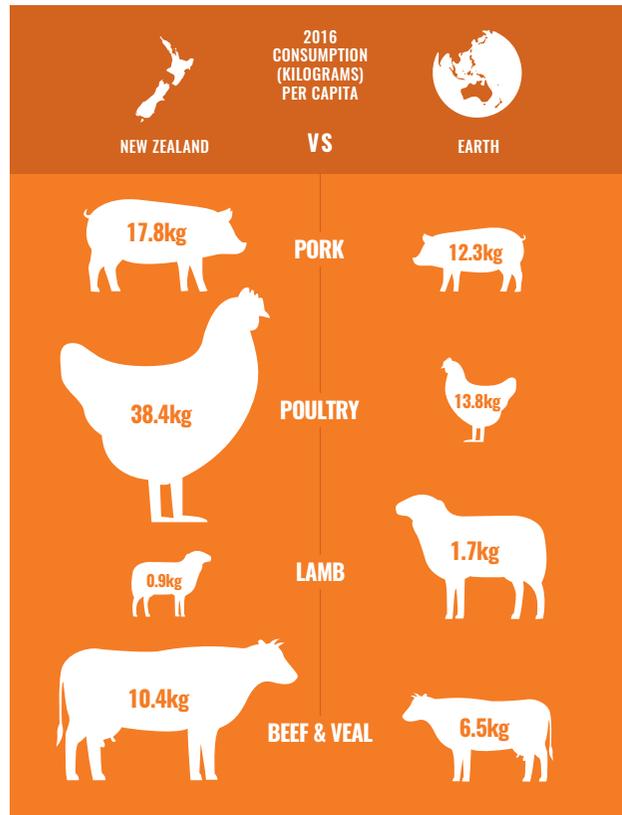
2.1 POPULATION AND DIET IN NEW ZEALAND AND GLOBALLY

In 2016, the New Zealand population was around 4.7 million (nearly doubled from 2.4 million in 1960). The 2016 population growth rate was 2.09%. The population is expected to grow to around six million people by 2061,²⁸ including a significant population of Asian descent. Whereas life expectancy was 71.24 in 1960, this had increased to 81.46 by 2015. Over the next few decades, the changing demographics will continue to increase the ageing population and decrease the proportion of children aged 0-14. The proportion of people living in urban compared to rural areas was even higher in 2016 (over 86%) than it was in 1960 (76%). Living longer means more demand for (finite) resources. Planning for the future, and a different kind of demographic in 30 years' time, requires environmental, social, economic and ethical considerations, including planning sustainable diets and methods of food production.

2.1.1 Meat consumption and changing diets

The proportion of animal versus plant-based protein sources in the average New Zealand diet steadily increased over the past several decades to 2002, and decreased in the last 16 years (Figure 1). It is estimated that New Zealanders consume around 40 kg of chicken, duck and turkey meat on average each year (Organisation for Economic Co-operation and Development (OECD) data).²⁹ Chicken has been the number one source of protein in New Zealanders' diets since 2001, when it displaced beef as the largest protein source.

New Zealand is among the top ten meat-eating nations in the OECD, with Australia and the USA ranking third and first, respectively. In 2002, New Zealanders consumed, on average, 142 kg of meat per person per year. By 2009, this had decreased to 106 kg. This is still 26 times the average meat consumption in Bangladesh, which consumes the least meat per capita.³⁰



1. Figure 1. Average meat consumption per person in New Zealand and globally (OECD, 2018)³¹

A 2016 ANZ Roy Morgan poll found one in 10 New Zealanders reported following a vegetarian diet, which was a 27% increase in five years. In June 2017, a survey carried out by New Zealand vegetarian product company Bean Supreme³² found that of the 1,007 survey respondents, 4% indicated they were currently vegetarian

or vegan. These people were most likely to live in Auckland or Canterbury and be female, and were aged 25-54. The growth in those going vegetarian or following a mainly meat-free diet was primarily in the millennials group, aged 16-24.

In a report commissioned by SAFE in 2016, Horizon found 3.3% of New Zealanders were eating a strict vegetarian or vegan diet (1.3% vegan, 2% vegetarian). Many Kiwis are already reducing their consumption, with 28% of respondents say are eating less meat than 12 months ago. Over half, 59%, of respondents who currently eat meat or fish would consider a diet where they excluded those foods.

These figures echo similar trends in the world. For example, in 2019, there were 600,000 vegans in the UK, or 1.16% of the population.³³ Hundreds of thousands more follow a plant-based diet for periods of time, and 3.6 million fewer animals were eaten in the first six months of 2019 by over 800,000 'flexitarians'.³⁴

Plant-based diets have also grown in Germany and Austria, where those eating vegan exceed 2%, as well as in Sweden, Poland, France, Italy and Spain. In June 2017, a report was published in the US indicating that a record number of people were switching to a vegan diet, with 6% of the population identifying as vegan, a 600% increase from 2014.³⁵

Largely plant-based diets are the norm in much of the developing world, mainly due to a lack of resources to adopt Western-style diets and lifestyles, while religious, spiritual, cultural and other reasons also play an important



OVER 800,000 PEOPLE IN THE UK ATE 3.6 MILLION FEWER ANIMALS IN THE FIRST 6 MONTHS OF 2019

role in many cultures that abstain from eating meat. In many developing and developed nations, plant-based meat substitutes and milk drinks based on soya, grains, nuts and seeds have long been popular.

53% OF NEW ZEALANDERS SAID THEY ARE EATING LESS MEAT, AND 24% EXPECTED TO BE MOSTLY MEAT-FREE BY 2025

2.1.2 Public health impacts of diets

Intensive animal farming has become big business in New Zealand, with over 120 million animals confined in so-called factory farms each year. Intensively farmed animals are often bred to grow unnaturally fast, and to be so highly productive that their health may be compromised. They are often closely confined in large numbers, in stressful and unhygienic husbandry systems, with daily antibiotic doses sometimes necessary to ward off disease and expedite growth. The focus on low overheads and heavily industrialised production methods can increase risks of foodborne illnesses and zoonotic diseases (those transferrable from animals to people). In addition, intensive farming puts the safety of our water at risk, and can increase antimicrobial resistance to antibiotics. In November 2017, the World Health Organisation (WHO) recommended that farmers and the food industry stop using antibiotics routinely to promote growth and prevent disease in healthy animals.³⁶ The New Zealand Veterinary Association aims for New Zealand to be antibiotic-free (apart from emergency cases) by 2030.³⁷

New Zealand consumers are targeted with marketing about, and saturated with, low-cost animal products of limited nutritional value, particularly processed foods. Consumers have become unwitting targets in the profit-driven food industries, and ultimately pay the price for these low-cost goods – with their health. Accordingly, public health care costs have risen drastically in recent decades. Unhealthy diets that are high in animal products and lacking in fruit and vegetables contribute to human diseases, and can lead to an early death. Obesity and non-communicable diseases such as heart disease, type two diabetes and various cancers, affect the health of too many New Zealand adults.

Diets in New Zealand

New Zealanders do not consume enough fruit and vegetables, but eat too much animal protein, and are therefore not meeting the recommended nutrition guidelines:

- According to the Ministry of Health survey 2016/2017,³⁸ 39% of adults met the recommended combined guidelines for vegetable and fruit intake in 2016/17, down from 43% in 2006/07, and only just over half the adult population consumed enough fruit.
- Around 60% of New Zealand adults eat red meat at least three times a week.³⁹
- Eighty five per cent of New Zealand adults eat chicken at least once a week.⁴⁰
- 42% of New Zealand adults eat fresh or frozen fish and other seafood at least once a week.⁴¹

Ministry of Health Guidelines suggest that New Zealanders would meet daily nutrition requirements if they ate only three servings of vegetables and two servings of fruit.⁴² However research from the Imperial College London found that eating seven and a half servings of fruit and vegetables daily lowered cancer risk, and 10 servings lowered the risk of heart attack, stroke and early death.⁴³

LOW CONSUMPTION OF FRUIT AND VEGETABLES [RECOMMENDED GUIDELINES]



HIGH CONSUMPTION OF ANIMAL PROTEINS [PER WEEK]

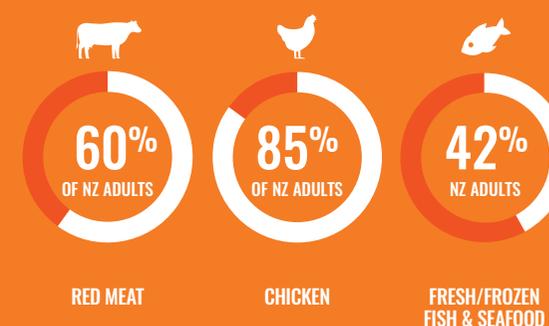


Figure 2. Diets in New Zealand (Ministry of Health Survey 2016/17).

OBESITY RATES HAVE TRIPLED IN THE LAST THREE DECADES IN NEW ZEALAND

Like many other Western countries, obesity rates have tripled in the last three decades in New Zealand, and BMI has overtaken smoking as the leading risk factor for health loss.⁴⁴ In fact, diet is the top risk factor contributing to 'health loss', or disability adjusted life years (DALYs) impacts.⁴⁵ New Zealanders consume too much saturated fat and sodium and not enough dietary fibre. The figures are even more pronounced for Pacific and Māori communities and those living in socio-economically deprived communities.

BODY WEIGHT IN NEW ZEALAND

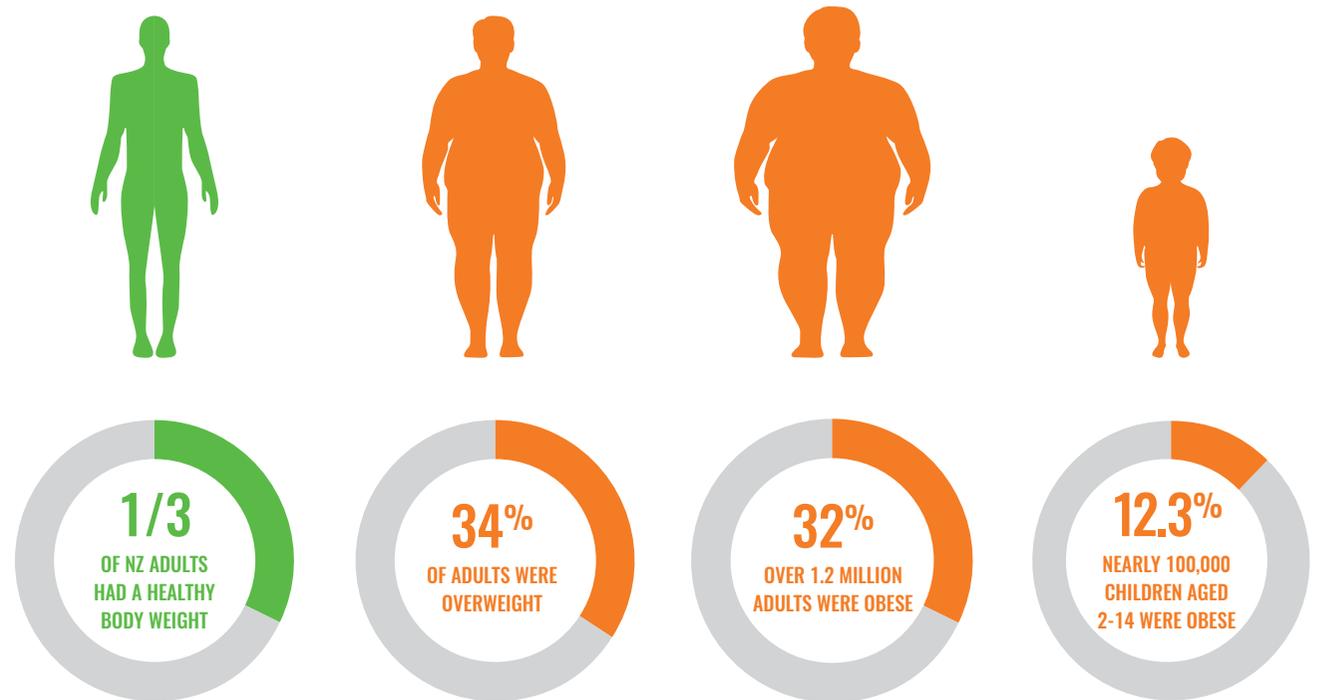


Figure 3. Body weight in New Zealand (Ministry of Health 2016/17)

Fish consumption

Current nutritional guidelines recommend that people increase their intake of fish and other seafood, despite a growing body of evidence demonstrating that high levels of toxins, fat and cholesterol, and a lack of fibre, make fish a poor choice.

Even modest consumption of moderately contaminated and commonly eaten fish can put people at risk. Mercury is classified as a human carcinogen by the International Agency for Research on Cancer (IARC),⁴⁶ and mercury exposure from fish consumption can cause irreversible damage to the cardiovascular and central nervous systems, brain damage and memory loss, and damage to a foetus.

New Zealand's 'pristine' waters are not free from the pollutants like polychlorinated biphenyls, dioxin, chlordanes, DDT and mercury, all of which accumulate in fish and shellfish. In 2009, a Food Safety Review found high levels of mercury in New Zealand fish, as well as high levels of cadmium and arsenic – both highly dangerous toxins. Regularly eating fish and seafood was associated with a two-fold increased risk of Amyotrophic Lateral Sclerosis due to increased mercury exposure.⁴⁷

In addition to these toxins, fish is high in cholesterol and most people do not realise that the fat in fish is not necessarily heart-healthy. A high intake of fish during pregnancy may increase the risk of childhood obesity.⁴⁸

**HIGH LEVELS OF TOXINS, FAT AND
CHOLESTROL, AND A LACK OF FIBRE,
MAKE FISH A POOR DIETARY CHOICE**



Figure 4. Possible contaminants found in fish

Dairy consumption

Humans are the only species who continue to drink milk after weaning; moreover, from another species. Dairy milk is ideal for growing calves and is not necessary for optimal health in the human diet.

New Zealand's agricultural growth strategy, which is responsible for promoting increased dairy production, has led to recommendations of dairy product consumption, despite scientific evidence that questions alleged health benefits and points instead to potential health risks.

Many people are lactose intolerant, caused by lactase deficiency. People of Māori and Pacific origin have a higher prevalence of lactase deficiency than New Zealand Europeans. Lactose intolerant people experience gastrointestinal issues ranging from discomfort to diarrhoea. Plant-milks are better alternatives that also have other health benefits.

DAIRY CONSUMPTION HEALTH RISKS

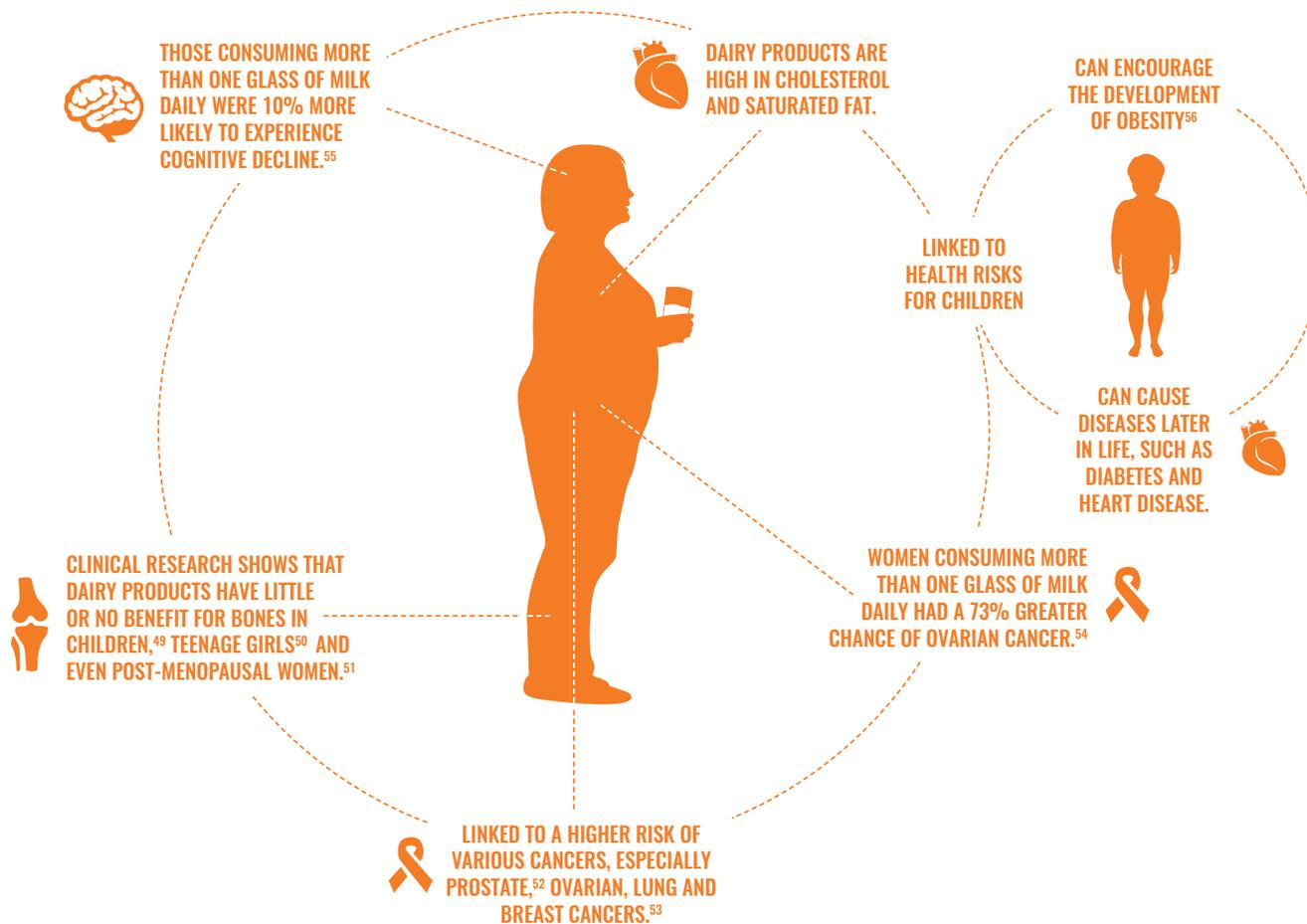


Figure 5. Dairy consumption health risks



Photograph: Farmwatch

A healthy diet

Healthy living on a plant-based diet has been practised for centuries.⁵⁷ All nutrients can be obtained from a plant-based diet, except for Vitamin B12. Vitamin B12 is produced by bacteria, and while animals have traditionally absorbed sufficient quantities through ingestion of soil, many farmed animals today receive Vitamin B12 supplements in their feed. Humans can similarly supplement their diets with appropriate levels of synthetic Vitamin B12. In addition, technologies to mimic animal products without the need for a living animal and associated environmental impacts are increasingly available.

The Eat Forum report recommends that a planetary health plate should consist by volume of approximately half a plate of vegetables and fruits; the other half, displayed by contribution to calories, should consist of primarily whole grains, plant protein sources, unsaturated plant oils, and (optionally) modest amounts of animal sources of protein.⁶⁶

It is the position of the American Academy of Nutrition and Dietetics that “appropriately planned vegetarian, including vegan, diets are healthful, nutritionally adequate, and may provide health benefits for the prevention and treatment of certain diseases.”⁶⁷

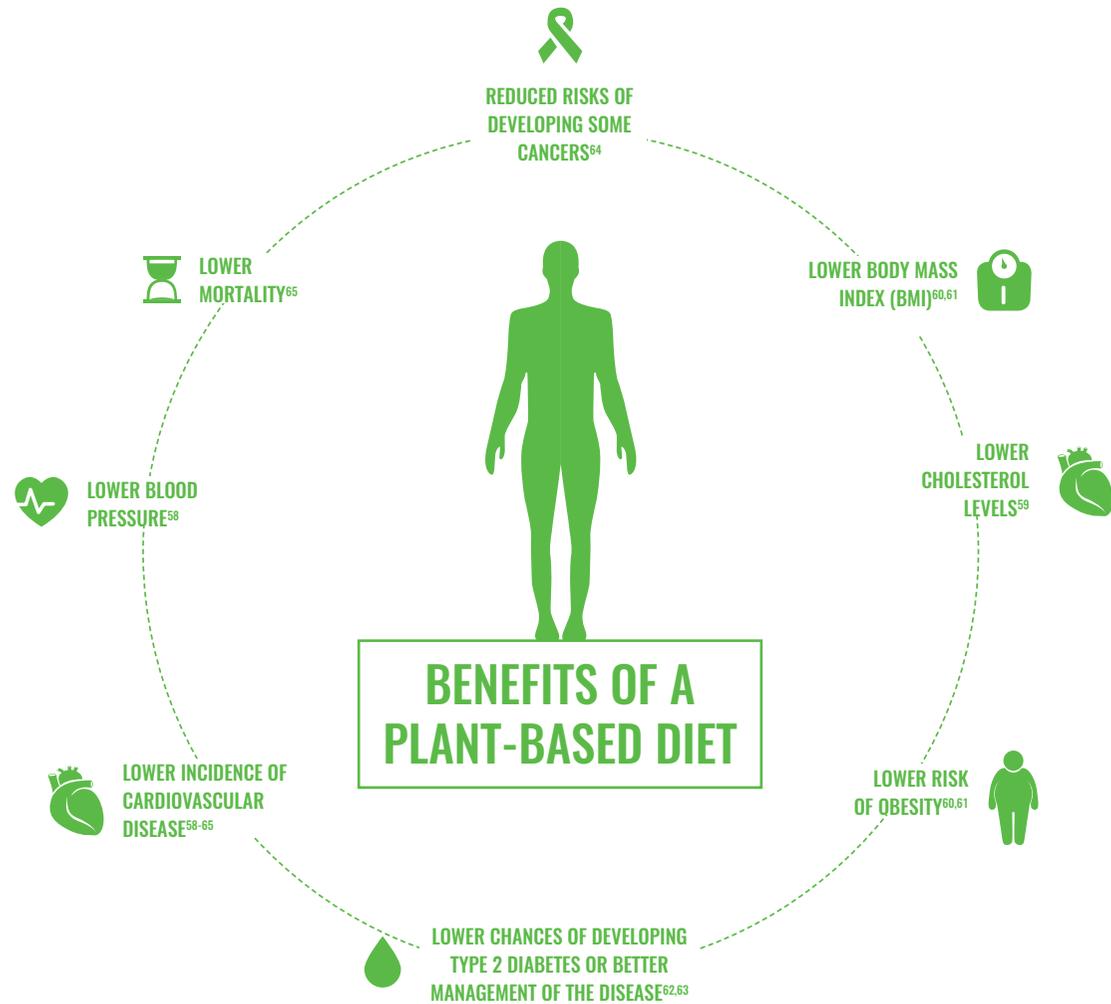


Figure 6. Benefits of a plant-based diet

A VEGAN DIET IS APPROPRIATE FOR ALL STAGES OF THE LIFE CYCLE

- 
 ✓ PREGNANCY
- 
 ✓ LACTATION
- 
 ✓ INFANCY
- 
 ✓ CHILDHOOD
- 
 ✓ ADOLESCENCE
- 
 ✓ OLDER ADULTHOOD
- 
 ✓ ATHLETES

**ACTIVE LIFESTYLES, AND EATING A WHOLE FOOD,
PLANT-BASED DIET CAN REDUCE THE RISK OF
DEVELOPING LIFESTYLE DISEASES AND CAN IN
SOME CASES REVERSE THEM**



2.2 ANIMAL PRODUCTION IN NEW ZEALAND

Dairy farming is New Zealand's predominant agricultural activity, followed by beef and sheep farming and horticulture. The total number of farmed (land) animals killed for food in New Zealand was around 170 million in 2019.⁶⁸ Millions of fish and other seafood are also farmed and caught each year.

Very large numbers of chickens (particularly), turkeys and ducks are farmed in New Zealand. By 2018, around 1.25 million 'broiler' (meat) chickens were killed, with numbers increasing around 16% annually for most of the previous decade. Around 3.8 million laying hens produced 1.1 billion eggs, and around 2.1 million turkeys and ducks were also slaughtered.⁶⁹

The number of sheep decreased from around 70 million in the 1980s to around 26.7 million in 2019. There were around 800,000 deer in 2019.⁷⁰

In total, there were 10.3 million cattle in 2019.⁷¹ The number of dairy cattle increased sharply from 3.84 million in 1994 to 6.6 million in 2016 (with around 12,000 herds of dairy cows in the financial year 2015/16). In the year ending 30 June 2019, 4.5 million dairy calves were born.⁷² Dairy calves are either slaughtered, raised for beef, or raised as dairy herd replacements. In the year ending September 2019, 1.8 million calves were slaughtered.⁷³ Almost all would have been dairy calves. These 'bobby calves' are normally slaughtered at the legal minimum of four days of age to allow harvesting of their mothers' milk.

By 2019, there were 25,500 breeding sows (aged one or more) in New Zealand. By 2015 most sows were housed in larger farms, that had an average of 349 sows each.⁷⁴ During the year ending September 2019, 621,248 pigs were slaughtered.⁷⁵

2.3 ANIMAL FARMING PROJECTIONS WORLDWIDE

Globally, around 70 billion land animals are farmed and killed for food (Food and Agriculture Organisation of the United Nations [FAO], figures for 2014),⁷⁶ in addition to an estimated one to three trillion aquatic animals.⁷⁷ Global demand for livestock products is estimated to increase by 70% by 2050 to feed a growing population.⁷⁸

Photograph: Farmwatch



AROUND 3.7 MILLION LAYING HENS PRODUCED 1.1 BILLION EGGS, AND AROUND 2.1 MILLION TURKEYS AND DUCKS WERE ALSO SLAUGHTERED

In 2010, FAO estimated that by 2050 the global average per capita calorie availability could rise to 3130 kcal per day, accompanied by changes in diet from staples to higher value foods such as fruit and vegetables, and to livestock products. This would require world agricultural production to increase by 70% from 2005/07 to 2050.⁷⁹

Based on past trends, global meat consumption per capita per year could increase from 41 kg in 2005 to 52 kg in 2050. In developing countries, annual per capita meat consumption has been predicted to increase from 31 kg in 2005 to 33 kg in 2015 and 44 kg in 2050, while annual per capita meat consumption in developed countries was projected to increase from 82 kg in 2005 to 84 kg in 2015 and 95 kg in 2050.⁸⁰ To meet the growing demand, the number of animals farmed for food was expected to grow worldwide in the next few decades, and world meat production is projected to double by 2050.⁸¹

However, the OECD-FAO Agricultural Outlook 2017-2026 report expects global meat consumption for the coming decade to be curbed by dietary preference, low incomes, and supply-side constraints. The report predicts that additional calories and protein will be obtained from vegetable oil, sugar and dairy products, and that the 'convergence' towards Western diets appears limited.⁸² The OECD-FAO Outlook report further anticipates:

- Cereal areas to remain largely the same, while soybean areas will expand to meet the growing demand for animal feed and vegetable oil.
- Growth in meat and dairy production to be achieved from larger herd sizes and increased output per animal.

- Poultry production to constitute nearly half of total meat production over the next decade, and milk production is expected to accelerate, particularly in South Asia.
- Farmed fish production to be the fastest growing source of protein among the commodities in the Outlook. Capture fish production is determined by available level of stocks and governed by policies to limit over-fishing.
- Agricultural trade to be more resilient to macroeconomic fluctuations than trade in other goods. The Outlook expects prices of most agricultural and fish commodities to follow a slightly declining trend. However, such prices are subject to volatility and may show large variations for extended periods of time.
- Ongoing food insecurity to be a critical global concern, and the concurrent forms of malnutrition to pose new challenges in many countries.

2.4 NEW ZEALAND FARMING DEVELOPMENTS AND TRADE

New Zealand's modern agricultural sector began when the first European settlers established themselves and their livestock across the North and South Islands in the 18th and 19th century. Large swathes of forest were cleared to create grazing pastures. Following the Second World War, while pursuing food security goals and economies of scale, genetic selection for production traits and intensification of farm husbandry systems increased. Animal farming became ever more automated, and 'factory farms' started replacing many of the traditional small-hold farms in the 1960s and 1970s.

In the 1970s and 1980s, substantial government subsidies were awarded to farmers to support and expand the livestock sector, when New Zealand lost preferential export to the UK. The bilateral agreement was terminated when the United Kingdom (UK) entered the European Economic Community in 1973. New Zealand's trade diversified, and expanded with nations such as the USA, Japan and Australia between 1980 and the 2000s, when subsidies were being phased out. Beef, sheep and wool, and dairy products became the main agricultural export items.

Agriculture contributed 5.0% (\$10.6 billion) to New Zealand's gross domestic product (GDP) in the year ended March 2012.⁸³ In 2018, agriculture, forestry and fishing contributed NZ\$12,431 million to total GDP (the 10th ranked sector).⁸⁴ In 2013, the agriculture, forestry and fishing sector ranked 7th in employment sectors, and employed around 6.7% of the population.⁸⁵ In 2015, around 27,100 people were employed in NZ dairy farming, increasing to 46,000 in 2019.⁸⁶

2.4.1 Contribution of the dairy sector to the New Zealand economy

New Zealand dairy farming has increased substantially over the last two decades, and is now conducted on a scale that is unusually large by world standards. Dairy cattle farming accounted for 50% of agricultural GDP in 2012 prices, and a 2017 report indicated that the dairy sector contributed \$7.8 billion (3.5%) of New Zealand's total GDP.⁸⁷ Although ranked only 125th among nations by population in 2017,⁸⁸ New Zealand produces 3% of all dairy produce, and is responsible for 33% of world trade.⁸⁹

Waikato and Canterbury are the main dairy farming regions.

Around 95% of New Zealand's dairy produce is exported.⁹⁰ By June 2019 dairy products were New Zealand's greatest primary industry source of export revenue, worth \$18.1 billion, up from 14.0 billion in 2015. By 2017 there had been a 70% increase in dairy cattle, compared with 1994.⁹¹ New Zealand produces around a fifth as much milk as the USA – a country 70 times more populous.

When considering conversions from arable to dairy farming, farmers cited improved cashflow, absence of harvest risk and increased profitability (MPI, 2012).⁹² However, dairy farming poses similar risks, with harvest problems substituted for animal-related risks, and price volatility due to international market pressures and changes. If a 'water tax' were to be introduced, this could further reduce dairy profits.

Fonterra is the largest dairy company in New Zealand. It describes itself as "a global dairy nutrition company owned by 10,500 farmers and their families, united by a fundamental belief in the power of dairy to make a difference". With operations across four continents, Fonterra employs 22,000 people; has contributed to New Zealand's global export for over 50 years and provides up to 25% of New Zealand's exports; and claims to put \$8 billion back into rural and provincial towns.⁹³ In the financial year 2016, the total turnover of Fonterra amounted to approximately \$17.2 billion, and the earnings before interest, taxes, depreciation and amortization (EBITDA) amounted to approximately \$2 billion.⁹⁴

2.4.2 Costs of dairy to the New Zealand economy

New Zealand is proud of its global dominance in the dairy market and its alleged clean, green image. However, the true costs, to animals, the environment and society are not properly reflected in the usual financial statements. Rather than a net contribution to GDP, the dairy sector may actually result in certain losses.

One study calculated the cost of dairy production when considering the costs of repairing the environmental damage from dairy farming.⁹⁵ Excluding some major losses in biodiversity and ecosystem degradation ('ecosystem services'), which were not valued, the costs could be as high as \$15 billion. The largest issue created by dairy farming is the need to remove nitrates from drinking water (the potential cost of repair may be up to \$10.7 billion), followed by dealing with greenhouse gas emissions (\$3.1 billion) and soil compaction (\$611 million).

A Ministry for the Environment 2001 study suggested there might be a potential loss in revenue (up to \$569 million) of dairy products from international consumers who would purchase 54% less dairy products if New Zealand's environment was perceived as degraded.⁹⁶

Co-author of the 2015 study, Dr Mike Joy of Massey University, suggested the environmental costs of dairy farming "at the higher end" exceeded the export value of dairy for 2012 of \$11.6 billion. Given that several impacts have not been included and the 'clean, green image' study is nearly 20 years old, the total negative external impact of intensified dairying is probably grossly underestimated.

Other (agricultural) production industries and energy sectors that produce GHG emissions and other waste obviously also have costs due to externalities that are not reported. All such sectors should be part of the ETS, but the dairy sector is unique in its disproportionate 'contribution' to New Zealand's export markets and its large environmental impact, and therefore warrants closer scrutiny.

2.5 NEW ZEALAND EXPORT OF ANIMAL PRODUCTS

In the year ended June 2017, total export was \$71,817 million, of which nearly a third (30.5%) of the top 30 export commodities and services comprised animal products (Table 1, in bold font). The total value of animal-based commodities exported was \$21,952 million. Horticultural exports (fruit, vegetables, flowers and wine) were \$3.9 billion in 2014, with kiwifruit, apples and potatoes comprising 64% of the horticultural produce export value that year. Other successful export products included avocados, processed peas, and vegetable seeds,

THE DAIRY SECTOR IS UNIQUE IN ITS DISPROPORTIONATE 'CONTRIBUTION' TO NEW ZEALAND'S EXPORT MARKETS AND ITS LARGE ENVIRONMENTAL IMPACT

as well as wine. Domestic production dominates the vegetable sector and is a core element of New Zealand's food network. Total domestic horticultural value exceeded \$3.2 billion.⁹⁷

TABLE 1. OVERVIEW OF THE MAIN COMMODITY AND SERVICE EXPORT INDUSTRY.

COMMODITY / SERVICE	2016	% OF TOTAL	2017	% OF TOTAL
 MILK POWDER, BUTTER, AND CHEESE	11,162	15.8	12,506	17.4
Travel: business and other personal	10,264	14.5	10,238	14.3
 MEAT AND EDIBLE OFFAL	6,602	9.3	6,048	8.4
Logs, wood, and wood articles	3,823	5.4	4,223	5.9
Travel: personal: education related	3,472	4.9	3,649	5.1
Transportation	2,705	3.8	2,881	4.0
Fruit	2,636	3.7	2,690	3.7
Other business services	1,844	2.6	1,932	2.7
Wine	1,569	2.2	1,664	2.3
 FISH, CRUSTACEANS, AND MOLLUSCS	1,586	2.2	1,577	2.2
Mechanical machinery and equipment	1,726	2.4	1,560	2.2
Preparations of cereals, flour, and starch	1,099	1.6	1,218	1.7
Confidential items	311	0.4	1,194	1.7
Miscellaneous edible preparations	1,221	1.7	1,158	1.6
Aluminium and aluminium articles	984	1.4	1,023	1.4
Electrical machinery and equipment	1,083	1.5	1,004	1.4
 CASEIN AND CASEINATES	995	1.4	858	1.2
Telecommunications, computer, and information services	883	1.2	857	1.2
Optical, medical, and measuring equipment	850	1.2	835	1.2
Financial services	726	1.0	761	1.1
Wood pulp and waste paper	748	1.1	729	1.0
Crude oil	589	0.8	646	0.9
Precious metals, jewellery, and coins	785	1.1	642	0.9
Iron and steel, and articles	658	0.9	622	0.9
Textiles and textile articles	612	0.9	550	0.8
 WOOL	760	1.1	523	0.7
Plastic and plastic articles	501	0.7	477	0.7
Paper and paperboard, and articles	495	0.7	460	0.6
Charges for the use of intellectual property (not elsewhere included)	446	0.6	455	0.6
OTHER ANIMAL ORIGINATED PRODUCTS	477	0.7	440	0.6
Total ⁽¹⁾	70,868	100	71,817	100
Commercial services ⁽²⁾	4,682	6.6	4,761	6.6

Export NZ\$(million) free on board (fob) (3)

Table 1. Overview of the main commodity and service export industry. Animal products have been emphasised.

Notes:

1. Only a limited commodity and service breakdown is shown in this table, therefore data does not sum to stated totals.
2. Commercial services includes trade in all services except travel (expenditure by international visitors), transportation, insurance and government services.
3. Exports are valued fob (free on board – the value of goods at New Zealand ports before export) and include re-exports.

Data source: Stats NZ (2018)⁹⁸

In 2015, the export value for dairy products from New Zealand amounted to approximately nine billion U.S. dollars, down from 13.1 billion U.S. dollars the previous year. Casein exports amounted to 30.8% of the value of global casein exports, followed by 24.4% in global butter exports.⁹⁹

Bilateral trade for milk powder is primarily traded among members of Asian Pacific Economic Cooperation, Association of Southeast Asian Nations and the Gulf Cooperation Council. Sheep meat is mainly traded among OECD and EU countries, and frozen beef meat among OECD and North American nations.¹⁰⁰ The top four countries New Zealand exports to include the People's Republic of China, Australia, United States of America and Japan. Within the EU, the main destinations for New Zealand exports are the UK, followed by Germany, the Netherlands, France and Italy.

While the preferential trading relationship with the UK ended in the 1970s, and New Zealand has since developed trading agreements with a range of countries, Figure 7 (page 28) shows a few examples of recent trade in animals and products between the UK and New Zealand. Following Brexit, these figures may vary, although there is no clarity yet as to how trade relations may change.

IMPORT AND EXPORT OF SELECTED ANIMAL PRODUCTS BETWEEN NEW ZEALAND AND THE UNITED KINGDOM

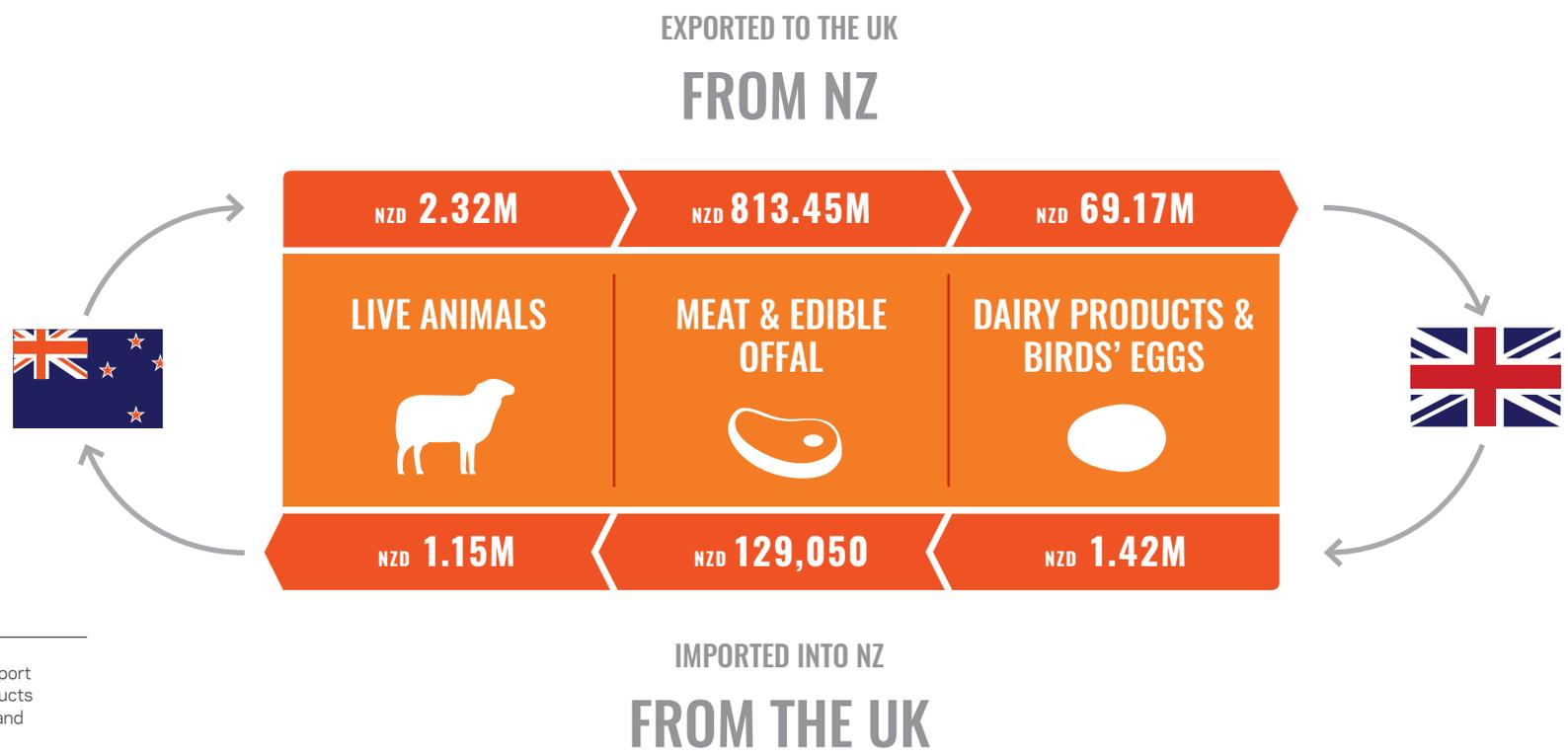


Figure 7. Import and export of selected animal products between New Zealand and the United Kingdom in 2014 (data compiled from www.Statista.com on 17/04/18).

2.6 FOOD JUSTICE

For the immediate foreseeable future, animal-based industries will continue to dominate. This is enabled by economies of scale, ever-increasing automation of intensive animal farming operations, and cheap human (and sometimes even slave) labour in animal agriculture, fisheries and slaughterhouses. The psychological costs of people working in those industries are high. Furthermore, the exclusion of externalities (see chapter four) in animal product retail prices and subsidies of livestock farming keeps the costs of animal products artificially low, while in some regions healthy food such as fruit and vegetables are expensive and inaccessible for people on low incomes.

High consumption of animal products in developed, and increasingly, developing, countries results in depletion of resources that will no longer be available to people in 'producing' countries. Soy production in South America for livestock feed in the West, for example, has resulted in dramatic deforestation, biodiversity loss and poverty.

Global food justice and sovereignty are severely impacted by the inequitable distribution of edible crops and grains. It takes an area of arable land as large as the EU land surface (or half the land area of the United States) to grow food to feed factory-farmed animals. As most of the energy (or plant-based calories) is used for animals' physiological maintenance and reproduction, the conversion of feed to meat, milk and eggs is inefficient and wasteful. Even considering the energy value of meat produced, in 2009, the United Nations Environmental Programme estimated that the loss of calories resulting

from feeding cereals to animals instead of directly to humans represented the annual calorie needs of more than 3.5 billion people.¹⁰¹ We now produce enough food for an extra four billion people on the planet. However, unfair global agricultural trade policies continue to promote the economic interests of a few (in the West) at the expense of the global south, thereby making slow progress on Sustainable Development Goals to eradicate

CONSUMERS ARE INCREASINGLY BECOMING AWARE OF SOCIAL JUSTICE ISSUES, AND ARE BECOMING MORE INTERESTED IN SUSTAINABLE, ETHICAL, ANIMAL—AND ENVIRONMENTALLY-FRIENDLY PRODUCTS AND SERVICES

global hunger. The adverse social and environmental impacts may be largely out of sight; however, consumers are increasingly becoming aware of social justice issues, and are becoming more interested in sustainable, ethical, animal—and environmentally-friendly products and services.

The New Zealand Government upholds important social justice values and has a progressive vision for a sustainable future. As part of this direction, it should initiate a change in agricultural production, declaring that out-dated animal production methods are no longer socially and environmentally acceptable, nor needed for a truly modern and progressive nation. The last chapter in this report deals with recommendations for a more environmentally sustainable, socially just and animal-friendly New Zealand.





3. FARM ANIMAL WELFARE CONCERNS

The unusual prominence of animal agriculture within New Zealand raises concerns about animal welfare. Welfare compromises are prevalent within the modern farming of most animal species. Welfare challenges are created by management factors, such as space and environment, nutrition, husbandry, access to veterinary care, and degree of opportunities to express normal behaviours, including social behaviours. They are also created by animal factors such as genetics and temperament. Welfare problems may occur when animals are farmed, transported and slaughtered. Some of the main concerns are summarised here, with the exception of farmed fish and land animals farmed in smaller numbers such as ducks and turkeys. This chapter is not necessarily a comprehensive overview of all welfare and ethical concerns raised by animal farming in New Zealand.

3.1 GOVERNMENT AND INDUSTRY CLAIMS ABOUT FARM ANIMAL WELFARE

Despite the risks to welfare created by the prominence of animal agriculture within New Zealand, its government has repeatedly asserted that the nation leads the world in animal welfare. In 2017, then Minister for Primary Industries Nathan Guy asserted that “In 2014, New Zealand’s animal welfare system was ranked 1st equal [sic] out of 50 countries assessed by the global animal protection charity World Animal Protection.”¹⁰² Later that year New Zealand’s Ministry for Primary Industries expanded on this claim: “New Zealand’s animal welfare systems are world-class, as demonstrated by our ‘A’ grading for animal welfare, alongside the United Kingdom (UK), Switzerland and Austria, in the Animal Protection Index produced by World Animal Protection.”¹⁰³

Such claims continue to be repeated by organisations and individuals representing New Zealand’s animal production industries, such as by Dairy NZ in 2018, who added that animal care provided by New Zealand’s dairy industry is “world leading.”¹⁰⁴

Given such governmental and industry positions, it might be argued that New Zealand has made sufficient progress within the domain of animal welfare, and that investments of time, energy and money aimed at achieving further progress are not currently warranted.

This chapter examines the welfare concerns associated with the main animal species farmed in New Zealand (poultry, pigs, cattle and sheep), and asks whether ongoing welfare problems are significant enough to warrant substantial further resource investment and policy reform.



Photograph: Farmwatch

3.2 POULTRY

3.2.1 Meat chickens

Meat chickens are normally confined within giant, windowless sheds, at very high stocking densities. Single sheds may hold over 50,000 birds.¹⁰⁵

Genetic selection for increased growth rates dramatically decreased the time needed to achieve a marketable body weight of around 1.5 kg, from 120 days in 1925, to just 30 days in 2005.



Figure 8. Impact of genetic selection on chicken growth

Bagshaw *et al.* (2006)¹⁰⁶ found that average mortality for 36 batches of birds on a number of New Zealand farms was 3.8%. For the 2016 national meat chicken population, this equated to 500 birds dying every hour of the year.

In their final weeks and days, the surviving chickens struggle to move their heavy bodies around overcrowded sheds, on increasingly painful legs and feet. It becomes ever more difficult to perform highly motivated natural behaviours, such as wing stretching, dust-bathing and foraging. Affected birds spend ever longer lying on substrates increasingly contaminated with urine and faeces – because sheds are not cleaned until the entire flock is removed to slaughter. Prolonged periods lying on dirty, urine-soaked substrates causes chemical burns to breasts and hind limbs (hocks), and predisposes the birds to hock infections, all of which further increases the pain and suffering these chickens endure. Bagshaw *et al.* (2006)¹⁰⁷ recorded that 29% of birds had footpad lesions, and 28% had hock burns, on the New Zealand farms studied. Using a gait scoring system devised by Kestin *et al.* (1992)¹⁰⁸, with 0 normal and 5 immobile, the average gait score was 2.14, and 8% of all deaths were due to leg problems (Bagshaw *et al.*, 2006).

Poultry may also experience significant stress during catching (which may be manual or mechanical, in the case of meat chickens). Raised in windowless sheds with minimal human contact or stimulation of any kind, stress

and panic are common when birds encounter human or mechanical chicken catchers. After capture, the birds are crammed into crates and loaded en masse onto trucks for transport to the abattoir. The unfamiliar bumps, sounds, sights and smells, and sometimes injuries and thermal stressors (heat or cold) they experience, compound substantial existing stress levels.

IN THEIR FINAL WEEKS AND DAYS, THE SURVIVING CHICKENS STRUGGLE TO MOVE THEIR HEAVY BODIES AROUND OVERCROWDED SHEDS, ON INCREASINGLY PAINFUL LEGS AND FEET

On arrival at the slaughterhouse, poultry are shackled and hung upside down from their feet, which is also extremely stressful and can cause injuries (increased by skeletal bone density problems). The production line normally delivers the birds to a water bath electrical stunning system, which aims to render them unconscious prior to throat cutting and subsequent scalding, plucking and processing. However, these systems are known to fail in a significant number of cases^{109,110} resulting in levels of suffering that are difficult to contemplate (for example, some birds might still be conscious after their throats have been cut when they enter the scalding hot water tanks). Such failing systems also violate the Animal Welfare Act. With over 1.25 million chickens passing through this system annually in New Zealand, the multiple stressors and significant suffering these birds endure create one of New Zealand's greatest animal welfare concerns.

**THESE VERY RAPID RATES OF MUSCULAR GROWTH
PREDISPOSE THE BIRDS TO DEVELOPING SERIOUS
SKELETAL AND CARDIOVASCULAR PROBLEMS, CAUSING
PAINFUL LAMENESS, AND EVEN SUDDEN DEATH**



3.2.2 Laying hens

Although laying hens may be farmed in barns, free range or organic systems, Black and Christiansen (2009)¹¹¹ estimated that nearly 90% of New Zealand eggs are produced by conventionally caged hens. These 'battery' cages typically house 4-8 hens, providing about 500 square cm per bird – less than an A4 sheet of paper. (One sheet of A4 paper provides 624 square cm.)

The close confinement and lack of environmental enrichment within caged systems inhibits many behaviours hens are highly motivated to perform, including wing-stretching, perching, nesting, foraging and dust bathing. This violates New Zealand's Animal Welfare Act, which requires animal owners to ensure animals' basic needs, including behavioural needs, are met.

Battery cages will be outlawed in New Zealand in 2022, with colony cages housing up to 60 birds already being introduced. While such cages do provide extremely limited perching, scratching and nesting areas, they remain very barren environments, and severe crowding inhibits the use of such enrichment devices (for example, a single nest box may be provided for up to 60 birds). The perches, if not properly designed, can cause claw problems, and occasionally hens get trapped and die underneath them.

Insufficient opportunity to express highly motivated natural behaviours can result in chronic stress and behavioural pathologies, such as injurious feather pecking, and outbreaks of cannibalism. Rather than modifying environments and stocking densities through introduction of more natural, but more

INSUFFICIENT OPPORTUNITY TO EXPRESS HIGHLY MOTIVATED NATURAL BEHAVIOURS CAN RESULT IN CHRONIC STRESS AND BEHAVIOURAL PATHOLOGIES, SUCH AS INJURIOUS FEATHER PECKING, AND OUTBREAKS OF CANNIBALISM



Photograph: Farmwatch

expensive systems, producers usually seek to minimise such adverse impacts through beak trimming. Although this frequently results in substantial pain, painkillers are not normally used, due to cost – even though costs are not high. Chronic pain as a result of beak trimming is also common¹¹².

Egg production drops after one to two years of intensive production. Most New Zealand hens are killed after a single cycle of laying, well short of their natural lifespan of seven to fifteen years. The flock is replaced by new chicks. However, half of all chicks born are male and cannot lay eggs. These chicks are usually killed by maceration on their first day of life, again, without painkillers or anaesthetics.

Alternative housing systems for laying hens and other fowl include modifications to cage design, as well as cage-free systems such as barns, free range and organic systems. However, animal welfare concerns such as crowding, behavioural restriction, inadequate hygiene, disease and parasitism exist in virtually all confinement systems, to various degrees.¹¹³

**‘ BATTERY’ CAGES TYPICALLY HOUSE 4-8 HENS,
PROVIDING ABOUT 500 SQUARE CM PER BIRD
– LESS THAN AN A4 SHEET OF PAPER**

A4
210 x 297mm

THEY CAN BARELY TAKE ONE STEP FORWARDS OR BACKWARDS, AND CANNOT EVEN TURN AROUND



3.3 PIGS

3.3.1 Industry intensification

Historically, farmed pigs lived outdoors in sties and loose boxes, and most were able to root around. Today however, specialised housing, diets and intensive management systems are the norm. Productivity and efficiency are maximised by housing larger herds in more limited spaces, and by genetic selection for greater litter sizes and growth rates. By 2014 sows weighed a staggering 260 kg on average,¹¹⁴ and the average litter size had increased from under 11 to over 13.¹¹⁵

3.3.2 Farrowing crates

In New Zealand, the most serious sow welfare concerns currently result from their close confinement within farrowing crates. Larger sows, oversize litters, and highly

confined spaces, which limit sow opportunities to exercise and develop natural agility, have all increased risks sows will accidentally smother and suffocate their numerous tiny offspring, resulting in productivity losses.

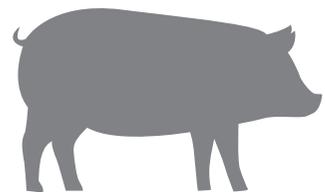
Accordingly, spatially restrictive farrowing crates were developed in the 1940s to limit sow access to her piglets. Under New Zealand's *Code of Welfare (Pigs)* sows may be confined within these crates from one week prior, until four to five weeks after farrowing.¹¹⁹

These sows experience particularly severe deprivations. They can barely take one step forwards or backwards, and cannot even turn around. They cannot meet their highly motivated behavioural needs to build nests, or to interact socially with other pigs.

The near-total lack of stimulation in barren environments results in unremitting weeks of boredom and frustration, and they are reduced to repetitive chewing on the bars of their cages (stereotypical behaviour). The hard concrete, plastic or wooden surfaces on which they're forced to lie cause pressure sores, joint injuries and lameness. And unfortunately, despite all of this, piglet mortality remains significant.^{120,121}

Pigs are highly intelligent, social animals, and New Zealand's *Code of Welfare (Pigs)* acknowledges that these conditions violate New Zealand's Animal Welfare Act.¹²² Nevertheless, the Act allows such violations when economic and practical considerations for the industry are considered more important.

UNNATURAL HOUSING AND MANAGEMENT REGIMES RESULT IN A RANGE OF SERIOUS WELFARE PROBLEMS.¹¹⁶



Increased aggression, tail and vulva biting, and stereotypical behaviours (repetitive, apparently purposeless behaviours, believed to indicate profound and chronic stress), are all common.¹¹⁷ These may be both symptoms and causes of poor welfare. Piglet mortality is heavily dependent on management factors and is highly variable between farms, but the New Zealand average was a very substantial 12.9% in 2010.¹¹⁸

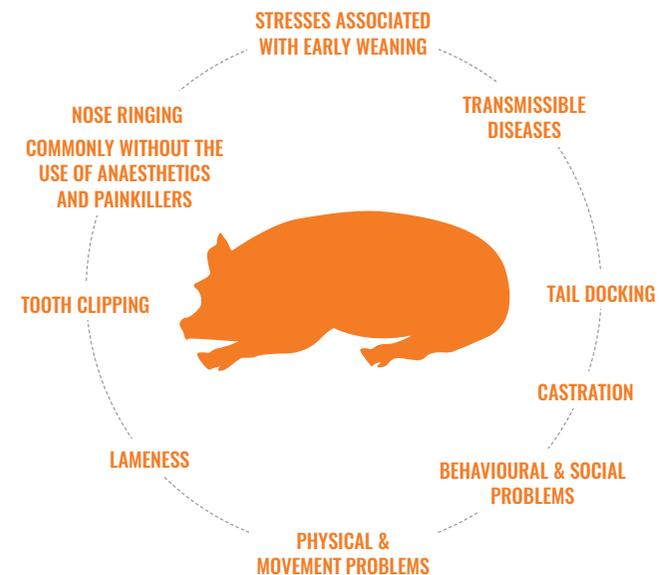


Figure 9. Impacts of intensive farming on pig welfare

Photograph: Farmwatch



MORE THAN 20% OF THE DAIRY HERD IS KILLED EACH YEAR.¹²⁹ AFTER ABOUT FIVE YEARS OF PREGNANCY AND LACTATION, COWS' MILK PRODUCTION NORMALLY DECLINES AND THEY ARE SLAUGHTERED, HAVING LIVED ONLY A QUARTER OF THEIR NORMAL LIFESPAN

3.4 COWS AND CALVES

Driven by market pressures, over time sheep and beef farming have given way to dairy farming.¹²³ Cattle welfare concerns relate to the intensification of dairy farming, and to housing and management, physical problems, painful husbandry procedures, and the welfare of calves.

3.4.1 Intensifying production

As with the farming of most other species, dairy farming has intensified over time.¹²⁴ By the 2016-2017 season, the average New Zealand dairy herd size was 414 cows.¹²⁵ Genetic selection has resulted in a 2-3% annual increase in milk production per cow in Western countries.¹²⁶ New Zealand dairy cows are typically connected to a milking machine twice (or, increasingly, once) daily, and produced, on average, over 4,200 L of milk per cow annually in 2014-2015. This was 18% more than a decade previously.¹²⁷

Genetic selection for increased productivity has resulted in the diversion of a greater proportion of biological resources into milk and muscle production, in dairy and beef cattle respectively. This means that fewer are available for maintenance (with many dairy cows being chronically hungry), or for immune function, to support tissue repair, or to respond to stressful stimuli. Unsurprisingly, therefore, rates of some diseases appear to be increasing, including reproductive problems (such as failure to conceive), mastitis (udder inflammation), lameness and metritis (uterine inflammation).¹²⁸

3.4.2 Housing and management

As part of production intensification over time, the trend has been towards larger herds, larger farms, more indoor housing, and more concentrated diets (including adding palm kernel expeller, a by-product of palm oil production, to cattle feed).¹³⁰ Indoor housing can provide protection from inclement weather. However, it can also result in crowding, and can restrict freedom of movement and the expression of natural social and grazing behaviours.¹³¹ These restrictions can cause stress, which can weaken the immune system. Build-up of urine and manure can also result in less hygienic housing. All of these factors combined can facilitate the spread of infectious diseases. Prolonged standing on hard surfaces such as concrete can also increase problems such as sole ulcers and digital dermatitis, which cause lameness¹³².

Outdoor farming systems often lack sufficient trees, hedges or other forms of shelter, especially when cattle are grazed intensively. This is increasingly common, with pasture growth assisted by artificial irrigation, which depletes water supplies, and impedes the planting of shelter belts. High stocking densities can also compact soils, increasing effluent run-off into rivers and streams.¹³³

Cattle in such outdoor systems are often exposed to excessive wind, rain, snow and sunshine, which can be stressful and can decrease their welfare.^{134,135} Cattle are particularly vulnerable to snowfall during winter. They have a large body surface area, and modern Holstein Friesian dairy cow breeds do not have thick coats for insulation.¹³⁶

3.4.3 Physical problems

Numerous physical problems cause pain and suffering for farmed cattle. In some cases, pain can be severe. These problems may also lead to premature death, when farmers choose to kill affected animals rather than invest time and money treating them, or because their productivity is reduced. Some of the main physical issues are summarised here.

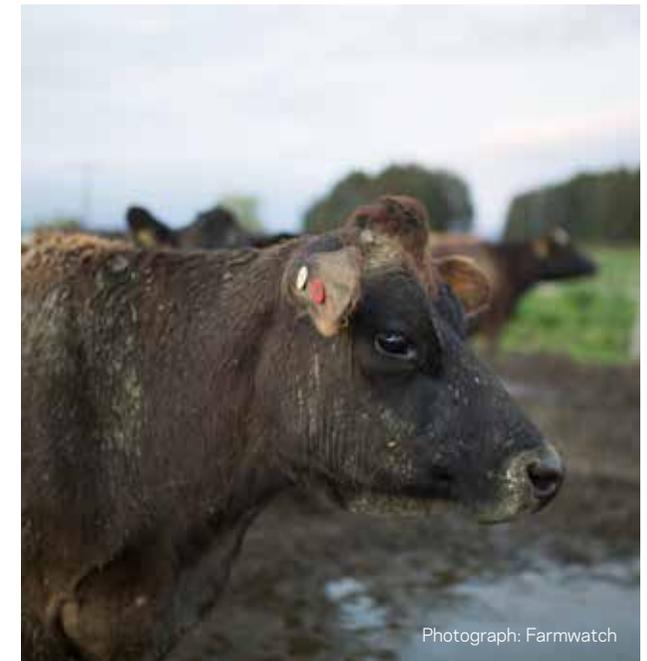
Lameness

Lameness has been described as the “most important animal welfare problem for the dairy cow”.¹³⁷ It is increased by wet or unhygienic conditions, or when cattle must walk long distances, along poorly maintained tracks. Cases last four-six weeks on average¹³⁸ and can cause severe pain. Hoof sensitivity is increased, and stimuli that are not normally painful may become so.

**LAMENESS HAS BEEN DESCRIBED AS THE
“MOST IMPORTANT ANIMAL WELFARE PROBLEM
FOR THE DAIRY COW”**

Large-scale, prospective studies assessing lameness prevalence in New Zealand are scarce; however, Fabian and colleagues (2014)¹³⁹ locomotion-scored 23,949 cows on 59 farms, using the DairyCo mobility scoring system to estimate lameness prevalence. The mean lameness prevalence was 8.3% (median, 6.7%; range, 1.2%–36%). In contrast, mean lameness prevalence as estimated by farmers was 2.3% (median, 1.4%; range, 0–20%). Only 27.3% (range 0–95%) of cows

with reduced mobility were identified as such by New Zealand farmers – a detection rate broadly similar to that of farmers in the US¹⁴⁰ and UK.¹⁴¹ Hence, identification and treatment in the case of this very important welfare problem presently appears inadequate. An extreme example of neglect occurred in 2015, resulting in over 950 cows on Castlerock Dairies farms suffering severely from lameness and neglect. Nearly 200 were euthanised and over 760 cows needed treatment.¹⁴² While this case made the news in 2017, chronic lameness on most farms goes unreported.



Photograph: Farmwatch

Nutrition

Beef cattle may suffer nutritional stress when pasture cover is insufficient, or their metabolic needs are increased, for example during cold winter weather.

For dairy cows, foetal growth is most rapid during the last trimester of pregnancy, and lactation after birth also consumes a very high level of biological resources. Modern dairy cows are so highly productive that they are often physically unable to consume sufficient calories to replace what they use during this period, resulting in a negative daily energy balance, chronic hunger, and a weakened immune system. Cows lose body condition during late gestation and for six to ten weeks after calving.¹⁴³ On a typical, well managed New Zealand dairy farm, Roche et al. (2007)¹⁴⁴ assessed 23% of cows as being thin. Such cows are at significant risk of metabolic and infectious diseases,^{145,146} which can result in serious welfare problems.

Dystocia (obstructed labour)

In the New Zealand dairy herd as many as 15% of heifers and 10% of cows suffer from dystocia annually.¹⁴⁷ Among beef cattle, average calf mortality during birth ranges from 0-15% depending on the bull and cow size and breed, and on management factors, and is probably responsible for two thirds of all calf deaths.¹⁴⁸

The pain or distress experienced by such mothers and calves can be substantial. Sometimes veterinarians or farmers may assist, but not always, especially in large herds.^{149,150} Birthing difficulties can also damage hind leg nerves, resulting in 'downer' cows who are unable to rise. If these cows do not recover, they will die. When birthing

is unsuccessful, the cow initially experiences great distress, followed by depression. The foetus will die and decompose, which can lead to the death of the mother.

With beef cattle, the major calving problem relates to lack of supervision. Problems may not be seen or addressed in time, and the calf and cow may die or require euthanasia as a result. Another problem is the breeding of beef cows that require caesarean sections to give birth. The Belgian Blue breed is notorious for this problem.¹⁵¹

Mastitis

The large, heavy udders of modern, highly producing dairy cows have increased risks of mastitis (udder inflammation). This is exacerbated by stress and unhygienic conditions.

In a large New Zealand-wide study in 2007, the average mastitis rate was 12.7 cases per hundred cows.¹⁵² Acute mastitis is painful, and also contaminates milk with white blood cells, which, combined with dead bacteria, creates pus. Mastitis cases can last for two months or longer.

Disease

Farmed animals also suffer from a number of diseases. Some health risks are mitigated by preventative and curative (herd) health care, such as the routine application of antibiotics (which in itself is hugely problematic and contributes to antimicrobial resistance, affecting human health). Many thousands of animals are culled due to disease each year prior to reaching so-called 'slaughter weight'. Notifiable diseases such as *Mycoplasma bovis* pose a biosecurity risk, and frequently leads to culling of herds. Following the 2017/18 *M. bovis* outbreak, the

government planned to kill over 150,000 cattle¹⁵³ in an attempt to rid the country of the bacterial disease, which can cause untreatable mastitis, abortion and arthritis in cows. The phased eradication was expected to cost \$886 million and to have knock-on effects on the economy.

3.4.4 Husbandry procedures

Several husbandry procedures routinely applied to cattle are frequently painful. These include dehorning and disbudding,¹⁵⁴ tail tip amputation,¹⁵⁵ ear tagging, freeze branding and castration.¹⁵⁶ Unfortunately, these are often performed without painkillers or anaesthetics, mainly to minimise costs.¹⁵⁷



PAINFUL SWELLING OF THE UDDER (MASTITIS) IS COMMON IN MODERN DAIRY COWS



Photograph: Farmwatch

3.4.5 Calves

Calf-cow separation

Cows, like humans, are pregnant for nine months, and they too bond strongly with their babies. A strong maternal bond is formed after only five minutes of contact, following calf birth.¹⁵⁸ Calves would naturally suckle five to eight times a day for the first few weeks, and stay with their mothers for up to two years. However, dairy calves are generally taken from cows within 12 hours of birth, and cows may show signs of extreme distress,¹⁵⁹ searching for their lost calves for days.

Both cow and calf may exhibit altered behaviour and prolonged bellowing.¹⁶⁰ Numerous studies have shown that early weaning causes stress to cows, and mood depression in calves appears similar to that caused by pain following hot-iron dehorning.¹⁶¹

COWS MAY SHOW SIGNS OF EXTREME DISTRESS, SEARCHING FOR THEIR LOST CALVES FOR DAYS

Transportation

Although bobby calves must be healthy and fed on the morning of transport, Donovan (2008)¹⁶² found that three to four per cent died daily on trucks, in yards, or were condemned as unfit for human consumption due to disease or weakness. Rough and abusive treatment of calves during transportation and slaughter was also evident in New Zealand undercover video footage from 2015 and 2016.¹⁶³

3.5 SHEEP

By mid 2019, 26.7 million sheep were farmed in New Zealand for their meat and wool.¹⁶⁴ Like other mammals, sheep are sentient, capable of feeling pain, stress and fear.

3.5.1 Lamb morbidity and mortality

Problems begin at birth. Disturbing numbers of lambs die from cold and inadequate nutrition during their first few days of life. Adverse weather, lack of shelter, winter lambing, ewes with twins or triplets, and poor management such as winter shearing of ewes while keeping them exposed to cold weather, all contribute.¹⁶⁵ West *et al.* (2009)¹⁶⁶ documented mortality rates of 10-17%, 6-20% and 22-41% for single, twin and triplet lambs respectively, depending on the breed. An extensive study carried out in 1999-2000 demonstrated that over 42% of New Zealand lambs had pneumonic lung lesions.¹⁶⁷

3.5.2 Painful husbandry

Lambs also face painful husbandry procedures such as tail-docking, castration and ear-tagging, usually in their first six months of life. These are acutely painful, with tail-docking and ear-tagging resulting in severe pain for hours to days.^{168,169,170} Many animals continue to experience these procedures without adequate pain relief, because it is cheaper and quicker not to administer it.

Sheep also experience varying levels of nutrition, hunger and exposure to the weather, throughout their lives, and many become lame, suffering from painful conditions such as footrot.^{171,172}

3.5.3 Shearing

Shearing is stressful for sheep. The animals are herded by sheepdogs or people, of whom sheep are naturally fearful. Then individuals are isolated from their flock. This stresses these highly social animals that are naturally a prey species, fearful of separation and capture. The sheep are then forced into awkward and uncomfortable postures, often on their backs, to have their wool coat shorn. In addition to mental suffering, shearing can cause physical animal welfare problems and also human injuries.¹⁷³

Most shearers are skilled, but the job is very physical and paid by volume rather than hourly. As a result, shearers handle as many sheep as possible in a working day. Tired shearers may become frustrated when frightened animals balk. 2015 video footage showed Australian shearers punching sheep in the face, kicking them, and subjecting them to other abuses.¹⁷⁴

After shearing, sheep experience the shock of cold – particularly those shorn in winter, in cold climates such as New Zealand's southern or mountainous regions.



LAMB MORTALITY IN NEW ZEALAND IS HIGH, WITH DEATH RATES ESTIMATED AT 10-20%.¹⁷⁵ HYPOTHERMIA DUE TO ADVERSE WEATHER CONDITIONS IS ONE OF THE MOST COMMON CAUSES

Photograph: Farmwatch



3.5.4 Transport and slaughter

As with other farmed animals, sheep are rounded up by people and sheepdogs, taken off normal feed,¹⁷⁶ and crowded into trucks, enduring the stresses associated with transportation, before arriving at the slaughterhouse. Further welfare problems and stress are experienced there. Animals may be very young, for example just days old; some may be downed (unable to get up and walk); animals may be forcibly washed and roughly moved around; and some may have been without food for prolonged periods.

Perhaps the most serious concern centres on those sheep that are unsuccessfully stunned prior to being shackled and hung upside-down, and having their throats cut, because of failures of equipment or technique.

This affects a small but significant proportion of all animals slaughtered.¹⁷⁷ For ruminants that are not successfully stunned, time to insensibility after exsanguination (throat-cutting) is at least 2–8 seconds in sheep, but may be 8–20 seconds in duration.

PERHAPS THE MOST SERIOUS CONCERN CENTRES ON THOSE SHEEP THAT ARE UNSUCCESSFULLY STUNNED PRIOR TO BEING SHACKLED AND HUNG UPSIDE-DOWN, AND HAVING THEIR THROATS CUT, BECAUSE OF FAILURES OF EQUIPMENT OR TECHNIQUE

For cattle the mean duration is similar, but can commonly be extended to longer than 60 seconds, and occasionally, even longer. All of these animals are likely to experience significant pain, as well as other forms of suffering.¹⁷⁸

3.6 ANIMAL WELFARE CONCEPTS AND DEFINITIONS

Understanding of animal welfare has significantly evolved over recent decades. Initial definitions focused solely on animal health, but affective states (feelings and emotions) have recently become important considerations. Additionally, Rollin (2007)¹⁷⁹ has revived the Aristotelian concept of telos: the essence of an animal, or the “constellation of functions constitutive of its nature”. Today, an animal is considered to have good welfare if it enjoys physical and mental wellbeing, and has the ability to engage in most natural behaviours (not all are necessarily beneficial).

THE FIVE FREEDOMS

proposed by the UK’s Brambell Committee (1965)¹⁸⁰ provided a fundamental framework for assessing animal welfare.

FREEDOM...

1 FROM HUNGER AND THIRST

2 FROM DISCOMFORT

3 FROM PAIN, INJURY AND DISEASE

4 TO EXPRESS NORMAL BEHAVIOURS

5 FROM FEAR AND DISTRESS

Provision of all is considered essential for safeguarding welfare, so these Five Freedoms underpin much applicable policy and legislation worldwide. However, modern recognition that positive experiences are also important for animals, as well as avoidance of negative states,¹⁸¹ has led to an updated concept of Five Provisions, which may be succinctly summarised as Good nutrition, Good environment, Good health, Appropriate behaviour and Positive mental experiences.¹⁸²

Quality of life has also been conceptually developed. For lifetime welfare to be good, positive experiences should predominate, and the UK Farm Animal Welfare Council (FAWC) (2009)¹⁸³ has developed a continuum extending from “a life not worth living”, through “a life worth living” to “a good life”. FAWC asserts that the minimum socially acceptable standard should be a life worth living, and that we should always aim to provide good lives for the animals in our care.



HENS IN MODERN HATCHERIES ARE UNABLE TO EXPRESS MANY NORMAL BEHAVIOURS, CAN NEVER FEEL THE WARMTH OF THE SUN OR EVEN STRETCH THEIR WINGS

3.7 HAS NEW ZEALAND DONE ENOUGH TO SAFEGUARD ANIMAL WELFARE?

Unfortunately, examination of the main animal species farmed within New Zealand indicates that animal welfare problems remain prevalent. Violations of Provisions such as Good environment, Appropriate behaviour and Positive mental experiences appear common, and for many farmed animals it is reasonable to question whether they have “a life worth living,” let alone “a good life”.

As repeatedly noted by New Zealand’s government and animal production industries, WAP’s 2004 Animal Protection Index (<https://api.worldanimalprotection.org>) did indeed rank New Zealand as one of the leading nations in the world for animal welfare, primarily on the basis of its animal welfare legislation. On the face of it, New Zealand’s animal welfare legislation does compare favourably with that of many other countries. Its Animal Welfare Act 1999 (updated in 2015) recognises that animals are sentient and requires owners and others in charge of animals to safeguard their welfare, by considering their needs, which are described in terms that closely parallel the Five Freedoms and Provisions above. Protected animals include all vertebrates (and some of their foetal or early life stages), octopi, squid, crabs, lobsters and crayfish.

In some respects, New Zealand’s legislation is internationally progressive – as evidenced by specific mention of animal sentience, and by the protection of some non-vertebrates and early developmental stages. A much-touted example has been the specific restrictions on the use of great apes (gorillas, chimpanzees, bonobos and orangutans) in research under its Animal Welfare Act. Any use must be in the best interests of the individual animal or its species.¹⁸⁴

However, as Morris (2011: 369-370)¹⁸⁵ noted: "... the few nonhuman hominids residing in New Zealand are all in zoos, and there have been no plans to conduct any intrusive experiments on them. The reputation of the Animal Welfare Act therefore appears to be based on protecting a few animals who do not require it. It is far more constructive to look at the way the Act protects the animals who are caused to suffer in New Zealand farms, since this would present a far more realistic indicator of its effectiveness."

In this respect, it seems clear that favourable animal welfare legislation alone is insufficient to adequately safeguard the welfare of New Zealand's animals. Unfortunately, major, systematic welfare compromises persist within most New Zealand animal farming systems, and instances of severe neglect, and even abuse, are regularly reported by New Zealand's media outlets and animal advocacy organisations (see previous examples). Continuing education and support for the achievement of higher welfare standards is clearly warranted, among stakeholder groups such as farmers, transporters and meat processors, along with greater enforcement of welfare legislation.

Good ethics and consideration of animal welfare alone justify such steps. However, they are also in the interests of New Zealand's agricultural sector. Consumers are increasingly concerned about animal welfare both domestically and internationally. Within New Zealand, comparison of surveys conducted in 1994 and 2008 shows consumers have become more concerned about the confinement of pigs and poultry, and about common husbandry procedures such as tail-docking.¹⁸⁶ In addition, as mentioned previously, New Zealand is

strongly economically reliant on export income derived from farmed animals and their products. New Zealand's Ministry for Primary Industries (MPI) recognises the importance of animal welfare to international markets: "New Zealand's animal welfare practices add value to our exports by contributing to our reputation as a responsible agricultural producer. Animal welfare is increasingly important for accessing premium markets and differentiating New Zealand's products." (MPI 2013: 3).¹⁸⁷

This growing importance has been demonstrated by sociological research such as that of Zhao and Wu (2011),¹⁸⁸ who investigated factors influencing willingness to pay for higher welfare standards in



FOR MANY ANIMALS IT IS REASONABLE TO QUESTION WHETHER THEY HAVE "A LIFE WORTH LIVING", LET ALONE "A GOOD LIFE"

Chinese consumers. Ninety per cent of their survey participants confirmed their willingness to pay for higher levels of animal welfare, with factors such as age, level of education and annual income influencing participant positions.

FAVOURABLE ANIMAL WELFARE LEGISLATION ALONE IS INSUFFICIENT TO ADEQUATELY SAFEGUARD THE WELFARE OF NEW ZEALAND'S ANIMALS

Conversely, as stated by MPI, "cases of poor animal welfare can have a negative impact on our reputation and result in a loss of export markets, inability to gain access to new markets, or additional conditions and checks being placed on our products or production processes" (MPI 2013: 3).¹⁸⁹

It is clear that substantial ongoing welfare problems remain prevalent within the farming of poultry, pigs, cattle and sheep in New Zealand, and that this is contrary to good ethics, our duty of care toward these animals, the wishes of domestic and international consumers, and the interests of New Zealand's animal production industries. The latter provide an unusually large contribution to New Zealand's national economy, as demonstrated in chapter two. Accordingly, and despite the gains made to date within the field of animal welfare, significant further resource investment and policy reform within this field are indeed warranted in New Zealand. One of the most effective ways to reduce animal suffering is simply to reduce the number of chickens, sheep, cattle, pigs, and other animals farmed and killed for human food consumption and export.



THE WORLD ALREADY PROVIDES ENOUGH FOOD FOR ALL AND COULD FEED AT LEAST THREE BILLION ADDITIONAL PEOPLE IF THE GRAINS FED TO ANIMALS WERE USED TO NOURISH PEOPLE DIRECTLY

4. THE ENVIRONMENTAL IMPACT OF ANIMAL AND CROP PRODUCTION FOR HUMAN FOOD CONSUMPTION

Agriculture covers around 37% of the world's land surface (13.4 billion ha). In New Zealand 45% of our land surface is used for agriculture and horticulture.¹⁹⁰ Twenty-six per cent of the planet's ice-free land is used for livestock grazing and the remaining 11% (1.5 billion hectares) is used in crop production (arable and land under permanent crops). Approximately 33% of croplands is used for livestock feed production. The 1.5 billion-hectare area of crop production represents slightly over a third (36%) of the land estimated to be, to some degree, suitable for crop production. The fact that there remain some 2.7 billion hectares with crop production potential suggests that there is still scope for further expansion of horticultural land.¹⁹¹

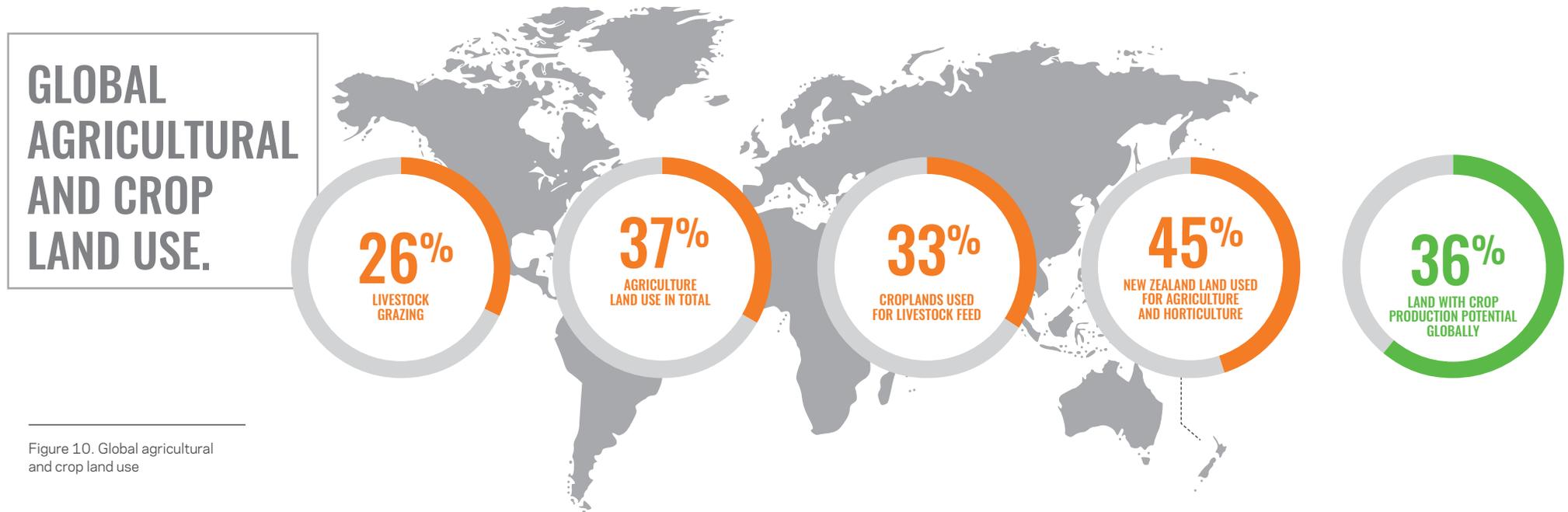


Figure 10. Global agricultural and crop land use

4.1 THE GLOBAL FOOD SYSTEM

Intensive agriculture is dependent on nitrogen fertiliser and fossil fuels. The impact of using these finite resources to feed seven billion people is vast environmental degradation, risks to human health and an unsustainable food system.¹⁹²

The overproduction of food, and unjustified focus on animal production in particular, and the rapid population growth and associated environmental impacts, have led to severe risks for humankind. In 2009, 28 scientists developed the Planetary Boundaries Framework,¹⁹³ which has since been updated. It defines nine planetary boundaries that must not be exceeded in order to protect people and the planet. The nitrogen cycle (part of the 'biogeochemical flows' boundary) has exceeded the high-risk upper limit (three times the safe limit). Phosphorus is not far behind. Two other boundaries, climate change and land-system change, have progressed well into the zone of uncertainty. Additionally, most of the world's resources have been used up by less than 20% of the world population.



The world already provides enough food for all and could feed at least three billion additional people if the grains fed to animals were used to nourish people directly (see chapter two).¹⁹⁴

Due to the inefficiency of animals converting plant resources into calories for human food, the scale of livestock farming, and the particularly high level of greenhouse gas (GHG) emissions, diets rich in animal protein have higher environmental costs than plant-based diets.

The agricultural sector is in the top three global causes of all major environmental problems, including climate change, environmental degradation (such as pollution, soil erosion), and habitat and biodiversity loss.¹⁹⁵

Livestock farming is responsible for methane, resulting from enteric fermentation and manure; carbon dioxide, which is released from the clearing of forests for pasture; and nitrous oxide, which is generated in feed production (Gerber *et al.*, 2013).¹⁹⁶ Industrialised livestock systems tend to generate fewer GHG emissions per unit of product than other livestock systems such as pasture systems, but they have other significant social and environmental impacts, including higher withdrawals of freshwater, more pollution, greater use of antibiotics with the associated risks of increased antimicrobial resistance, and potentially more outbreaks of zoonotic diseases (which normally exist in animals but can infect humans).¹⁹⁷

Clearly, the status quo is unsustainable. Greenpeace International has published a summary of their technical report¹⁹⁸ on their vision of the meat and dairy system. Recognising that if humanity does nothing, GHG emissions from the food system will represent more than half (that is, 52%) of the total global emissions associated with human activities by 2050, Greenpeace suggests that we urgently need to start eating more plant-based food and less meat and is calling for a "global reduction of 50 per cent in production and consumption of animal products by 2050 as compared to the current situation".¹⁹⁹

They continue: "Achieving this goal is possible under a vision of ecological farming. In other words, we propose a level of production that ensures food security while protecting the climate and biodiversity." The food awareness organisation ProVeg International is calling for a 50% reduction of animal consumption by 2040 to avoid runaway global temperature rises and climate change, biodiversity loss and to halt other negative environmental impacts of animal agriculture.

“A GLOBAL 50% REDUCTION IN ANIMAL CONSUMPTION BY THE YEAR 2040 TO AVOID RUNAWAY GLOBAL TEMPERATURE RISES AND CLIMATE CHANGE”

4.2 WHAT IS THE CURRENT THINKING ON TACKLING FOOD-RELATED GHG EMISSIONS?

In early 2018, New Zealand media outlet Stuff ran a series of special investigation articles focused on 'Meat under heat', responding to global and national developments (such as growing concern for animals, environment and health, and changing markets). Thousands of academic papers, reports, news stories, and popular articles have been written, and hundreds of videos, documentaries and films been produced in the last couple of decades about the ecological footprint of livestock farming. For example, in November 2017, 15,000 scientists issued a catastrophic 'warning to humanity'.²⁰⁰ It asked the public to pressure their political leaders to take more decisive action, and one of their recommendations was more vegetarianism.

The number of papers and reports has exponentially increased since the seminal 2006 publication of the United Nation (UN) FAO's Livestock Long Shadow report.²⁰¹ The evidence and recommendations are clear: governments, policy-makers, businesses and citizens need to act now, before it is too late – and climate change actions must include a strong focus on agriculture.

Climate change is already happening around the world, causing devastation and disruption of much of life as we know it. If global temperatures are allowed to rise much further, the damage will be irreversible.

Some of these suggestions are not ambitious enough, and effectively maintain the unsustainable status quo. Technocratic solutions to climate change include interventions in the atmosphere. And on Earth, such

Debates around the future of agriculture in New Zealand, and in other countries, have included recommendations such as:

1. Further intensifying and increasing animal production to meet growing world population demands, whilst paradoxically attempting to curb GHG emissions
2. Technocratic solutions, including developing animal and environmental interventions aimed at reducing GHG emissions and water pollution, and increasing feed conversion efficiency, resulting in more 'protein yield' per emitted GHG emissions
3. Encouraging consumer willingness to pay more in order to reduce GHG emissions (for example \$15.85 per person annually over a period of five years to reduce dairy methane gas emissions by 30%²⁰²)
4. Adding value to existing animal products and specialising in premium items (quality over quantity), and emphasising the 'value' of agricultural ecosystem services
5. Decreasing the livestock sector while increasing other sectors' contributions to the GDP, including agroforestry and less emission-intensive protein sources for human food consumption, such as:
 - Insects
 - Cultivated meat ('clean meat' or 'cellular agriculture')
 - Protein-rich grains, crops and legumes, and other plant-based protein solutions, such as algae-based and mushroom/fungi products.

research focuses on changing animals to make them more 'efficient' (through genetic manipulation). For example, the New Zealand Agricultural Greenhouse Gas Research Centre is investigating new means of breeding or feeding sheep and cattle so that they produce less methane, or of introducing enzymes to their stomachs, through harm-free drug treatment or vaccination, to reduce their methane emissions. Prior to 2019, the Government was reported to have committed \$48.5 million to the

research centre.²⁰³ Other suggestions include making animal agriculture less polluting (for example by keeping cattle indoors) to meet climate goals.

GOVERNMENTS, POLICY-MAKERS, BUSINESSES AND CITIZENS NEED TO ACT NOW, BEFORE IT IS TOO LATE – AND CLIMATE CHANGE ACTIONS MUST INCLUDE A STRONG FOCUS ON AGRICULTURE

Meat without harm to animals

Emerging developments around cultivated meat are interesting and very relevant, but beyond the scope of this report. Briefly, just a few animal cells from a swab could produce 10,000kg of beef, and if immortal cow cell lines were developed, living animals may not even be necessary in the future.²⁰⁴ This is something that Winston Churchill predicted in 1931, although he forecast this revolution would take place within 50 years:²⁰⁵

"We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium."

Given decreasing social and ethical acceptance of substantial, severe and chronic animal suffering (chapter three), and the fact that eating a diet heavy in animal products is not beneficial to public health, the most viable solution is to increase plant-based protein production and reduce animal production.

The rest of this chapter considers the impacts of New Zealand animal agriculture on the environment.

"WE SHALL ESCAPE THE ABSURDITY OF GROWING A WHOLE CHICKEN IN ORDER TO EAT THE BREAST OR WING, BY GROWING THESE PARTS SEPARATELY UNDER A SUITABLE MEDIUM"

WINSTON CHURCHILL

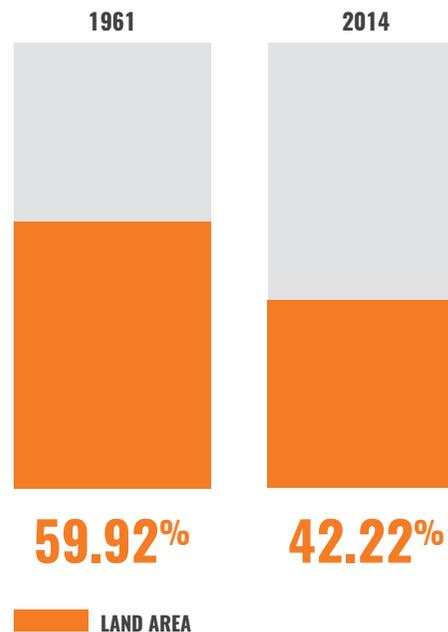
4.3 LAND AND WATER USE IN NEW ZEALAND AGRICULTURE

Of New Zealand's total land area of 263,310 square kilometres, 101,520 square kilometres was forested in 2015, compared with 96,580 sq. km in 1990.

(Except where stated otherwise, the figures on this page are based on World Bank data).²⁰⁶

AGRICULTURAL AND ARABLE LAND USE IN NEW ZEALAND

NEW ZEALAND AGRICULTURAL LAND USE



NEW ZEALAND ARABLE LAND USE

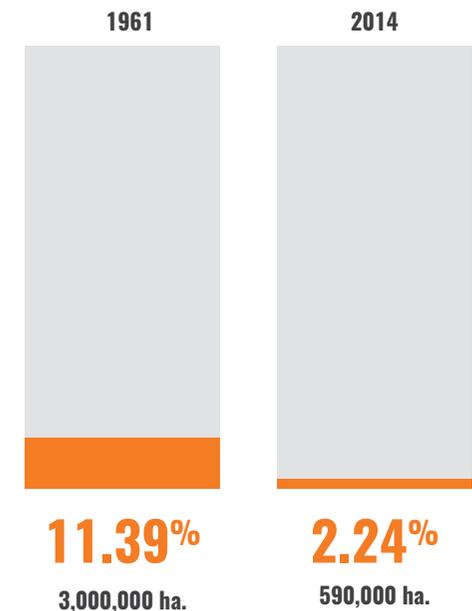


Figure 11. Agricultural and arable land use in New Zealand.

Notes: Permanent cropland increased from 0.08% of land use in 1961 to 0.25% in 2014. In the financial year 2018-19, around 1.75 million hectares of land had been used for dairy farming.²⁰⁷ Land use for dairy

production is expected to continue to increase and intensify in 2020 and beyond.

Cereal production increased from 388,705 metric tons in 1961 to 1.1914 million metric tons in 2014, with cereal yield increasing from 3,125.3 kg per hectare in 1961 to 8,026.5 kg per hectare in 2014.

The New Zealand Arable Industry

While a variety of ecosystem services are provided by arable production systems in New Zealand, the majority (>85%) is attributed to food production. The arable industry is centred on the Canterbury region; production of arable crops in formerly important regions including Manawatu and Southland has declined over the past 20 years.

A diverse range of crops is grown including cereals, pulses, herbage seeds and vegetables. Cereals account for most of the area planted in crops each year. In 2012 the total area in cereals (wheat, barley, maize, and oats) was 145,000 hectares producing about 1.1 million tonnes of grain. However, production is not sufficient to meet domestic requirements, requiring ongoing imports of

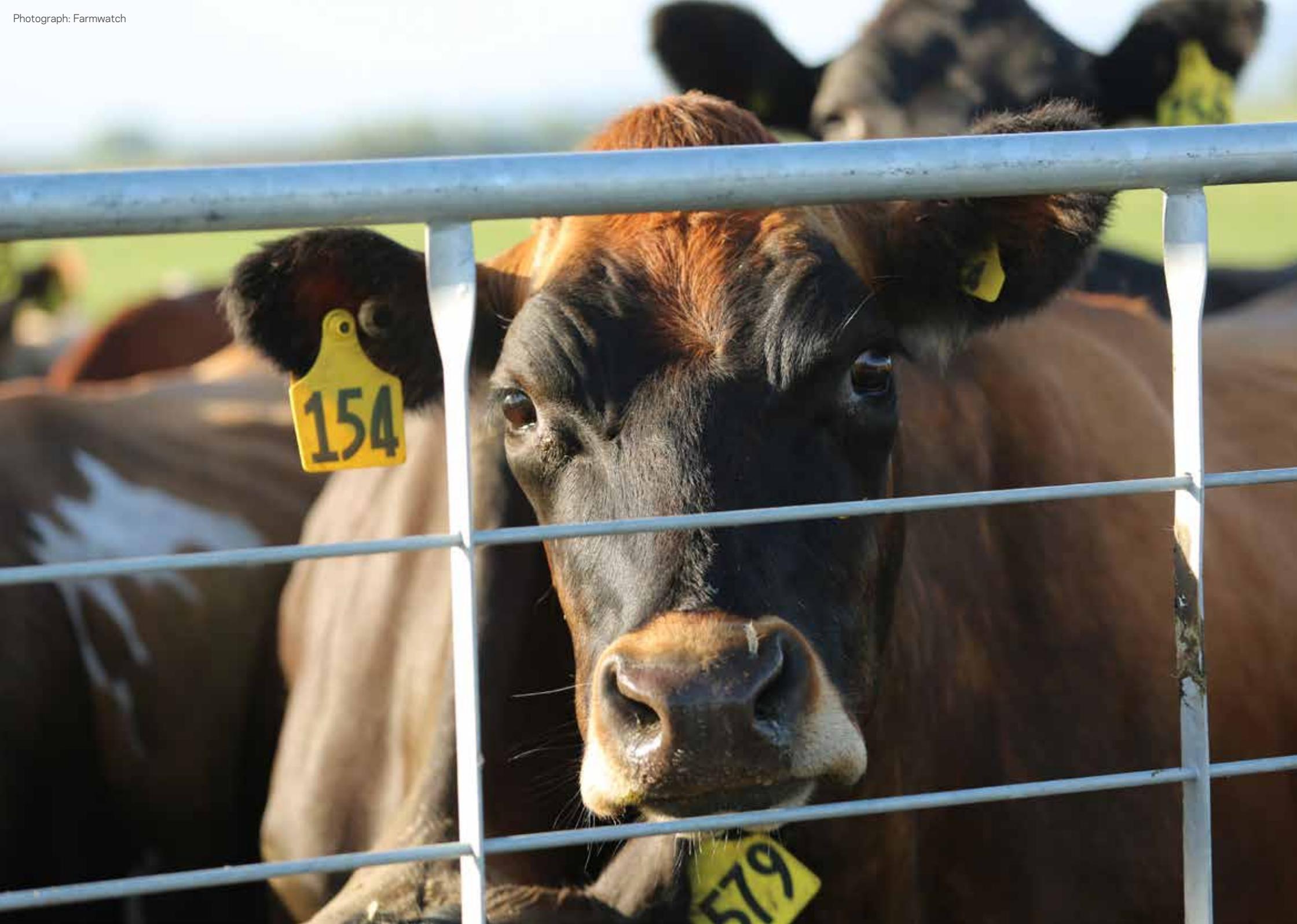
milling wheat and feed grains (wheat, barley and sorghum). More recently, forages supplied to local dairy farmers and vegetable seed produced for export, principally peas, radish and carrot, have become important sources of income; production of pulse crops has declined. Herbage seeds, dominated by perennial ryegrass and white clover, are produced to supply the requirements of New Zealand's pastoral industries and for export.

Vegetable production includes both fresh and processed crops; potatoes, peas and sweetcorn are the major process crops, with significant exports. Onions and buttercup squash are the main fresh crop vegetables. Export earnings from fresh and processed vegetables generated \$614 million in 2011.

Conversion of arable and mixed-arable farms to dairy is a threat to the industry through reduced economies of scale and loss of infrastructure. The development of large community irrigation schemes has facilitated dairy conversions, particularly in Canterbury. Nutrient loss limits, proposed by many regional councils, suggest that nutrient management is likely to become a challenging issue for many arable farmers, particularly those growing winter vegetables and forage crops for winter grazing of dairy cattle.

Source: Millner JP, Roskrige NR 2013. The New Zealand arable industry. In Dymond JR ed. Ecosystem services in New Zealand - conditions and trends. Manaaki Whenua Press, Lincoln, New Zealand.





4.3.1 Agricultural water use

To support the growing livestock sector in New Zealand, particularly dairy production, annual freshwater withdrawals increased from 44% in 1985 to 61.66% in 2014.²⁰⁸ Groundwater levels are becoming depleted in certain areas of the country.

To boost crops and grass grown for animal feed, the percentage of irrigated agricultural land doubled from 3.17% in 2002 to 6.3% in 2014. This percentage will have been higher in 2017, as a result of a Crown irrigation scheme (which is controversial due to its negative environmental impact). The scheme was set up in 2013 by the former National Government. By 2017, around \$120 million of subsidies for the irrigation scheme had been spent.

In 2011, Sustainability NZ predicted that the carbon bill to the taxpayer resulting from increased dairy production, enhanced by irrigation schemes, could be an additional \$30 million to \$140 million a year.²⁰⁹ The current Government has pledged to stop Crown subsidies for new irrigation schemes. In response, the Federated Farmers claimed this decision was “short-sighted”, and argued that some regions are very horticultural-based and that water gives growers options.²¹⁰ Crop growing requires less water than the production of dairy. Based on Dairy NZ figures, the 12,000 dairy herds in New Zealand are estimated to consume around 4.8b cubic metres of water per year, the equivalent of around 58.2 million people.²¹¹

The New Zealand horticulture industry is more efficient and has a lower land and water footprint than dairy and beef production. According to Horticulture NZ, approximately 50,000 people were employed in the >\$7 billion industry in 2014, operating off approximately 123,000 hectares. Dairy returned around \$18 billion, employing 30,000 people off a footprint of approximately 2.5 million hectares.²¹² The production of one kilogram of beef can require over 15,000 litres of water, and 1,000 litres of water are required to produce one litre of milk. The water footprint per gram of protein for milk, eggs and chicken meat is about 1.5 times larger than for pulses.²¹³

4.3.2 Water pollution

Already in 2013, the Parliamentary Commissioner for the Environment, Dr Jan Wright, suggested that the ‘large-scale conversion of more land to dairy farming will generally result in more degraded freshwater’.²¹⁴ Dairy takes place on generally ‘high quality’ land, but erosion and eutrophication of waterways (when a body of water becomes overly enriched with minerals and nutrients that induce excessive growth of plants and algae) are caused by run-offs. The enormous quantities of

manure and urine that the national dairy herd produces, (approximately equivalent to 90 million people, but without any sewage system) seeps into groundwater, and runs into rivers and streams, many of which are now contaminated.

Higher ruminant stocking density, fertiliser use on soils, and the clearing of natural vegetation including forest for pastures, are the main risk factors for run-off and leaching into groundwater, for soil saturation and for reduced groundwater levels, resulting in the disruption of natural processes that normally enhance dilution of contaminants.

Nitrogen and phosphorus pollution cause the growth of choking invasive weeds, riverbed slime and (sometimes toxic) algal blooms. Nearly half of monitored New Zealand river sites are now polluted enough to trigger algal blooms, and the worst is yet to come, as an estimated 30-60 years’ worth of nitrate is still making its way into the groundwater system.²¹⁵

THE ENORMOUS QUANTITIES OF MANURE AND URINE THAT THE NATIONAL DAIRY HERD PRODUCES, (APPROXIMATELY EQUIVALENT TO 90 MILLION PEOPLE, BUT WITHOUT ANY SEWAGE SYSTEM) SEEPS INTO GROUNDWATER, AND RUNS INTO RIVERS AND STREAMS, MANY OF WHICH ARE NOW CONTAMINATED



4.4 GREENHOUSE GAS EMISSIONS

Climate change is accelerating dangerously across the world due to human-made (anthropogenic) greenhouse gas emissions. Figure 12 shows a breakdown of the main GHG emissions in New Zealand and globally over the last 40-50 years.

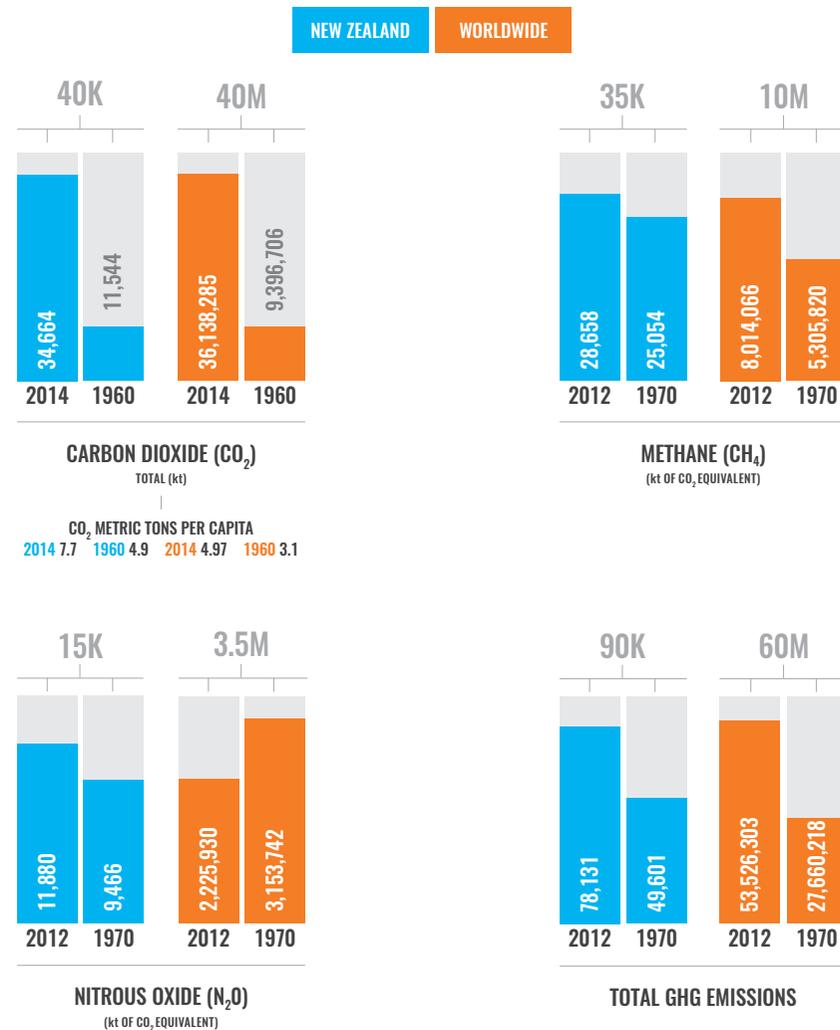
In October 2016, New Zealand ratified the 2015 Paris Climate Agreement and committed to reducing GHG emissions by 30% below 2005 levels, by 2030. Globally, the farming of animals for food was responsible for around 16% of GHG emissions in 2010, which exceeded the emissions from all transport combined.²¹⁷ Unless serious measures are implemented to change the way that New Zealand farms, the 2030 targets will not be met.

In 2015, New Zealand's gross greenhouse gas emissions²¹⁸ were 80.2 million tonnes of carbon dioxide equivalent (Mt CO₂e), comprising emissions from:

- Energy (including transport; approximately 40.5%)
- Agriculture (approximately 47.9%, or 38.4 Mt CO₂e)²¹⁹
- Industrial Processes and Product Use
- Waste sectors.

New Zealand's gross emissions have increased 24.1% from the year 1990, and were only 0.1% lower than 2014 emissions. Between 1990 and 2015, emissions from the agriculture sector increased by 16.0%. This is primarily due to an 88.5% increase in the national dairy herd size since 1990, and an approximately five-fold increase in the application of nitrogen-containing fertiliser.²²⁰

GREENHOUSE GAS EMISSIONS





THE ENTERIC EMISSIONS FROM NEW ZEALAND RUMINANTS ALONE, NEARLY 19 MEGATONS IN TOTAL, ARE THE EQUIVALENT OF CO₂ EMISSIONS FROM NEARLY 26 MILLION RETURN FLIGHTS FROM AUCKLAND TO SAMOA

Compared with other nations, New Zealand's high level of agricultural production has led to increased methane and nitrous oxide emissions per capita. New Zealand's emissions per person ranks seventh among 41 'Annex 1' countries (nations that made commitments under the United Nations Framework Convention on Climate Change). Methane and nitrous oxide have higher global warming potential, (approximately 56 and 280 times, respectively), over a 20 year period compared with CO₂. These gases, largely from the agriculture sector, make up nearly half of New Zealand's gross national emissions.²²¹

According to the Ministry for Environment's (MfE's) New Zealand's Greenhouse Gas Inventory 1990-2015²²² report, methane emissions from ruminants made up the largest contribution to agricultural emissions:

In 2015, enteric fermentation contributed 28,090.7 kt CO₂e. This represented 35.0 per cent of New Zealand's gross CO₂e emissions and 73.1 per cent of agricultural emissions. Dairy and non-dairy cattle contributed 13,665.3 kt CO₂e (48.6 per cent) and 5,198.6 kt CO₂e (18.5 per cent), respectively, of emissions from the Enteric fermentation category. Sheep contributed 8,695.0 kt CO₂e (31.0 per cent) of emissions from this category. Emissions from the Enteric fermentation category in 2015 were 1,375.1 kt CO₂e (5.1 per cent) above the 1990 level of 26,715.6 kt CO₂e.

Another analysis²²³ suggested that Fonterra's 2015 GHG footprint was larger than the figures in the Ministry for the Environment report. In addition to enteric fermentation, nitrous oxide and carbon emissions added to Fonterra's dairy emissions, leading to 41.5 million tonnes CO₂ equivalent, or over half of total New Zealand emissions. Fonterra disputed the higher level of CO₂ per kg of fat- and protein-corrected milk used in the analysis, and referred to lower CO₂ AgResearch data that Fonterra commissioned. However, their estimates of 22% on-farm emissions do not match the government's figures. Different carbon counting methodologies can create different outcomes, but Fonterra's own estimates are most likely too low. In any case, the large contribution of the dairy sector to New Zealand's total GHG emissions is both undisputed and unsustainable.

In November 2017, Fonterra published a plan to reduce carbon emissions.²²⁴ It claimed to have "set a target of net zero emissions for our global operations by 2050, with a 30 percent reduction by 2030 from a 2015 baseline". However, these 'operations' only apply to the 10% generated by the total supply chain, while 90% is generated on-farm,²²⁵ where the potential to reduce GHG emissions (without reducing herd sizes) is minimal.

In contrast to livestock farming, crop emissions in New Zealand are very small, and make up less than 3% of total agricultural emissions.²²⁶

The MfE's New Zealand's Greenhouse Gas Inventory 1990-2015 listed among the challenges to reduce GHG emissions that there are few economically viable options currently available to reduce emissions within agriculture. This would be true if current growth trends in livestock and dairy production expansion were not curbed.

However, introducing land use changes towards more horticulture production and less animal farming, and rewilding some current grazing areas, could lead to significant reductions, particularly in methane, but also in CO₂ emissions to some extent.

An increasing number of scientific publications and other authoritative reports highlight New Zealand's unsustainable agricultural practices. For example, in March 2017, the OECD issued a report suggesting that "New Zealand's growth model, based largely on exploiting natural resources, is starting to show its environmental limits with increasing greenhouse gas emissions and water pollution".²²⁷ The report made 50 recommendations to reduce the environmental burden. Given that, among OECD countries, New Zealand has the highest share (80%) of renewable energy (primarily hydroelectricity), further gains to reduce carbon emissions may be limited in this area. However, New Zealand is also among the 10 most energy-intensive OECD economies, so further efficiencies should be feasible. The OECD report suggested reassessing the irrigation scheme, including agriculture within the ETS, and introducing pricing and regulations to curb agricultural emissions, as well as developing long-term policy strategies to safeguard the environment.

In addition to contributions to GHG emissions in New Zealand, the dairy industry imports vast quantities of livestock feed, including 1.86 million tonnes of palm kernel expeller (PKE). Palm kernel is a by-product of the palm oil industry, which is the leading cause of rainforest destruction. Tropical forest clearance and peat fires cause

substantial carbon emissions and significantly eliminate many forms of wildlife, including iconic orangutans. In 2017, Landcorp (a state-owned enterprise with 140 farms) stopped importing PKE.²²⁸

INTRODUCING LAND USE CHANGES TOWARDS MORE HORTICULTURE PRODUCTION AND LESS ANIMAL FARMING, AND REWILDING SOME CURRENT GRAZING AREAS, COULD LEAD TO SIGNIFICANT REDUCTIONS, PARTICULARLY IN METHANE, BUT ALSO IN CO₂ EMISSIONS



4.5 BIODIVERSITY

The previously mentioned Planetary Boundaries Framework²²⁹ indicates that genetic diversity within the 'biosphere integrity' boundary has reached the upper high-risk limit. The Earth is currently experiencing its sixth mass extinction event.²³⁰

The rapid decline in biodiversity is almost entirely caused by anthropogenic activities, including: "habitat conversion, climate disruption, overexploitation, toxification, species invasions, disease, and (potentially) large-scale nuclear war — all tied to one another in complex patterns and usually reinforcing each other's impacts. Much less frequently mentioned are, however, the ultimate drivers of those immediate causes of biotic destruction, namely, human overpopulation and continued population growth, and overconsumption, especially by the rich".²³¹ Examples of negative impacts of intensive farming on wildlife are described in Philip Lymbery's 2017 book *Dead Zone: Where the Wild Things Were*.²³²

New Zealand's biodiversity and agro-ecosystem resilience are severely under threat. The expansion and intensification of agriculture is destroying habitats of indigenous species.²³³ Species extinction rates are among the highest in the world. More than half of amphibians, and roughly a third of mammals, birds, fish and reptiles, are threatened.²³⁴ Invasive and introduced species and habitat fragmentation and degradation are the main threats. This may be in part due to the lack of integrated biodiversity protection within land use planning and management, and overexploitation of land and marine areas.

It seems that pollution, habitat fragmentation and forest clearance due to livestock farming are downplayed by some in the farming industry, and some politicians. Introduced species, on the other hand, make for an easy scapegoat, and combative language is used to justify the killing of hundreds of thousands of so-called 'pests' each year. Although the Department of Conservation's 2050 Predator-Free programme (the mass eradication of rats, mice, stoats and possums through poisoning, trapping, and hunting) is widely supported by New Zealanders, critics have questioned its ethics, economics and ecological efficacy. Robust scientific data including meta-analyses examining the impact of introduced species, and the longer-term impacts of various interventions such as poisoning, trapping and other eradication methods on native New Zealand fauna and flora and wider ecosystem services, seem to be lacking.

While a full review of the eradication efforts and causes of New Zealand's biodiversity loss is outside the remit of this report, the contribution of animal agriculture and land use to New Zealand biodiversity loss is significantly understated, compared to the alleged impact of invasive or introduced species. There is clear evidence that agricultural intensification has degraded aquatic biodiversity, but there is a critical lack of research and monitoring of robust indicators of terrestrial biodiversity in New Zealand.²³⁵ Globally, around 80% of all threatened terrestrial bird and mammal species are threatened by agriculturally driven habitat loss. Significantly reducing meat consumption in human diets could reduce around 20-40% of the projected increase in extinction risk by

2060 for medium- and large-bodied species of birds and mammals.²³⁶ Comprehensive analyses and impact assessments of the impact of livestock farming on biodiversity in New Zealand are urgently needed.



4.6 THE ECOLOGICAL FOOTPRINT OF PLANT-BASED DIETS

Diets high in animal protein increase health risks and are responsible for high GHG emissions. In contrast, well-balanced plant-based diets have the potential to substantially save animal and human lives and improve health (for example Tilman and Clark 2014²³⁷), reduce emissions (for example Hedenus *et al* 2014²³⁸ and Scarborough *et al* 2014²³⁹), preserve water and land (for example Stehfest *et al* 2009²⁴⁰), and increase/improve biodiversity. This section provides examples of studies demonstrating that plant-based diets generally require less land, water and energy.

4.6.1 Diet-related Greenhouse Gas emissions

Agricultural production requires inputs and produces outputs such as food, biofuel, and fibre. Some forms of farming are more efficient and less polluting than others. This section provides a brief overview of the global impact of food production and the environmental impact of various diets.

Tilman and Clark²⁴¹ noted that: “from 2009 to 2050 global population is projected to increase by 36%. When combined with the projected 32% increase in per capita emissions from income-dependent global dietary shifts, the net effect is an estimated 80% increase in global GHG emissions from food production (from 2.27 to 4.1 Gt per year of CO₂e). This increase of 1.8 Gt per year is equivalent to total 2010 global transportation emissions.

In contrast, there would be no net increase in food production emissions if by 2050 the global diet had become the average of the Mediterranean, pescetarian and vegetarian diets.”

In a 2017 paper, Wynes and Nicholas²⁴² argued that the strategies commonly promoted by governments and agencies to reduce GHG emissions, such as recycling and changing light bulbs, are much less effective than four other actions people can take. The authors identified, in order of magnitude and impact these actions have on GHG emissions: having one fewer child, living car-free, avoiding airplane travel and eating a plant-based diet, with the latter saving nearly a tonne of CO₂ equivalent a year. However, the latter was actually framed as ‘avoiding all meat’ (that is, a vegetarian, not vegan, diet).²⁴³ As described in earlier sections, the environmental impact of dairy is substantial. A significant number of studies have demonstrated the

huge potential to reduce GHG emissions created by adopting completely plant-based diets.

Springmann and colleagues²⁴⁴ analysed the health and climate change cobenefits of dietary change to healthier, more plant-based diets on a global level. In line with results from other studies, they found that adopting plant-based (that is, vegan) diets had the potential to reduce GHG emissions (up to 70%) the most. ‘Healthy global diets’ that consisted of lower meat consumption could reduce up to 29% of GHG emissions compared to the FAO reference, or business as usual, scenario.

THE MOST ENVIRONMENTALLY-FRIENDLY DIET IS FREE FROM ALL ANIMAL PRODUCTS

The authors stated: “In our environmental analysis, we project reference emissions to increase by 51% between 2005/2007 and 2050 (from 7.6 Gt CO₂e to 11.4 Gt CO₂e) and dietary changes to decrease the reference emissions by 29–70% (3.3–8.0 Gt CO₂e). The latter is likely to be a conservative estimate because we did not account for the beneficial impacts of dietary change on land use through avoided deforestation. Other studies have estimated that the associated emissions reductions could amount to 2.1–2.8 Gt CO₂e per year between 2010 and 2050.”

The authors went on to suggest that: “[...] overall, adopting global dietary recommendations would reduce the food-related per capita emissions gap between developing and developed countries (*and close the gap completely if purely plant-based diets were adopted*). Our analysis also indicated that adopting global dietary guidelines would

not be enough to reduce food-related GHG emissions to the same extent that total GHG emissions will need to fall to achieve a climate stabilization pathway that would have a high probability of limiting global temperature increases to below 2 °C. *For managing food demand* (including efficiency improvements in line with current trends) to make its prorated contribution, *reductions in animal-based foods of the degree found only in the VGN [vegan] scenario would be required.*” [our emphasis]

In addition, Springmann and colleagues estimated the economic benefits of improving diets, in terms of health gains, to be 1–31 trillion US dollars, which is equivalent to 0.4–13% of global gross domestic product in 2050.

Other authors have similarly found that when assessing impacts using a life cycle analysis, (LCA, i.e., all stages in the production and manufacturing of products), the most environmentally-friendly diet is free from all animal products.



The following examples show carbon dioxide equivalent (CO₂e) emissions based on different diet choices:

Researchers may use different definitions for diets, and apply different methodologies to calculate CO₂ emissions, but the relative difference between diet types is consistent within all studies. Examples include:

"[...] dietary GHG emissions in self-selected meat-eaters are approximately twice as high as those in vegans."²⁴⁶ The reduction in emissions of those eating a vegan versus vegetarian diet would be around 336 kg of CO₂e per person per year. Even using the higher estimate of 5.6 kg of CO₂e/day in a vegan diet, Berners-Lee and colleagues found that the emissions were 25% lower than the UK average diet. In their scenario, the vegan diet had the highest carbohydrate content, the lowest added sugar and the lowest fat content of all the diets. The protein content (62 g) was above the recommended value. Taking their findings and applying them to New Zealand, the vegan diet was estimated to be over \$730 cheaper per year than the average Kiwi diet.²⁴⁷

Meier and Christen²⁴⁸ further found that as a result of land use changes, vegan diets show a 53% reduction in CO₂ emissions compared to omnivorous diets.

THE VEGAN DIET WAS ESTIMATED TO BE OVER \$730 CHEAPER PER YEAR THAN THE AVERAGE KIWI DIET

GREENHOUSE GAS EMISSIONS PER DIET TYPE

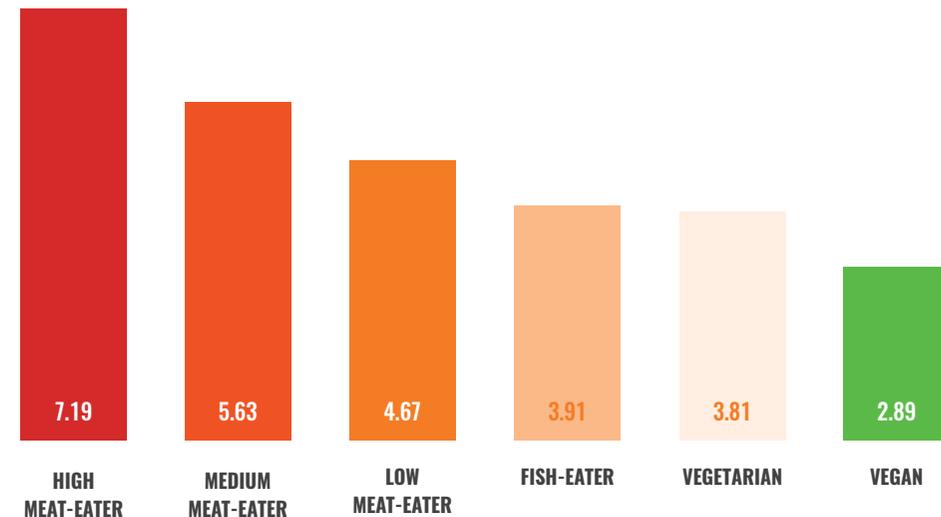
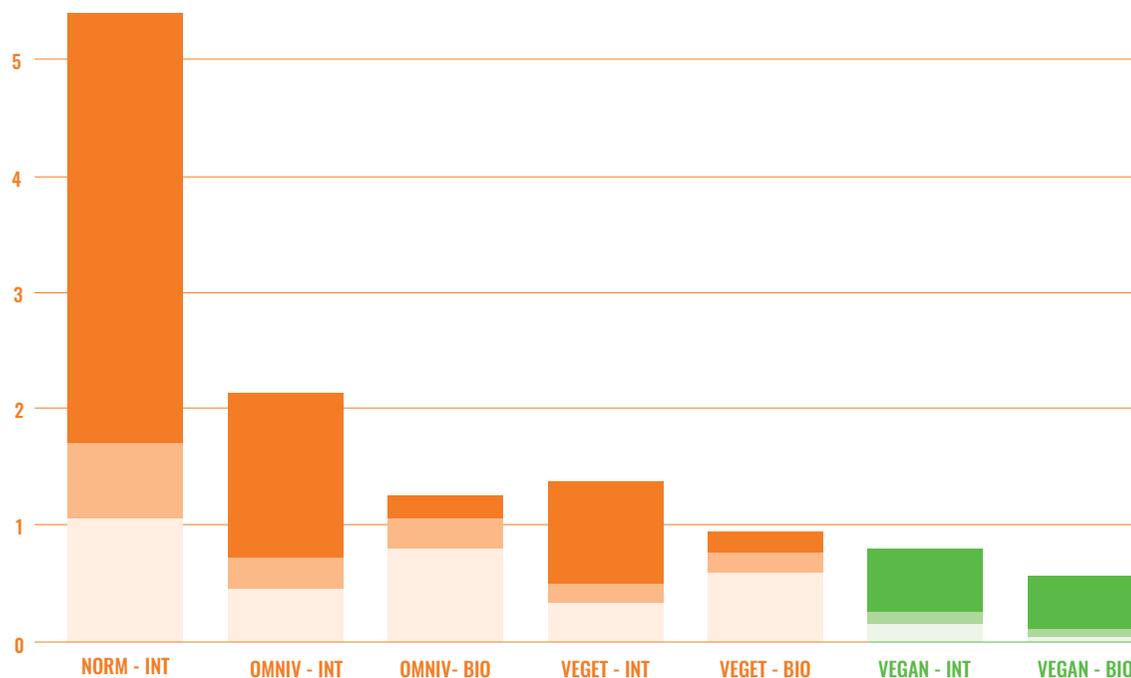


Figure 13. Greenhouse gas emissions (kgCO₂e/ per day) by diet type (Scarborough et al. (2014).

Note: high meat-eaters (>= 100 g/d), medium meat-eaters (50 to 99 g/d), low meat-eaters (>0 and< 50 g/d).

SCARBOROUGH ET AL. (2014)²⁴⁵

AVERAGE ENVIRONMENTAL IMPACT OF VARIOUS DIETS



Category	NORM - INT	OMNIV - INT	OMNIV - BIO	VEGET - INT	VEGET - BIO	VEGAN - INT	VEGAN - BIO
RESOURCES USED	3.7	1.415	0.798	0.878	0.594	0.544	0.455
ECO SYSTEMS QUALITY	0.65	0.268	0.268	0.167	0.177	0.112	0.0714
HUMAN HEALTH BURDEN	1.06	0.458	0.2	0.335	0.18	0.15	0.039

Figure 14. Average environmental impact: comparison among the various dietary patterns, based on conventional and organic farming methods (Baroni et al., 2007).²⁴⁹

A LIFE CYCLE ANALYSIS FOUND THAT A DIET BASED ON PRODUCTS FROM CHEMICAL-CONVENTIONAL AGRICULTURE AND CONVENTIONAL FARMING HAD THE HIGHEST ENVIRONMENTAL IMPACT, WHEREAS THE VEGAN DIET BASED ON ORGANIC PRODUCTS (FOLLOWED BY A VEGAN DIET BASED ON CONVENTIONAL AGRICULTURE) HAD THE LOWEST ENVIRONMENTAL IMPACT

OMNIV-INT omnivorous diet based on food from conventional farming.
 OMNIV-BIO omnivorous diet based on food from organic farming.
 VEGET-INT vegetarian diet based on food from conventional farming.
 VEGET-BIO vegetarian diet based on food from organic farming.
 VEGAN-INT vegan diet based on food from conventional agriculture.
 VEGAN-BIO vegan diet based on food from organic agriculture.
 NORM-INT 'normal' Italian diet, equivalent to the average Italian weekly diet, with food from conventional farming.

4.6.2 LAND, WATER, AND ENERGY USE, AND OTHER INDICATORS OF DIET-RELATED ENVIRONMENTAL IMPACTS

This section provides some brief examples of other important environmental indicators per diet type.

Land

Clearing land to grow crops to feed livestock, rather than nourishing people directly, leads to significantly increased land use requirements for meat-based diets, compared to plant-based diets.

Depending on types of food consumed, i.e. animal or plant-based protein, and farming method, origin, soil types, seasonal availability and so on, land use per person per year may vary from around 1,800m² to 8,600m², based on 42 different diets analysed in New York State.²⁵⁰

In 2012, the FAO estimated that 'vegetarian' diets could take up even less space, requiring just 500m² of land, with a predominantly vegetarian diet requiring around 700m², a Western diet 4,000m² and a mainly meat-based diet requiring around 7,000m² of land.²⁵¹

Meier and Christen estimated that with the implementation of a vegan diet, up to 1,000m² per person per year could be freed up, with a slight increase in permanent crops abroad.²⁵²

Stehfest and colleagues found that moving towards a plant-based diet could free up to 2,700 million hectares of pasture and 100 million hectares of cropland, resulting in a large carbon uptake from regrowing vegetation.²⁵³

Land use is not just about space but also intensity of use, pollution and erosion. For example, nearly 20 years ago, already about 60% of United States pastureland was being overgrazed and was subject to accelerated erosion.²⁵⁴ Erosion of fertile agricultural land in New Zealand is also a severe threat.

CLEARING LAND TO GROW CROPS TO FEED LIVESTOCK, RATHER THAN NOURISHING PEOPLE DIRECTLY, LEADS TO SIGNIFICANTLY INCREASED LAND USE REQUIREMENTS FOR MEAT-BASED DIETS, COMPARED TO PLANT-BASED DIETS

Energy

Meier and Christen found that a vegan diet required a third less primary energy use than a meat-based diet. At the lower estimate, for every 1 kg of high-quality animal protein produced, livestock are fed about 6 kg of plant protein.

The ratio of fossil energy input per kcal protein output is 57, 40 and 39:1 respectively for lamb, beef cattle and eggs produced in the USA. Average fossil energy input for all the animal protein production systems studied is 25 kcal fossil energy input per kcal of protein produced. This energy input is more than 11 times greater than that for grain protein production, which requires about 2.2 kcal of fossil energy input per kcal of plant protein produced. This applies to corn, and assumes 9% protein in the corn. However, animal protein is a complete protein based on its amino acid profile, and has about 1.4 times the biological value of grain protein.²⁵⁵

Other indicators studied by Meier and Christen included ammonia (NH₃) and phosphorus (P) use. The authors found that a vegan diet required up to 90% less ammonia. Phosphorus use was related to the consumption of dairy (usually consumed in higher proportions within vegetarian diets), while a vegan diet used only a third as much phosphorus compared to that associated with the reference omnivorous diet.



Water

Animal farming and agriculture are responsible for 70% of freshwater consumption on the planet. Various studies have demonstrated that the total amount of water (so-called 'virtual water' made up of 'green', 'blue' and 'grey' water use) needed to produce animal products is many times higher than for most fruit, vegetables, grains, legumes and other crops.

Mekonnen and Hoekstra compared water use for the production of animal and plant-based protein foods. The average water footprint per calorie for beef was 20 times larger than for cereals and starchy roots. They concluded that it is more water-efficient to obtain calories, protein and fat through crop products than animal products.²⁵⁶

In another paper by Hoekstra and colleagues, the water footprint of certain processed foods was studied. The water footprint of one litre of soy milk was 297 litres, of which 99.7% referred to the supply chain, and the water footprint of a 150 g soy burger was 158 litres, of which 99.9% referred to the supply chain. In contrast, the global average water footprint of a 150 g beef burger was 2,350 litres, and the water footprint of one litre of cow's milk was 1,050 litres. They further concluded that shifting from non-organic to organic farming can reduce the grey water footprint related to soybean cultivation by 98%.²⁵⁷

When the water required for forage and grain production is included in the production of animal protein, the water requirement for livestock production dramatically increases. For example, in the USA, producing 1 kg of

fresh beef may require about 13 kg of grain and 30 kg of hay. It requires about 100,000 L of water to produce 100 kg of hay, and 5,400 L for 4 kg of grain. On rangeland for forage production, more than 200,000 L of water are needed to produce 1 kg of beef. Animals vary in the amounts of water required for their production. In contrast to beef, 1 kg of broiler meat can be produced with about 2.3 kg of grain, requiring approximately 3,500 L of water.²⁵⁸

Meier and Christen found that blue water use (ground and surface water) was found to be higher in vegetarian and vegan diets due to higher nut and seed consumption. Nuts and seeds consumption was not included in the other (meat-based) diets, while the authors admitted that increased consumption of nuts and seeds in other diets was probable.²⁵⁹

With the exception of some nuts and seeds production, and some fruit and crop growing systems that require a great amount of irrigation, plant-based diets generally have a much lower water footprint than meat-based or vegetarian diets. As freshwater availability becomes increasingly scarce, and with major, developed cities such as Cape Town in South Africa having to ration water use due to extreme drought, wise use of water and other resources is not just the more sustainable option, but also the most practical solution. Transitioning from meat-based towards plant-based diets is no longer just a personal choice, but must become an international priority.

THE WATER FOOTPRINT OF CERTAIN PROCESSED FOODS ²⁵⁷

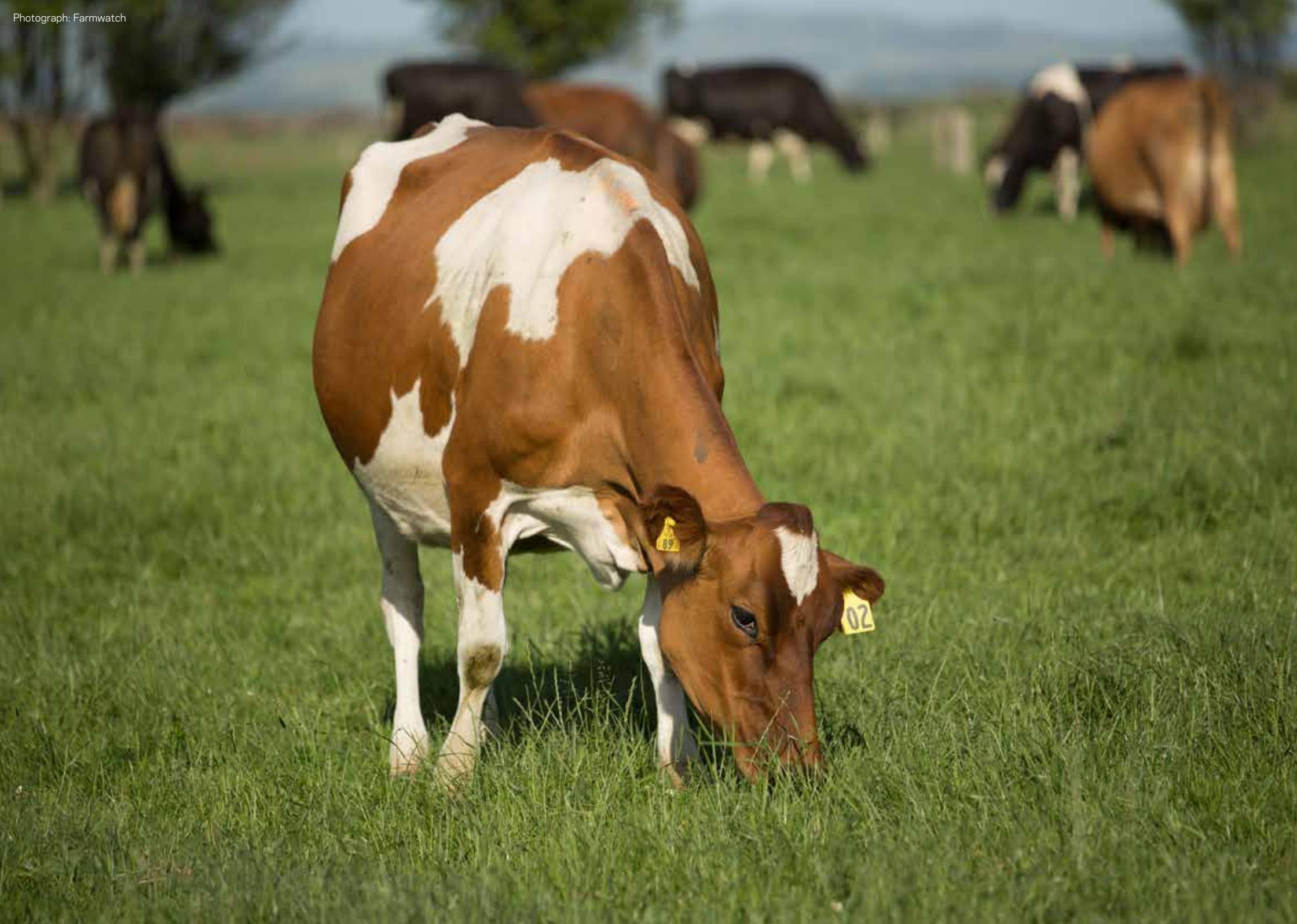
by Hoekstra and colleagues.



SHIFTING FROM NON-ORGANIC TO ORGANIC FARMING CAN REDUCE THE GREY WATER FOOTPRINT RELATED TO SOYBEAN CULTIVATION BY 98%

Figure 15. The water footprint of certain processed foods (Hoekstra and colleagues).

Note: *of which 99.9% referred to the supply chain.



5. THE 'FUTURE PROTEIN REVOLUTION'

In 2011, Google searches for the word 'vegan' became more popular than searches for the word 'vegetarian', a trend which continues around the world to this day. Campaigns and education initiatives by non-profits, celebrities leading by example, more favourable articles in the news, and increasing scientific evidence that plant-strong diets are better for health and the environment, have influenced public opinion in favour of reducing meat consumption. However, many people would still like to eat 'burgers', 'sausages', 'pies' or other traditional animal-based products, but without animal ingredients.

Recent corporate developments in New Zealand include more vegan products or options available in supermarkets, and community developments include a marae that went vegan to improve community health,²⁶⁰ and a day care centre offering a vegan menu.²⁶¹ In this chapter, developments around the growing interest in and production of alternative plant-based protein sources and the implications for New Zealand's economy are explored.

5.1 AGRICULTURAL ECONOMISTS' ANALYSIS OF THE CHANGING PLANT-BASED FOOD MARKETS

The Ministry of Primary Industries (MPI),²⁶² meat industry organisations, such as Beef and Lamb NZ²⁶³ and financiers and insurers of, and investors in, agricultural enterprises, agribusiness and livestock operations, have started analysing risks and opportunities of the global developments that are now reaching New Zealand's shores. The threat to the 'traditional' (i.e., intensive) farming model, driven by concerns around health, animal welfare and sustainability, and the growing interest in alternative protein sources, may be profound for New Zealand's economy.

The Rabobank, a Dutch bank with affiliate branches in New Zealand, for example, has supported agricultural businesses for over 40 years, and its predecessor, the Boerenleenbank, has done so for much longer. They have financed intensive farming systems aimed at maximising profits and minimising human labour, which often compromise animal welfare, although they brand themselves as a global leader in food and agriculture financing and sustainability-oriented banking. In November 2017, the bank published a report entitled *Watch Out... Or They Will Steal Your Growth*. The report examined why alternative proteins are starting to successfully compete for the 'centre of the plate'. A media release²⁶⁴ about the report is summarised below:

"Rabobank's initial projection is for the market of alternative protein products to grow at a compound annual growth rate of eight per cent in the EU, to reach a level of between 200,000 and 250,000 tonnes by 2022. [...] alternative proteins could represent one-third of total EU protein demand growth in the next five years.

In the US and Canada, alternative proteins are forecast to grow at a slightly lower rate of six per cent to reach 165,000 to 200,000 tonnes by 2022. For New Zealand (and Australia), local food industries were not considered to be at the pointy end of the trend towards substitute food.

Rabobank believes that domestic market penetration of alternative proteins and substitute foods in New Zealand and Australia will lag behind that in the EU and US, where current market development efforts are focused. Similarly, their adoption in the emerging markets that we export to are also likely to lag - with most consumers still trading up to traditional protein products, like red meat and dairy, rather than embracing meat 'analogues.'

THE THREAT TO THE 'TRADITIONAL' (I.E., INTENSIVE) FARMING MODEL, DRIVEN BY CONCERNS AROUND HEALTH, ANIMAL WELFARE AND SUSTAINABILITY, AND THE GROWING INTEREST IN ALTERNATIVE PROTEIN SOURCES, MAY BE PROFOUND FOR NEW ZEALAND'S ECONOMY

That said, the trends in New Zealand and Australia often eventually follow what unfolds in the EU and US, and it would be a waste not to learn from the experiences of producers in these markets. Emphasising the naturalness of traditional food products is a useful strategy, but in many cases isn't likely to be enough in itself. In line with their processing partners, meat producers need to recognise what is driving these substitutes, and do what they can to tap into the desire for healthy, sustainable and novel products delivered through a supply chain that consumers trust. Alternative proteins are not the only answer to the question the market is asking right now. But right now they are the answer that is attracting the most attention."

Such reports may try to play down the acceptability or palatability of plant-based products, claiming the quality, including taste and texture of meat substitutes may not be as good. With the exception of some plant-based products, such as the Impossible and Beyond Meat burgers, like-for-like taste and texture may be difficult to replicate. However, an increasing number of people do enjoy most modern plant-based substitutes, and accordingly, sales of certain products have exponentially increased.

Some reports even claim that "alternative proteins might have their own health concerns to overcome, such as the role of GM crops in their production".²⁶⁵ This could be misleading, as most meat substitutes use GMO-free soy and other ingredients. Over 90% of genetically modified soy is fed to livestock, particularly beef cattle, rather than consumed by vegetarians and vegans.

5.1.1 Economic performance assessment of different types of industry

In May 2017, the Humane Party of the United States published a comparison of nine animal agriculture industries and six plant-based agriculture industries using Key Business Ratios (KBRs).²⁶⁶ KBRs provide an overview of the efficiency, solvency and profitability of publicly owned companies within an industry. The report found:

- Animal-based industries are, overall, more liquid than plant-based industries. Animal-based industries have a better capacity to meet their short-term obligations.
- Plant-based industries are, overall, more efficient than animal-based industries. Plant-based industries make better use of their assets and liabilities.
- Plant-based industries are, overall, significantly more profitable than animal-based industries. Plant-based

industries generate for shareholders, overall, a higher return on their investment.

Given that animal farming requires a significant amount of (valuable) land, and that land assets are a key part of business liquidity, it is not surprising that the animal-based industries generally fare better, and are better resourced than plant-based industries. There is a need for more economic research relevant to New Zealand industries, but similar patterns are likely. Since 2017, a multitude of financial reviews and investment strategies have been published, including by organisations such as Farm Animal Investment Risk & Return (FAIRR), demonstrating that divestment from animal agriculture industries is warranted, and investments in plant-based industries provide a much better return.



5.2 PLANT-BASED INNOVATION AND SUCCESSFUL BUSINESS MODELS

As a reduction in meat consumption and the adoption of plant-based diets have increasingly become more popular around the world, the demand for plant-based versions of many traditional animal products and dishes has steadily grown. The rapid increase in research and development of innovative plant-based products that cater for this new demand has taken traditional producers and manufacturers by surprise. Around five-10 years ago, the interest in meat substitutes was attributed to a dietary fad. However, the so-called 'flexitarian' trend has continued, and the growth in plant-based products and lifestyles resembles a 'Green Protein Revolution'.

The market share growth, particularly for meat substitutes and dairy alternatives such as soy, almond, rice, coconut, hazelnut and other plant-based milks, is continuing to increase, while opportunities for insect or algae-based products and lab-grown meat products are in their infancy, due to limited consumer trust and long regulatory approval tracks.

The global meat substitute market size is expected to be valued at \$8.1 billion by 2026, registering a CAGR of 7.8% from 2019 to 2026. The European meat substitutes market accounts for around 40 per cent of the global market. The market is forecast to grow to €2.4bn by 2025 from €1.5bn in 2018. The European market, of which the UK is the largest sub-

market, is the leader currently by value.

The key players profiled in the meat substitute market report include Amy's Kitchen, Beyond Meat, Cauldron Foods, Garden Protein International Inc, Meatless B.V., Quorn Foods, Vbites Food Ltd, Morningstar Farms, MGP Ingredients, and Sonic Biochem Extractions Limited. While consumer demand is growing at a faster pace in Asia, Europe will continue to lead the meat-free revolution. Globally, the dairy milk alternative market was worth around \$16 billion in 2019 (ref 268), of which over \$3 billion in the US alone.²⁶⁹

Consumers are also increasingly looking for alternatives to whey protein (frequently used in sports supplementation) and energy and protein bars. Substantial growth in vegan protein shakes, supplements and energy and protein bars, particularly in the USA, has fuelled demand in athletes and everyday health conscious consumers. The global plant-based protein supplement industry garnered \$4.2 billion in 2018, and is expected to generate \$7.0 billion by 2026, registering a CAGR of 6.7% from 2019 to 2026.²⁷⁰ New Zealand could expect similar profitability in the plant-protein sector as seen elsewhere in the world. Examples from successful plant-based businesses and acquisitions, including New Zealand enterprises, are in Appendix 1.



5.3 THE GREEN PROTEIN REVOLUTION AND NEW ZEALAND'S ECONOMY

It is time to change New Zealand's focus, and to substantially reduce reliance on animal farming. Chapters two to four of this report demonstrated how New Zealand's overreliance on animal agriculture causes significant environmental, public health and animal welfare problems. These are unnecessary, as viable, economically sound, and acceptable alternatives are already available.

Chapter two discussed New Zealand's exports and imports of animal products. The global trade may at first seem advantageous to New Zealand's economy. However, the hidden and direct environmental impact of export, trade and transport of animal products is significant, and problems will be passed on to future generations, causing significant social injustice. In addition, risks associated with the volatility of world food prices, climate change, and changing markets and consumer demands, make New Zealand's current export strategy (and economy) vulnerable and unsustainable. From an economic and ethical perspective, the export of animal products to nations where domestic markets produce the same food and animal derivatives appears counterintuitive. Regional production and consumption, agricultural specialisation, and agro-ecological practices are more sustainable and robust.

Some might argue that New Zealand's economy would be severely affected if the export of animals and animal products were substantially reduced or ended altogether. However, good quality horticultural

products; value-added timber and other natural products; other industries such as tourism; the IT sector, the renewable energy sector and possibly other service sectors, are all likely to contribute significantly more to the economy.

Exporting 'raw' natural resources is likely to yield less, whereas New Zealand has a rich culture, history, sports and unique arts sector that could all be used to make New Zealand's export and economy much more sustainable, ethical and attractive.

SOME [LAND] COULD BE USED FOR CROP PRODUCTION, AGROFORESTRY, 'REWILDING' [...] OR OTHER PURPOSES, SUCH AS ECOTOURISM OR OTHER ECOLOGICAL PROJECTS

Chapter four discussed the environmental impact of farming globally and within New Zealand. Much of New Zealand's current viable agricultural land is used for ruminant (cattle and sheep) grazing. The expectation that land use for dairy production may continue to increase and intensify beyond 2020 is particularly worrying, and this trend should be reversed as quickly as possible. While some of this land would be less suited to crop production, particularly the higher and drier regions (the latter are technically not suited to dairying either due to the need for irrigation), a vast amount of current grazed land could be reallocated. Some could be used for crop production, agroforestry, 'rewilding' (tree planting is part of the Government's current agenda and is much-needed to store and capture CO₂ from the atmosphere) or other

purposes, such as ecotourism or other ecological projects. Globally, there is up to 2.7 billion hectares of land with crop production potential. New Zealand's agricultural strategy will need to focus on transitioning current animal pastures to crop and other horticultural land use.

5.4 OVERCOMING RESISTANCE TO CHANGE

The societal acceptance of tasty, generally healthy, plant-based foods is improving rapidly. However, many people struggle with behaviour change, and in particular, dietary change. One of the main explanations for this challenge is that most people believe in an invisible system, or ideology, that conditions people to eat certain animals (carnism²⁷¹) while treating others as companion animals. Carnism is the dominant ideology in society. Humans have developed various arguments to justify the rearing and killing of 70 billion animals a year. We have decided that thousands of species of fish and around a dozen species of land animals (mainly chickens, ducks, rabbits, pigs and cows) are to be regarded as food. As a result, many policy makers and researchers ascertain that solutions such as a society-wide substantial reduction in meat consumption (let alone adopting vegetarian diets) would not be attainable due to limited social acceptance. Sustainability is often framed in terms of existing, socially acceptable solutions that are close to current practice, rather than evidence-based solutions.

The FAO has developed "a common vision and an integrated approach to sustainability across agriculture, forestry and fisheries. This unified perspective, valid across all agricultural sectors and taking into account social, economic and environmental considerations, ensures the effectiveness of action on the ground and is

underpinned by knowledge based on the best available science, and adaptation at community and country levels to ensure local relevance and applicability.”

The notion of practices that are ‘socially acceptable’ could lead to maintaining a status quo, given that what is the norm (as determined by the majority of citizens adopting such practices), and what are truly sustainable practices, could be in conflict. Therefore, leadership from governments is required to inspire new practices that help society to adopt pro-environmental behaviours, which would limit global warming and keep the global rise in temperature below 1.5 degrees Celsius²⁷². As mentioned in paragraph 4.4.1, Wynes and Nicholas demonstrated that commonly promoted government messages such as waste recycling and changing light bulbs may be more socially acceptable, but their impact is only a drop in the ocean compared to the more impactful actions of having one fewer child, and adopting completely plant-based diets.

As with governmental environmental messages, official dietary health guidelines and messages do not seem to be effective either. Obesity and other non-communicable diseases that threaten public health are rapidly growing. Public policies aimed at preventing disease and deficiencies should be largely lifestyle-related, and governments and community initiatives should focus more on educating citizens to choose healthier diets (that is, mostly plant-based).

Researchers are calling for sustainability to be included in dietary guidelines. Some nations have done this,



for example in Sweden, Brazil, the Netherlands,²⁷³ the forthcoming Nordic nutrition guidelines 2022,²⁷⁴ and recently in Canada.²⁷⁵ Generally speaking, dietary guidelines tend to consider the already accepted social, economic and cultural aspects of food, and will not propose more radical, but much-needed changes. Many research and policy papers do not recommend meaningful

solutions that will make a difference either. If anything, reports focus only on gradual and minimal diet shifts towards a healthier and lower environmental impact diet (for example Macdiarmid *et al.*, 2012,²⁷⁶ Horgan *et al.*, 2016²⁷⁷).

The business-as-usual model, that tinkers around the edges for minor environmental improvements, is proffered as the only acceptable way to reconcile our current lifestyle patterns with the inevitable climate change damage for which we are responsible.

Governments are reluctant to be prescriptive, and value personal choice and responsibility over responsible policies ensuring future sustainability and public health. Examples include “less but ‘better’ meat” messages, or advice to replace beef with pork, chicken and other so-called ‘lean’ meat alternatives, which essentially do not lessen the environmental impacts adequately, nor improve health sufficiently.

From an animal welfare perspective, eating more chicken than ruminant meat results in the suffering of over 125 million broiler chickens in New Zealand alone (and over 62 billion worldwide). Kept in intensive conditions, these birds live short, deprived, lives for around six weeks. From an ethical perspective, we must implement Winston Churchill’s prediction immediately.

Overcoming resistance to change is about nudging people in the direction of making better choices. It is about rewarding food producers, businesses and caterers for providing healthier food for everyone. It is about increasing the availability, affordability and quality of plant-based food options everywhere, and making it the norm or default, which requires leadership. Our education systems must start questioning carnism and offer more sustainable food practices with lower environmental footprints. The answer to achieving our climate targets is right in front of us; we should consume fewer animal products, and ideally only plant-based foods, as well as tackling fossil fuels.





6. A 'GREENPRINT' FOR NEW ZEALAND: RECOMMENDATIONS FOR ECONOMIC, ENVIRONMENTAL, SOCIAL AND TECHNOLOGICAL SOLUTIONS

This report provides a rationale for changing New Zealand's national Agriculture strategy. Now is the time to change course, and to transition from animal-based production, export and trade, to healthy and sustainable plant-based production that will nourish the world and keep environmental damage within acceptable planetary boundaries.

A detailed UK report identifying the opportunities, barriers and policy recommendations to enhance the development of protein crops was published in 2017.²⁷⁸

Animal farming and exports are not the only options to maintain a healthy New Zealand economy. In fact, on balance, they do more harm than good. Diseases, such as the recent outbreak of *Mycoplasma bovis*, have led to the decision to cull hundreds of thousands of cattle. Scarce MPI resources are spent on dealing with such diseases, while other areas, such as animal welfare law enforcement and improvement, are under-resourced.

Farmers, the agribusiness support sector, including finance, logistical support and analysts, researchers and politicians will need to work together to initiate a transition to a truly cleaner and greener New Zealand. The Government and all relevant stakeholders will need to take bold measures. As society is changing and becoming more interested in greener, cleaner and healthier living, better food policies that are aimed at environmental preservation and health are more likely to be supported. The following recommendations provide a starting point for a better future. A full dialogue among all stakeholders and development of an action plan should commence as soon as possible.



6.1 RESEARCH AND DEVELOPMENT

1. The New Zealand Government and agricultural sector should increase research funding for impactful projects, and redirect funding away from research that may only marginally lead to a reduction in GHG emissions towards:

- Applied research at institutes, universities and field locations to study the suitability of various crops grown in different New Zealand geographical, climatic and other conditions. Examples could include quinoa,²⁷⁹ oats,²⁸⁰ hemp,²⁸¹ peas,²⁸² fava beans (also known as broad beans), lupins and other pulses and legumes, and other nourishing grains, fruits and vegetables for the domestic and international market, which is growing.²⁸³

Canada has become the largest producer of pulses, which was supported by prior extensive research.

In the UK, the charity Processors and Growers Research Organisation carries out research into pulses, legumes and vegetables. In New Zealand, non-profit, corporate and governmental partnerships could boost funding for similar research. Data collection on growing and consumption of pulses should be part of the

wider research and development strategy. As pulses are free from gluten, they could appeal to consumers with allergies and preferences for avoiding certain foodstuffs. Increased consumption of pulses also substantially benefits health thanks to high fibre and protein content; they increase longevity and help reduce the risk of obesity and certain diseases.

- Identifying suitable land use, and land use change, for a variety of protein crops that are sustainable and provide good return on investment across New Zealand.

Where possible, arable farming should be organic or vegan-organic²⁸⁴ ('stockfree' using green manures, and no animal inputs). In addition, the planting of crops such as hemp and legumes requires less fertiliser, and they naturally fix nitrogen in the soil, which helps mitigate climate change.

- Research into, and development of, value-added plant-based products and technology required (the 'post-farmgate infrastructure') within New Zealand to upscale new markets.

2. The economic and marketing position of horticulture and agroecology within New Zealand will need to be strengthened. The dairy industry, in particular, and beef and lamb, egg, and meat chicken industries, have disproportionate lobbying power, at the expense of other farmers, sectors and communities affected by animal farming.

3. To boost consumer knowledge, interest and consumption, the horticultural sector should investigate ways to improve marketing of plant-based products.

For example, celebrity chefs and other celebrities promoted kale's health properties, contributing to the 2013 boost in leafy green's popularity. In another example, potatoes had steadily fallen out of favour in the UK and Ireland, particularly among younger generations, but EU funding (£3.6 million) for a marketing campaign between 2015 and 2018 sought to reverse the decline in potato consumption, which boosted consumption somewhat.

6.2 POLICY

1. The New Zealand Government and agricultural sector should provide direct funding for transitioning from animal to protein crop farms through:
 - A direct payment support scheme for trial farms, and farmers growing protein crops (as is the case in Ireland²⁸⁵)
 - A young farmers' protein crop start-up grant scheme to address the ageing population among farmers
 - Considering introducing a sustainability charge on animal products, to account for externalities in animal farming.
2. The government, agricultural sector and researchers should set up a multidisciplinary think tank and establish an action plan to:
 - Develop an integrated agricultural roadmap fit for the future. This will need to consider animal welfare, environmental and public health impacts. It should include the promotion of sustainable farming methods, binding climate emission targets, reduction targets for the national cattle and sheep herds, and practical support for farmers interested in transitioning from dairy and other animal-based farms to crop farms and other non-animal based agricultural and forestry enterprises. Expansion of animal industries should be halted, while non-animal based sectors should be increased.
- Identify and prepare knowledge exchange and knowledge transfer opportunities for (young) farmers and anyone interested in growing protein crops.
3. Discontinuation of the Crown Irrigation Investment fund for dairy farm irrigation projects. Public funding for large-scale irrigation projects has already started to wind down.²⁸⁸ A water use tax should be investigated, according to the overall environmental impact of production methods ('polluter pays' principle²⁸⁹).
4. Inclusion of agriculture within the ETS.
5. Given the conflict of interest within the Ministry of Primary Industries (which is focused on increased production and the economy), the Government should establish a separate government body responsible for animal welfare policy and enforcement. MPI will require further resourcing to better support horticulture and agroforestry, particularly when dairy farmers start transitioning to other types of farming.

Tax interventions may attract criticism and arguments that public support for such measures would be low, and that they would be socially regressive. A landmark 2015 Chatham House report cited focus group studies that indicated public resistance to such interventions may be short-lived, particularly if people understood the policy rationale.²⁸⁶ A recent report investigating a sustainability charge on meat in the Netherlands demonstrated that a large proportion of the public and farmers' organisations support the gradual introduction of a 'levy' on various animal products, to be used for the common good, including investing in better agricultural systems, lowering VAT on fruit and vegetables, and supporting people on lower incomes.²⁸⁷ In addition, cheap alternatives to animal products are already available, as dried and canned pulses, beans and legumes are generally cheaper than most animal products. As plant-based diets, supplemented with Vitamin B12 and omega 3 (found in ground linseed, for example), provide all the nutrients for a healthy life at all ages and life stages, animal products are not essential for any particular group in society. Substituting plant-based products for meat, eggs and dairy should be easily accessible and affordable for all citizens.

6.3 PUBLIC AND CORPORATE PRACTICE

1. Public procurement for canteens and restaurants in schools, hospitals and government and council venues, as well as within the private hospitality sector, should increase the number of plant-based dishes and pulse- and legume-based cuisine. Customers may not always express a demand for alternatives to meat. Therefore, an increase in what is on offer will need to be pro-actively stimulated. For example, if plant-based meals were the norm,²⁹⁰ not the exception, especially for institutional meals where health, economy and environmental impact should be considered, significant and lasting change could be achieved at a national level.

As (omnivorous) consumer expectations may be high, such plant-based dishes will need to demonstrate they are just as, if not more, appealing than meat-based versions. While simple dishes may be

wholesome, many people prefer interesting and delicious textures, tastes and food presentation when eating out. Fortunately, amazing recipes and world-class plant-based cuisine dishes continue to develop at a rapid pace, and are becoming increasingly popular, including among 'flexitarians'.

Research found that the location of vegetarian options on a restaurant menu influences customer choice. The common practice of separating vegetarian dishes on a menu can, in fact, reduce the proportion of people who choose a vegetarian option. Finding out about the preferences of regular and infrequent customers is important for restaurateurs when designing their menus.²⁹¹

2. Retailers should take a lead in offering sustainable, healthy and affordable plant-based products that are appealing to their customers.

Promotions, discounts, and favourable placing of plant-based products in shops may nudge customers to buy more 'responsible' products. Free plant-based recipes and samples in store also encourage increased consumption of plant-based products.

3. A conference for medical practitioners about plant-based nutrition and health could provide continuous education on the role of wholesome nutrition and health. Such events have been held for a number of years in the USA and in Germany,²⁹² and a similar New Zealand symposium was held in Gisborne in January 2018.²⁹³ The Australian-based 'Doctors for Nutrition' organisation, which includes New Zealand medical professionals, hosted a successful first Nutrition in Healthcare conference in 2019. Medical degrees should also include more lectures on plant-based nutrition and health within curricula.

6.4 CONCLUSIONS

As the impact of animal farming on the environment, public health and animal welfare is becoming increasingly negative, to the extent that it affects climate change and future sustainability and food security, a change in economic direction is warranted.

New Zealand is among the highest methane emitters per capita in the world, which can only be sufficiently limited by reducing the reliance on animal agriculture. To meet agreed climate targets by 2030, the New Zealand government will need to change course. It should initiate a more sustainable form of agriculture and economy, by promoting, supporting and developing a significant

transition from dairy (and other forms of animal) farming to protein crop growing (and other forms of horticulture, agroforestry and other sectors).

All stakeholders, including the farming community; agricultural industry and marketing bodies; finance and insurance companies and analysts; food innovation, development and technology firms; researchers; retailers

and the hospitality sector; the medical profession, non-profit organisations and community groups and iwi, will need to work together to establish how this transition will be developed and supported. The 'greenprint' in this report provides economic, environmental, social and technological win-wins.

Research into plant-based crops and products, land use, knowledge exchange and sector development, is key to the success of the new economy, as is funding to support this transition. The transition plan will need to be implemented within the next five years, or else environmental problems may spiral out of control. Time is of the essence.

NEW ZEALAND IS AMONG THE HIGHEST METHANE EMITTERS PER CAPITA IN THE WORLD, WHICH CAN ONLY BE SUFFICIENTLY LIMITED BY REDUCING THE RELIANCE ON ANIMAL AGRICULTURE



APPENDIX 1 EXAMPLES OF GLOBAL PLANT-BASED FOOD MANUFACTURERS AND BUSINESS GROWTH

This appendix builds on the economic arguments to invest in plant-based companies. When plant-based start-up companies do well, one of three outcomes usually seems to follow:

- They are ahead of their time, grow too quickly, are affected by competition, or otherwise do not manage to develop further, and after a while, fizzle out.
- They expand and continue to go from strength to strength, gaining supermarket and possibly hospitality sector contracts. Brands become established and gain consumer confidence and appreciation.
- After some years of profitability, large companies acquire very successful plant-based enterprises. The products' vegan ethos may be kept intact if they remain an independent subsidiary, although the parent company is normally not vegan. The new owner may include the opposite product in their portfolio (such as dairy products), or commission or conduct animal research. This is not in line with the founding principles of the plant-based companies that have been bought out, or of their customer base. However, vegan brands often need to partner with larger, more mainstream, companies in order to improve market access and grow further.

Eleven examples of successful plant-based businesses acquisitions between 2013 and 2017 are described. Many more recent examples could be added to this list.

1. In 2014, Pinnacle Foods acquired Gardein for \$155 million

Gardein is best known for their frozen meat-less products, which were launched in the 1990s. The brand continues to grow worldwide.²⁹⁴

2. In 2015, Monde Nissin Corporation (Philippine instant noodles maker) acquired Quorn Foods for \$831 million (£550 million)

During the 1960s it was predicted that there might be a shortage of protein-rich foods in just a few decades, and programmes were initiated to find alternative protein sources. The fungus *Fusarium venenatum* was discovered in a soil sample in 1967. Eventually, a continuous fermentation process for the production of *F. venenatum* biomass was developed in the 1970s and 1980s. The mycoprotein product was marketed and launched as 'Quorn' by Marlow Foods in the UK in 1985, after a ten-year safety evaluation programme.²⁹⁵

The launch in the USA was controversial and complaints about Quorn were lodged from so-called consumer rights groups. Such groups are frequently backed by established industry bodies firmly fighting off any competition or attempts to reduce consumption of their products (particularly when these are tobacco or other products). They may cite false 'adverse reaction' rates, and have contested the labelling of Quorn, which subsequently changed late in 2017. Quorn products containing the fungus in the US must now be labelled with the statement: "Mycoprotein is a mold (member of the fungi family). There have been rare cases of allergic reactions to products that contain mycoprotein." However, the proportion of people allergic

to eggs or dairy is likely higher than the low number of people allergic to mycoprotein.

Clearly, a successful meat-free product has the potential to displace or affect competitors and even the traditional meat-based sausage and other meat products market. While the patent expired around a decade ago, the expensive investment in the fermentation vat is likely to discourage many new companies from trying to replicate similar mycoprotein production. Vegan versions of the product (using potato protein binder instead of egg albumen) were launched in 2015 and have proven very popular worldwide.

3. In 2015, Hain Celestial Group acquired Mona Group for an undisclosed sum

Mona Group is a leader in plant-based foods and beverages in Germany and Austria. Their products include soy-, oat-, rice- and nut-based drinks as well as plant-based yogurts, desserts and creamers, and tofu.

4. In 2016, Tyson, the largest US meat processor, invested an undisclosed amount for a 5% stake in Beyond Meat

Beyond Meat is a plant-based meat company that has successfully sold their meatless products next to meat products in supermarkets, and on menus in national restaurant chains such as TGI Fridays. In January 2020 Beyond Meat was vastly outperforming major US indexes with its 73% year-to-date gain, driven by extended partnerships with other restaurant chains and a lack of major competition in the expanding sector.²⁹⁶

5. In 2017, Danone acquired plant-based company WhiteWave Food for \$10.4 billion

WhiteWave was formerly a wholly-owned subsidiary of Dean Foods, until their IPO in 2014. WhiteWave's food portfolio includes 10 brands, most notably:

- Silk
- So Delicious (acquired in 2013 for \$195 million)
- Vega (acquired in 2015 for \$550 million)
- Alpro (acquired in 2009 by Dean Foods for €325 million)
- Earthbound Farm (acquired in 2013 by WhiteWave for \$600 million. This deal gave WhiteWave a 56% share of the branded organic packaged salad segment)

Danone likes to advertise itself as a company that is part of changing the way the world eats for the health of people and the planet. They claim to help meet "the needs of the growing number of 'flexitarians', who wish to diversify their protein sources and see plant-based products as part of their diets. And at the same time, better cater to consumers with dietary constraints".²⁹⁷ Danone promotes its products as natural and sustainable. However, as long as Danone continues to sell dairy products, the environmental impacts of the company will be larger than if they only sold plant-based products.

Alpro, with headquarters in Belgium, on the other hand, is a good example of a sustainable, successful and growing brand. In 2015, Alpro invested €80 million to expand operations, following a 2012 expansion of €75 million.

It recruited 250 new staff members (200 in Belgium and 50 in the UK). It increased its range to 26 product lines, and the new products proved most popular; non-soy products represented 30% of Alpro's turnover in 2014.

6. In 2017, Nestlé acquired Sweet Earth for an undisclosed amount

Sweet Earth's products are sold in more than 10,000 stores, and they are known for their frozen meals, burritos, breakfast sandwiches, and chilled plant-based burgers.

7. In 2017, Maple Leaf Foods Incorporated, the largest distributor of packaged meats in Canada, acquired Field Roast Grain Meat Co, a US vegan meat producer, best known for their vegan sausages, for \$120 million

In the same year, Maple Leaf Foods Inc. acquired LightLife Foods for \$140 million. LightLife owns 38% of the US market share for refrigerated plant proteins, and was originally founded in 1979.

8. In 2017, Otsuka Pharmaceutical Company acquired Daiya for \$325.97 million

Founded in 2008 in Canada, Daiya is among the pioneers in developing plant-based cheese alternatives. The company offers over 20 successful plant-based food products, found in more than 25,000 stores across North America.

Otsuka Pharmaceutical's takeover, like Tyson's share in Beyond Meat and Danone's acquisition of WhiteWave, have been somewhat controversial among minor vegan communities, although the majority of vegans understand how the market place works, and will continue to buy the plant-based products.

Through these acquisitions, a larger customer base can be reached, and more funds will be available for research and development, and advertising of the plant-based products.

9. In 2017, Cargill Incorporated invested in Memphis Meats, a cell-cultured meat startup, in their \$17 million Series A funding round

The world's largest supplier of ground beef, Cargill Inc. stated that they "will exit the business of feeding cattle to direct capital toward other investments" and that the company "wants to expand its North America-based protein business by exploring plant-based protein, fish and insects, along with other opportunities linked to livestock and poultry".

10. In 2017, Campbell acquired Pacific Foods for \$700 million

Pacific Foods produces non-dairy soup, cream, milk, broth, meals and sides.

11. In 2017, Coca Cola acquired AdeS from Unilever (who acquired the company from Bestfoods in 1992) for \$575 million

AdeS is the second largest global manufacturer of soy-based beverages.

Below are seven examples of plant-based food innovation that have attracted public attention.

On a monthly basis, new developments take place in plant-based food innovation, particularly in the USA and Europe. Initially, private investors, 'flexitarians' and technology companies backed new food technology start-ups, but increasingly, Asian companies are investing in such ventures.

1. Impossible Foods

A recent successful case study of plant-based food innovation is US company Impossible Foods, which announced on 4th April 2018 that it had "raised an additional \$114 million in financing, making a total of \$396 million in funding since it was founded in 2011 by Stanford University biochemistry Professor Pat Brown. Best known for its Impossible Burger, a plant-based burger that cooks, tastes and looks much like a beef patty, the food technology company increased production last year with its new factory in Oakland. The burger is now served at the Oakland Coliseum and will be offered at San Francisco's AT&T Park as well, among some 1,000 food-service outlets that serve it across the country. The latest round of funding is from Temasek, a Singapore investment company, and Sailing Capital in Hong Kong and Shanghai. [...] The company's previous funders have included Open Philanthropy Project, Bill Gates, Horizons Ventures, Google Ventures and Viking Global Investors."²⁹⁸ In addition to the outlets mentioned above, Impossible Foods are now being sold by White Castle, an American fast food vendor.

2. Perfect Day

"Don't have a cow: making milk without the moo" was the headline of a New Scientist article in 2014.²⁹⁹ In 2018, Perfect Day started developing drinks that taste like dairy, but do not involve animals. The company is a new leader in the science, research and production of animal-free dairy, raising US\$24.7M in funding, and receiving the first patent for the use of animal-free dairy proteins in food applications.³⁰⁰

3. Just Mayo

In 2014, start-up company Hampton Creek, which manufactures vegan (i.e. eggless) mayonnaise 'Just Mayo', made headlines, when Unilever's Hellman's, the world's most popular mayonnaise maker, attacked it for 'inaccurate' labelling. Soon, the story turned around: "The Twitter hashtag #mayowars, chronicling a fight between two companies, morphed into #mayogate as the story became more about Unilever pulling a fast one".³⁰¹ The negative media attention had backfired on Unilever, while Just Mayo's profile had been boosted. In a statement, a Unilever spokesperson said they applauded Hampton Creek for its innovation, and that they shared Hampton Creek's sustainability vision.³⁰² One and a half years later, in April 2016, Hellman's started selling its own egg-free 'carefully crafted dressing and sandwich spread' (as well as an organic mayonnaise containing cage-free eggs). Since then, Hampton Creek has branched out with a Just Eggs product.

4. Oatly

In 2014, Swedish manufacturer Oatly raised the hackles of the Swedish Dairy Association (SDA), which took legal action to gag Oatly's claims that its product was 'like milk, but made for humans'. The SDA accused Oatly of making milk seem 'unmodern'. In an unprecedented step, the brand made the full 172-page summons, as well as its response, available on its website, allowing people to make up their own minds.³⁰³ To promote the brand, the non-conformist CEO Toni Pettersson wrote a song called 'Wow no cow' which is available on Oatly's YouTube channel.³⁰⁴ In March 2017, Oatly entered the US market, and the oat milk is now sold in over 1,000 shops.³⁰⁵

While soy and almond milk, and increasingly, coconut, hemp and other plant-based milks continue to increase in popularity, innovation in new dairy alternative products keeps apace. For example, in 2017 coconut milk specialist Rebel Kitchen launched three varieties of skimmed, semi-skimmed and whole 'mylk', made from a base of Himalayan salt, brown rice, cashews and nutritional yeast.³⁰⁶

In 2017, the European Court of Justice ruled that plant-based foods cannot be sold in the EU using terms such as milk, butter and cheese.³⁰⁷ Exemptions include coconut milk, peanut butter and almond milk. The problematic (in the eyes of meat-based industries) nature of sales denominations of meat alternatives such as 'sausage' is also discussed in EU territories. Such labelling laws are indicative of the pressure applied to animal agricultural industries and the potential for plant-based products to displace animal products. Protectionist laws may be reversed as they

are predicated on weak merits. Even many animal products are often labelled as something else (for example, 'beef' for cow's flesh, 'pork' for pig flesh).

5. **De Vegetarische Slager - The Vegetarian Butcher**

In 2012, The Independent published a long article entitled 'Is this the end of meat?', featuring the Dutch 'Vegetarian Butcher'.³⁰⁸ It heralded the age of plant-based meat products. Jaap Korteweg, the founder of the Vegetarian Butcher, used to like meat but started questioning the ethics of animal farming due to animal welfare issues and disease outbreaks. As well as soy-based products, the Vegetarian Butcher sells products based on locally grown sustainable lupin beans. The company started with one shop in 2010 and grew to 180 outlets and over 500 Dutch supermarkets two years later. A 2015 crowdfunding initiative raised €2.5 million in three weeks, and the company issued shares to raise the €10 million needed in total. The meat substitutes are now sold across Europe, Israel and South Korea.

After giving the company a slap on the wrist in October 2017, claiming that Vegetarian Butcher products were misleading as they referred to meat-based products, the Dutch Food Authority (NVWA) changed its position one week later. It apologised to the company, and clarified that the request to change labels referred to website descriptions, not product labels.

In 2018, Unilever acquired The Vegetarian Butcher to capitalise on the fast-growing plant-based food sector. 2019 resulted in on-trend innovations in plant-based products and 2020 is set to continue this trend.³⁰⁹

6. **Rügenwalder Mühle**

In Germany, meat processor Rügenwalder Mühle has responded to consumer demand by developing, to date, 11 vegetarian and seven vegan meat substitutes. Vegetarian/vegan alternatives have accounted for 34% of Rügenwalder Mühle's total revenue since May 2019.³¹⁰ The company has also decided to spend all of its marketing budget on advertising its plant-based products.

Mintel Marketing intelligence found that in 2012, only one per cent of food and drink products featured vegan claims in Germany. In 2015, one in ten newly launched food and drink products in Germany carried a vegan label, and only one in six a vegetarian label. In the rest of Europe, five per cent of new products were vegan, which was up from two per cent in 2013.³¹¹ In 2016, the German lead in plant-based products continued, and 18 per cent of new food and drink products were vegan. Seventeen per cent of all new global vegan food and drink products were launched in the US, and 11 per cent of new vegan products in the UK.³¹² By 2019, nearly a quarter of new food product launches in the UK were labelled vegan.

7. **Examples in New Zealand: Angel Food, Tonzu, Sunfed Meats and Air New Zealand**

In New Zealand, non-dairy cheese company Angel Food has expanded its range in recent years, and local soya product company, Tonzu, demonstrates that the market for sustainable tofu, tempeh and other products continues to grow. Sunfed Meats, founded by Shama Lee, launched its chicken-free chicken, based on pea protein, in July 2018. It instantly sold out, as many agree that its texture and taste are as good as that

of 'real' chicken. The product is deliberately aimed at flexitarians and everyone interested in cutting back on meat consumption, and not just vegetarians and vegans. The company has plans to substantially increase sales in New Zealand and beyond.

In the same way as the successful European meat-free and non-dairy companies had been challenged, Sunfed Meats was taken to the Commerce Commission in August 2017 for allegedly misleading consumers. The Poultry Industry Association New Zealand (PIANZ) claimed the chicken-free chicken 'wild meaty chunks' could be in breach of the Fair Trading Act.³¹³ The PIANZ followed up with a complaint to MPI, which responded as follows: "The overall context of the packaging means the product is not in breach of the code because the label identifies it as 'plant protein' and 'made from peas' and the ingredient list also makes it clear the product is not meat."³¹⁴

Even more public discussion consisting of support as well as criticism, including from the Deputy Prime Minister, was generated in July 2018, when Air New Zealand announced it would serve the award-winning, plant-based Impossible Burger as part of its Business Premier menu on flights from Los Angeles to Auckland.³¹⁵

The list of successful companies is long and growing and it is clear that consumer demand in New Zealand has changed what is on offer in supermarkets, at other retailers and in restaurants. The agricultural industry has noticed these changing trends and is starting to pay attention. Corporate trends will now need to be backed up with ambitious policy proposals, to ensure New Zealand will meet its 2030 climate change goals.

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