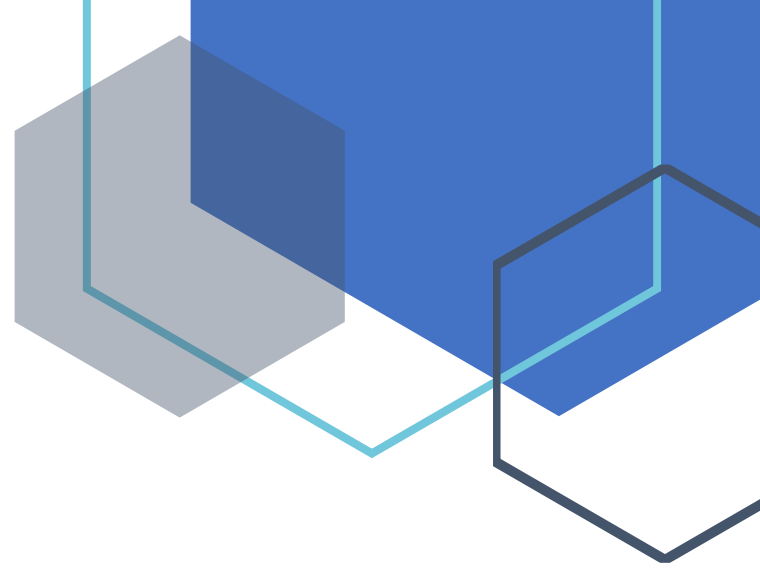




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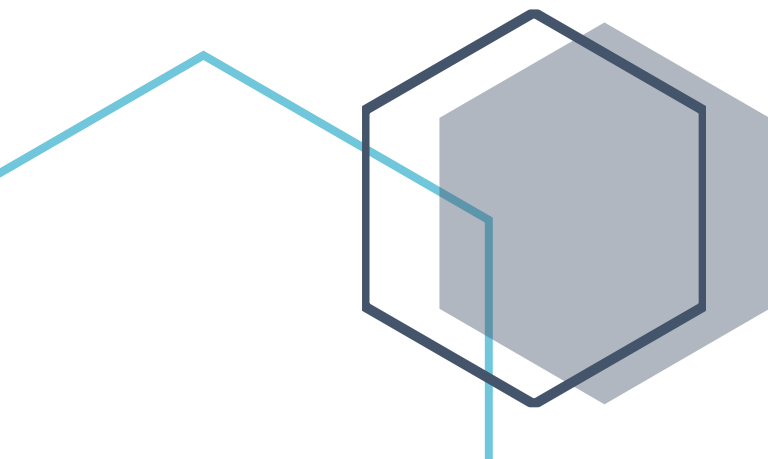


# Alternative Proteins & the Agri-Industry

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**Kellogg Rural Leadership**  
**Course 41 2020**

**Helen France**



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## Executive Summary

New Zealand's current protein production is dominated by meat and dairy. There are ongoing and increasingly growing challenges for sustainability, environmental limits, and pressure for greater efficiencies. Emergent and developing trends in plant-based proteins are creating movements and shifts in consumer demand and food production. Health and nutrition are influencing consumer demand more than ever, therefore the value propositions in the food market have to meet this demand. The current alternative protein industry is still in its infancy in New Zealand with some sectors such as Hemp and Quinoa rapidly growing. However, in general, New Zealand is behind the main growth countries producing plant based protein like Canada and the Netherlands. This presents an opportunity to take learnings and develop potential collaborations, to advance New Zealand's progression.

Throughout this study, a greater understanding was sought in the global positioning of alternative proteins and within the New Zealand context. This was then used to identify the considerations required to evaluate the importance of alternative proteins to the Agri-industry in New Zealand. Key findings and discussion points raised are:

- Food production needs to increase by 70% to feed the world population of 9.7 billion in 2050.
- New Zealand has a natural bioeconomy as there is low fossil fuel use and more energy produced by renewable sources (80%) such as wind, geothermal, hydro and biomass, but New Zealand needs to move into a new bioeconomy characterised by biotechnology and greater cross-sector thinking and actions.
- The Fourth revolution is here and characterised by building on the Third, the digital revolution, that has been occurring since the middle of the last century. The fourth is combining human and machine where technology is embedded in our societies enabling artificial intelligence, renewable energy, 3D printing and autonomous vehicles.
- Sustainability is key in all aspects of food production. Using the fourth revolution and utilising plant-based opportunities to create products that fill market gaps or outperforms the rest of the world will enable New Zealand to be a global leader in food production.
- The steps that enable New Zealand to be a global leader should coincide with achieving goals in climate change (the Paris Agreement) and mitigating the effects of greenhouse gases and the other pollution occurring like high nutrient loading in water bodies.
- "Farmers are motivated by a diverse range of drivers and constrained (and enabled) by a range of social, cultural, economic, and physical factors. Farmers will therefore react in different ways to external drivers of change and will respond differently to encouragement, incentives, and legislation aimed at influencing their farming practice."

From the above findings and conclusions, the following recommendations have been suggested:

- Keep monitoring consumer trends & food markets to increase awareness of markets and consumer change
- Maintain and grow our reputation/ story of being food producers of high value and highly nutritious ingredients or wholefoods.
- Leverage our competencies of current successful sectors especially as meat and dairy innovators

## Alternative Proteins & the Agri-Industry

- Seek expertise where knowledge or skills are low and empower people to become experts in new alternative proteins.
- Encourage and develop coalitions with the government departments such as Ministry for Primary Industries, the Ministry for the Environment and farmers to provide incentives and/or support in areas where New Zealand can deliver the world's best produce.
- Reward and support leaders paving the way for the nation and their peers in agricultural and especially in new products or production that adds value to the New Zealand Agricultural Industry.
- Develop a New Zealand plant-based food strategy for New Zealand agriculture
- Create and develop a greater understanding and technical expertise in plant-based opportunities to enable greater diffusion of adoption to farmers.

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## Foreword

I was motivated to undertake this research as it is currently a debated topic and there is a clear movement in consumer demands igniting the alternative protein sector. It is increasingly gaining interest from a consumer perspective. It also coincides with New Zealand's ambitions through climate goals, environmental, social, and cultural values whilst the government's goal of doubling production by 2025 is approaching. There is a need to remain competitive in world markets and have New Zealand's bioeconomy transform beyond a commodity-based industry. I believe New Zealand has the opportunity to remain competitive and innovative by accepting consumer drivers and delivering high-end value products in niche markets. This will ensure New Zealand can retain a valuable export industry in the primary sector. Another driver for this research is from interactions with farmers daily and meeting progressive innovative farmers keen to adopt new ideas. I want to determine how important the alternative protein space is, so I can be informed and support the diffusion of innovation to the early adopter farmers.

## Acknowledgements

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To industry representatives, you have help to add perspective and depth to my understanding of the topic. Again, I appreciate the willingness to take the time to share this knowledge and experience with me. You all play key roles in helping to support farmers with the farm to plate story. Your expertise enabled greater outcomes for all, which I believe will help the industry develop the future.

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## 1.0 Introduction

Land, including its water bodies, provides the basis for human livelihoods and well-being through primary productivity, the supply of food, fresh water, and multiple other ecosystem services (IPCC, 2019). To nurture and nourish this, the world needs food security in a sustainable manner. Alternative proteins can provide an option in the numerous solutions. This will enable the global population of 9.7 billion in 2050 protein requirements to be met. This global population will demand nutritious and sustainable protein whilst the wealthier will also demand greater choice.

It is well known that the current trajectory of the global food system will need to change to meet demand in 2050. Change will be driven by consumers, but supported by the fourth revolution. The fourth revolution is building on the third by enabling synergy between humans, technology and machinery. It is creating greater efficiencies and capabilities such as developing ways to better use renewable resources such as water and wind. This results in a greater opportunity to improve sustainability in the environment. Sustainable climate development goals have been committed to by 190 countries through the Paris Climate Change Agreement. They have committed to keeping the increase in global average temperature to well below 2°C above pre-industrial levels, with an aim to limit the increase to 1.5°C (UNFCCC, 2015). Therefore, the pressure is on food producers and countries dominated by agriculture to innovate and adapt, to enable greater value and create demand for their produce. Whilst ensuring they will be environmentally sustainable. New Zealand is not immune to this global shift in consumer demand. Hence, the need to research and develop market trends, consumer demand and products that will fit the trends and demand. To identify and enable pathways to remain an important supply of the world's protein. It is essential New Zealand can deliver sustainability in food and the agri-sector; environmentally, economically, and socially.

The backbone of New Zealand is built on agriculture. New Zealand needs to be the best producer for the world and deliver where others cannot in value and quality. We no longer can rely on key competencies and commodities that have built the agricultural industry. We need to/continue to innovate, overcome barriers/challenges, and implement change. Through research, collaboration, and strategy, the nation can choose to do this.

This study is intended to facilitate further debate and dialogue between key stakeholders, producers, and innovators in the agricultural sector. It seeks to encourage informed step-change in the alternative protein sector. It identifies the ability to harness the factors accelerating change especially the fourth revolution to build a sustainable and secure future. It enforces the need to have a systemic, collaborative approach to harness the new protein economy and empower the people to create it. The transformation will take different forms and evolve, but the goal is shared to create:

'a food secure, sustainable economy and environment where protein requirements are met'



## 1.1 Purpose of the research

This research is largely based on international trends and ideas towards alternative proteins. This project aims to better understand research and evaluate the current New Zealand situation in the alternative protein sector. It will assess the globally changing diets and their influence on protein production. It will identify the theory behind innovators and investigate consumer demand influencing innovation in the food and agricultural industries. It will summarise the current markets of alternative proteins and outline the global and New Zealand agricultural context for agricultural production.

It will gain insight into how innovative farmers are making changes to their farm systems and where motivations have come from. It will briefly look at the shifts and activities required to make changes. Also, it will consider the adoption in practice and transformation risks.

## 2. Methodology

This research has used a combination of literature review and qualitative analysis such as analysing non-numerical data on the theories of adoption and interviews. This has allowed me to apply critical thinking, draw key themes, and identify areas of key importance.

The literature review was used to better understand the emerging proteins sector worldwide, what it means, how it is happening, and the current markets. It also investigated adoption behaviour to help support the objective of how to encourage New Zealand farmers into this sector, which then was used for the qualitative analysis.

The qualitative analysis included semi-structured interviews and discussion with key industry figures and farmers currently in this sector. The industry figures were used to help gain further understanding of the topic and to get their ideas on where the sector is heading and how New Zealand should be involved. There were four farmers interviewed: two quinoa growers and two hemp farmers. The farmers were from South Taranaki, Taihape, Balfour (Southland), and Cheltenham (Manawatu). These people were used as case studies to gain insight into how innovative and progressive farmers are already introducing alternative proteins and what that looked like at a farm level. As well as learning the farm details and physical attributes, there was some exploration into the motivations and drivers around getting into alternative proteins.

All interviews and discussions happened over the phone or via zoom. They ranged from half an hour to an hour and a half. The interviewees were all introduced to the project and an explanation of why it was being carried out. All were more than happy to contribute and generally wanted to help.

Limitations to the farm level information are there was only a sample of 4 farmers, and these were already on the path to progressing in this sector. It could be useful to look at the next level of adoption (early adopters/early majority) where more barriers to entering the sector may be found. The industry interviews were also very limited as the sample size was only three.

## 3. Literature Review

### 3.1 Defining Alternative proteins

'Alternative proteins' is a general term that covers plant-based and food-technology alternatives to animal protein.' (FAIRR, 2020)

"Alternative proteins, such as plant-based protein, cultured meats, and edible insects, provide a substantial amount of protein but require fewer natural resources to produce than the most common protein sources, meat and fish. These are composed of different sequences of amino acids than conventional meat." (Beef & Lamb NZ, 2018)

'There are broadly three main types of alternative proteins: plant-based alternatives to traditional products (e.g. vegan sausages), alternative proteins as an ingredient in more traditional products (e.g. cricket powder, etc.), and cultured meats (aka lab-grown meat).' (Boyd, 2018)

### 3.2 Factors influencing food proteins worldwide

#### 3.2.1 Population Growth

The world population is expected to increase in 2030 to 8.5 billion people and 9.7 billion people by 2050. (Beef & Lamb NZ, 2018).

New Zealand has reached over 5 million in March 2020, due to recent net migration caused by Covid- 19. Although, Stats NZ predicted New Zealand would reach 5 million in 2020 previously. Over 1 million people born overseas now live in New Zealand. This increase: "is also the fastest million in our history, taking 17 years after reaching 4 million in 2003." (Stats NZ, 2020)

#### 3.2.2 Feeding the future population

As the population soars to 9.7 billion, so will demand for food. The Food and Agricultural Organisation (FAO) estimates to support this growth, food production will need to increase by 70% to feed the world population in 2050. Similarly, meat production will need to increase by 50-73% to maintain per person demand. Henchion *et al* 2017 also reports that animal-derived protein will double by 2050. In the shorter term outlook OECD/FAO (2020), 2020 has also projected a 12% increase in meat by 2029. This being mainly in poultry and beef and developing countries in Africa and Asia. The global meat trade has also said to be nearly 12% higher, however, this has declined in growth annually from 3% to 0.6%. An increase in population comes with a rise in incomes, especially in developing countries. The positive correlation between income and demand for food comes into effect. Bennet's law (Charles & Godfray , 2011), an economic theory, describes this as being when people become wealthier, they switch from simple starchy food to eat more diverse diets including more meat and vegetables, but lower carbohydrates. Therefore, these estimates will undoubtedly put a strain on natural resources and pressure on the sustainability of social, cultural, and environmental values in society.

### 3.2.3 Environmental Concerns

The world is becoming increasingly aware and concerned about the environmental impacts activities and people are having on land, water, and the atmosphere. As a result, policies and regulations are being ramped up to align with environmental values. The Paris agreement is a global agreement example that has evolved through the pressure of environmental concerns in which 190 countries have now entered. In Beef and Lamb's report (Beef & Lamb NZ, 2018), they have concluded that we need to reduce environmental and climate impacts, as it is one of the issues adversely affecting red meat. There is much debate about the environmental footprint of plant vs animal. Though most would consider the plant to be much more favorable, there must be consideration of energy density and nutritional density to accurately measure the environmental impact. Professor Paolo Tessari stated that in a study conducted, he found that 'the production of protein containing animal foods would retain a (much) lower environmental impact than previously estimated. It would approximately lay in the range of most of the vegetal origin proteins due to the animal protein being of higher quality. However, in a New Zealand study, the general rule was that the climate impact of animal-based foods tend to be higher than plant-based food in particularly compared to beef and lamb (Drew, 2017). This is also in the White Paper by Oxford Martin School, 2019, that switching from beef alternative can lead to significant reductions in Green House Gas Emission (GHG), especially if transitioning to plants or insects.

However, regardless of the size of the impact of individual outputs, agriculture has huge power in determining the devastation or opportunity it can create on the land, water, and atmosphere. 70 % of the freshwater in the world is used in agriculture, therefore the responsibility is for the entire world to work towards creating an environmentally sustainable future. A study done by the Global Food Security programme in the U.K has estimated that there will be need more 120% more water, 42% more cropland, lose 14% more forest, and produce 77% more GHG emissions. (Global Food Security, 2017) Therefore, there are huge balancing factors that will have to occur to ensure that the environment and production can be met simultaneously.

### 3.2.4 Crisis Causing Change

There have been many crises that have caused a change in the food industry and the consumer's behaviour. These have been international, within countries and cultures, and due to varying priorities of consumer drivers.

The African swine flu (ASF) has caused huge disruption in China which has had a ripple effect on the world. The ASF wiped out half of China's pork herds, therefore domestic prices skyrocketed. China is the largest consumer of pork and importer so much it influences the price and availability worldwide. As a result, Brazil's export of pork to China soared an additional 40%, along with chicken and beef rising as well due to China needing to fill the protein gap (Brown T. , 2019). It has spin-off effects such as a decline in the feed for piggeries, which resulted in the decline of maize and soybean production in other countries.

The bird flu known as avian influenza has created similar issues. The restricting of international trade and tourism is felt which creates a downturn in services related to the bird industry and employment.

Foot and mouth disease, another major crisis, is disrupting livestock trade and farm disease status, as it is one of the most contagious transboundary animal diseases (OIE, 2020). It can

severely affect and indeed disrupt regional and international trade in animals and animal products.

Covid-19 has caused various disruptions at the beginning of 2020 and has created a faster and stronger movement towards healthy and safe food (Levitt, 2020). The pandemic is reshaping the global markets, trade, pricing, and stock availability. It has highlighted the importance and crucial need to gain food security. Meat has been particularly hit with disruptions to supply chains and processing facilities.

In the U.S, meat plants that are responsible for 10% of all beef production and 25% of the pork production closed as of April 2020, due to staff testing positive for Corona virus (Meticulous Research)

In New Zealand, the meat plants had to go down to 50% of staff capacity due to the need for social distancing to reduce the risk of corona virus spreading. Therefore the processing capacity was severely reduced. Also due to the lockdowns overseas, like in China where 40% of NZ exports go, meat plants were struggling to have products received or accepted in normal timeframes, which created a backlog of products. Therefore, processing had to adjust.

The Covid-19 pandemic has created a boost to the alternative protein industry. This is because the risks of the virus are much higher when there are underlying health conditions present, such as heart disease, diabetes, and hypertension. Consuming plant-based alternatives are more popular because of this and due to the perceived environmental benefits, it can have vs meat. There has been an increasing demand for alternative protein as a result. For example, Beyond Meats in May 2020 had a 141% increase in its revenue over the previous year. A new plant-based startup in China called Green Monday, claimed that its online sales had more than doubled in the last 2 months, due to covid-19. Not only have sales increased though, but capital investment being given to plant-based sectors is continuing. Impossible Foods announced in April 2020 to be expanding into 777 more grocery store throughout the U.S, as Americans were doing more cooking at home. Beyond Meats also plans to expand manufacturing capabilities into Asia in 2020 despite the disruption of global commerce caused by the Coronavirus. (Meticulous Research). Sunfed in New Zealand also attributed a bottleneck of demand for its Chicken free chicken from Covid-19 (Neo, 2020). In Spain, a study found that 3 out of 10 people had chosen to consume more plant-based alternatives than usual and wanted to maintain these habits outside of lockdown.

Joining or following the change in consumer behavior KFC and Starbucks in China introduced plant-based products after the lockdown. (Gerstenberg, 2020).

Therefore, there are going to be factors that are not always controllable and will change consumer demand based on experience or perspective. So development needs to be flexible and adaptable to the on going change.

### *3.2.5 4th Revolution/Bioeconomy*

Producing meat in the laboratory without the involvement of living animals is a huge technical feat made possible by the Fourth Industrial Revolution (Oxford Martin School, Oxford University for the World, 2019).

- The First Industrial Revolution used water and steam power to mechanize production. The Second used electricity to create mass production.
- The Third used electronics and information technology to automate production.
- Now a Fourth Industrial Revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century.

This Fourth Industrial Revolution is characterised by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres (Xu, David, & Kim, 2018). Velocity, scope, and systems impact differentiate it from the third revolution. The rate of speed is incredible, and growth is exponential rather than linear creating mass disruption throughout the world. Combining the capabilities of human and machine is what is producing the revolutions of this era such as artificial intelligence, genome editing, renewable energy, 3D printing, autonomous vehicles and the Internet of Things (Gulandam & Isreb, 2018).

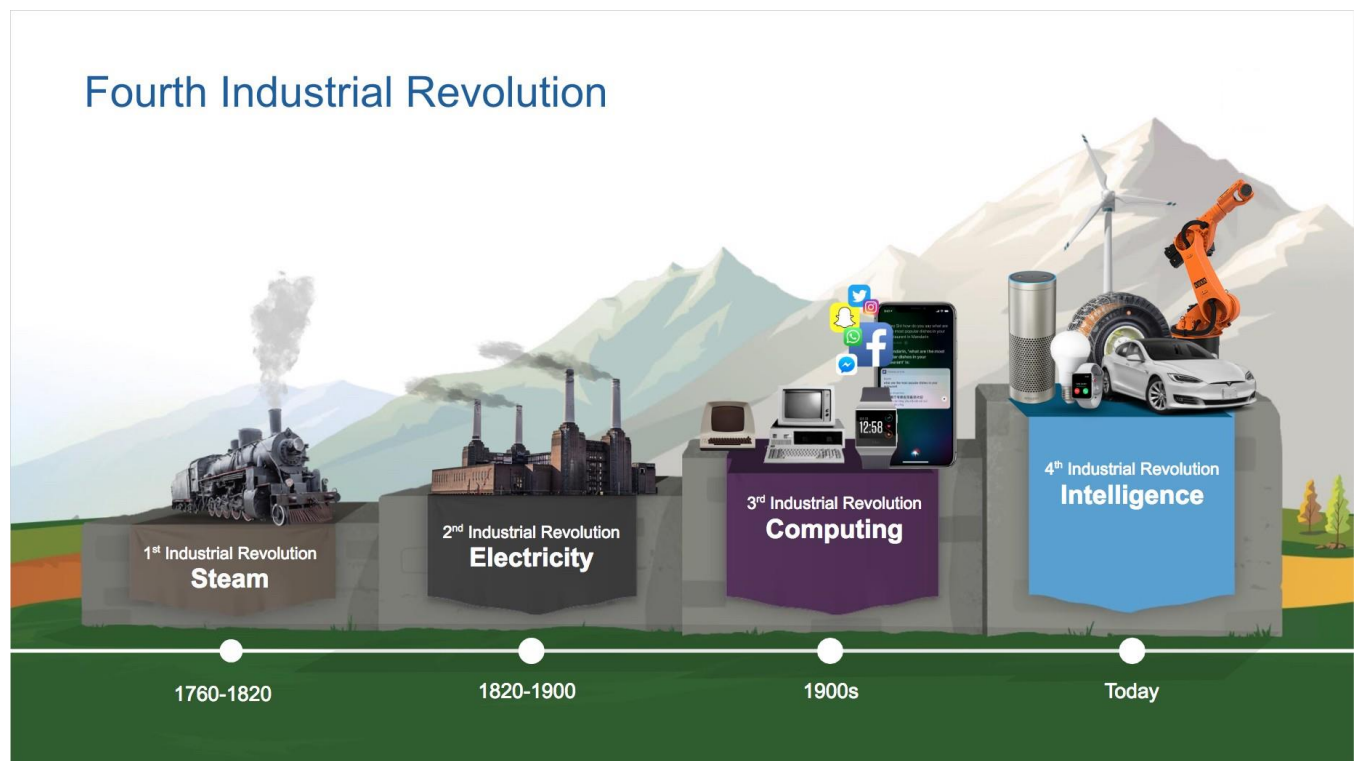


Figure 1: Sourced from : <https://images.app.goo.gl/8bwZvLsjAgokL8Fi7>

The breadth and depth of these changes signal the transformation of entire systems of production, management, and governance (Schwab, 2016). Whilst we have these transformations happening, we need to ensure that we are resourceful and sustainable. This also coincides with the need to protect our renewable resources and be smarter with outputs such as waste products or unwanted pollution. One way to help, is to look at New Zealand's bioeconomy.

The term “Bioeconomy” has various meanings but essentially is incorporating 3 elements; use of biomass (natural) sustainably, reduction in waste and pollution, and transitioning away from using biofuels to achieve economic and social growth and development. The definition that is followed in this context is from the Primary Sector Roadmap report (MPI, 2017) and is as follows:

*‘Set of economic activities relating to the invention, development, production, and use of biological products and processes (MPI, 2017)*

New Zealand is naturally a bioeconomy, as there is low fossil fuel use and more energy produced by renewable sources (80%) such as wind, geothermal, hydro and biomass (Wreford, Bayne, Edwards, & Renwick, 2019). However, we need to be innovative and sustainable to ensure we progress. In the report Wreford, Bayne, Edwards, & Renwick, 2019, it discusses the transformation to a bioeconomy. New Zealand's old bioeconomy has been based on primary production which has done extremely well for the country, however, now the need is to focus on the new bioeconomy which is more innovative and less reliant on fossil fuels.

The pressures on the social, cultural, and environmental aspects of primary production, particularly pastoral farming are under scrutiny and the environmental limits, freshwater issues, and threats to biodiversity are real.

10% of New Zealand's research spending targets is attributed to research in the environment space, which is the highest share in the OECD countries (OECD, 2017). This shows New Zealand is trying to take the lead in this space, however, speed and efficiency is of the essence with the growing population and need for food security. With the focus so much on the Primary sector, some smaller efficiencies maybe being missed, such as the fact that we have the highest ownership rate of cars and they are relatively inefficient and old (average is 14yrs old). In the report by the OECD for environmental performance in New Zealand, it highlights this. It also indicates we are still doing well compared to the other OECD countries, having almost 80% of the electricity generated from renewable sources, including hydro, geothermal, wind, and biomass. This does drop down to 40% when the overall energy balance is considered such as the energy for transport. Though it is still well above the average for OECD countries which are at 9%. See appendix for top 5 OECD countries, New Zealand being fourth. (OECD, 2017). The target for New Zealand is to generate 90% electricity from renewable sources by 2025, as part of reducing greenhouse gas (GHG) emissions.

The report published by MPI 'Primary Sector Science Roadmap' identifies the bioeconomy in New Zealand and the report has been completed to strengthen the bioeconomy. It has identified eight key science themes to enable an improved bioeconomy in New Zealand. These are adding value, harnessing the value and power of data, innovating with advance technology, with genetics, through Kaupapa Maori, protecting sustaining resources, deriving value from complex systems, and integrating people and values.

These key themes are related to the MPI strategic direction plan outcomes where the growth outcome has a key result area of increasing primary sector innovation by developing new and more high-value products and services. Also, to realise productivity improvements and innovation. The food safety section of the report has mentioned that the alternative proteins have the potential to impact significantly on export markets NZ has relied on.

Therefore, New Zealand cannot rely on the natural bioeconomy to continue to perform and

grow without accepting new challenges presented in the social, cultural and environmental. The government still also has the goal to double exports by 2025 and increase export value from 30% to 40% of real GDP. However, NZ needs to drive the value chain beyond commodity production to achieve this and encompass the new bioeconomy.

### 3.3 Behaviour Change and adoption

#### 3.3.1 *Adoption and Diffusion of Innovations Model*

To understand how farmers/industry respond to the consumer pressures of demand for alternative proteins can be reflected in the Adoptions of innovation by Rogers and Shoemaker (1971). The adoption curve has been around for many years and one of the most popular adoptions models. It has a board application to many disciplines where the model can be used as a theoretical framework.

Rogers defines diffusion as “the process in which an innovation is communicated through certain channels over time among the members of a social system”

Figure 1 illustrates the bell-shaped curve in which the population adopter distributions are theorised. The distributions can be divided into five key categories;

#### **Innovators, Early adopters, Early majority, Late Majority, Laggards**

The curve is not symmetrical and will not be as the research has found the laggards could be broken into two groups, however, in general, this group is homogeneous. Whereas, the innovators and early adopters could be combined, but have quite different characteristics. The 2.5% of innovators are willing to take a risk, have a higher socioeconomic status, and closest contact with science and interactions with other innovators. They are willing to take a risk that may fail and can also be gatekeepers bringing in innovation from outside the system. They may not be respected by other members of the social system because of their venturesomeness and close relationships with the outside of the social system. The 13.5% of early adopters have the greatest degree of leadership and are looked to by other adopters for advice. They generally have higher social-economic status, advanced education and are more socially forward than late adopters. Therefore, are key people in achieving positive behaviour change. The 34% early majority population adopt before the average time. They will take more time and investigation before adopting an idea and are unlikely to lead the idea but interact with their peers frequently. This part of the population begins to play an important part in the diffusion process. Therefore, they are deliberate and are more willing to follow in adopting innovations. (Journeaux, et al., 2018) 34% of the population are to the right of the mean and tend to be skeptical and cautious in their approach to new ideas. They are reluctant to adopt until someone else in their social system, does it first. They require strong pressure from peers to adopt and their adoption may be borne out of economic necessity as well as the pressure. The latter part of the adoption curve encompasses 16% of laggards. Laggards can have a traditional view and are skeptical about innovations more so than the late adopters. Generally, a localised group where their interpersonal networks consist of a population from the same category and usually do not hold leadership positions. The laggards will wait and decide after seeing the innovation before them and are suspicious not only of innovations but of innovators as well. (SAHIN, 2006).





Figure 2 Adoption curve as described by Rogers and Shoemaker (1971)

### 3.2.2 Factors influencing the rate of adoption

There is a range of factors that influence the rate of adoption with some being the characteristics of new ideas or change. The five factors have been summarised below (Rogers & Shoemaker, 1971; Giera et al, 2006; McManus & Powe, 2007):

1. **Relative Advantage**  
Rogers (2003) defined relative advantage as “the degree to which an innovation is perceived as being better than the idea it supersedes”. The type of adopters have a role here as the innovators, early adopters, and early majority and are more status motivated compared to the late majority and laggards. Therefore, costs and social status play into this. Generally, the greater the relative advantage, the faster the rate of adoption. In turn, the faster the adoption, the more appealing to others, hence faster diffusion.
2. **Compatibility**  
Rogers (2003) stated that “compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters”. So, compatibility will be affected by the values and characteristics of the social system. If these values and characteristics align with the innovation, then it will be more rapidly adopted. Past experiences can also affect the rate of adoption here.
3. **Complexity**  
Rogers (2003) defined complexity as “the degree to which an innovation is perceived as relatively difficult to understand and use”. Unlike the other factors affecting the rate of adoption, complexity negatively correlates with the rate of adoption. The more complex, the more likely people are to be slower to adopt.
4. **Trialability**  
According to Rogers (2003), “trialability is the degree to which an innovation may be experimented with on a limited basis”. The more the innovation is tried, the faster its adoption. It also may be changed or modified by the potential adopter. The early adopters see this as more important than the late adopters.



5. Observability

Rogers (2003) defined observability as "the degree to which the results of an innovation are visible to others". Role modeling and peer pressure is the key motivation for adopters and the diffusion of innovation. If results are readily observed, the innovation is more likely to be adopted.

As well as the characteristics of the people involved, Waters et al. (2009) found that the situational context influenced adoption as well. This work was focused on the Australian farming population to better target technology development extension and communication. He identified six groups of dairy farmers using the Derived Attitudinal Farmer Segments method. (Waters, Thomson, & Nettle, 2009).

1. The 'Family First' group was 5.5% of those in the study. They are driven by their families, are risk-averse, lower than average business orientation. Improvements and adoption of new practices are lower on average. Also, can be difficult to reach, being self-reliant for information.
2. The 'Winding Down' group make up 3.6% of the study. This group is difficult to motivate therefore have low motivation to sustain and improve their business. Due to being very risk-averse, they prefer others to try new things first and tend to have lower formal education.

The above two groups are similar to the laggards identified in the Rogers and Shoemaker (1971) study.

3. The 'Established and Stable' group (24.9%) are self-reliant, risk-averse, value tradition, not particularly concerned about an intergenerational transfer, under financial pressure and have relatively low levels of formal education. Consequently, they have below-average adoption levels and an aversion to sourcing information from others.

This group may be related to the late majority in the Rogers and Shoemaker study.

4. In contrast, a total of 17% of the population were in the 'Love Farming' group. They were generally not under financial pressure therefore very positive about the future and wanted to improve business. They would happily respond to research and development and tend to have higher levels of education. They gained their own information rather than from consultants or others and preferred practical advice.

The remainder of the population below all adopt new technologies and practices, but at different rates depending on their circumstances.

5. The 'Open to Change' group make up 21.5% of the population. These people can develop a sustainable and successful business and will take on calculated risk. They are non-traditionalists; therefore, inter-generational transfers are lower on priorities. They are not under financial pressure and are willing to accept new information and technologies. They tend to be younger and have formal education and enjoy running their business.

Compared to the Rogers and Shoemaker study, this group could be described as a combination of the innovators and early adopters.

6. The final group is 'Growing for the Kids' at 27.4%. These people are more traditionalists and run a sustainable business that can be moderately constrained financially. They will listen to information and will adopt practices that contribute to the lifestyle and/or intergenerational

success. Generally older than the average, therefore, will use consultants and advisors for advice. They could be aligned to the early majority in the Rogers and Shoemaker study.

(Journeaux, et al., 2018)

This research was Australian based, but the concepts are relatable to New Zealand agriculture and extension services.

The Red Meat Profit Partnership (Primary Growth Partnership Project) in New Zealand has a segmentation study of New Zealand sheep and beef farmers. The study was conducted by UMR Research. See Figure 3 for the segmental outcomes.

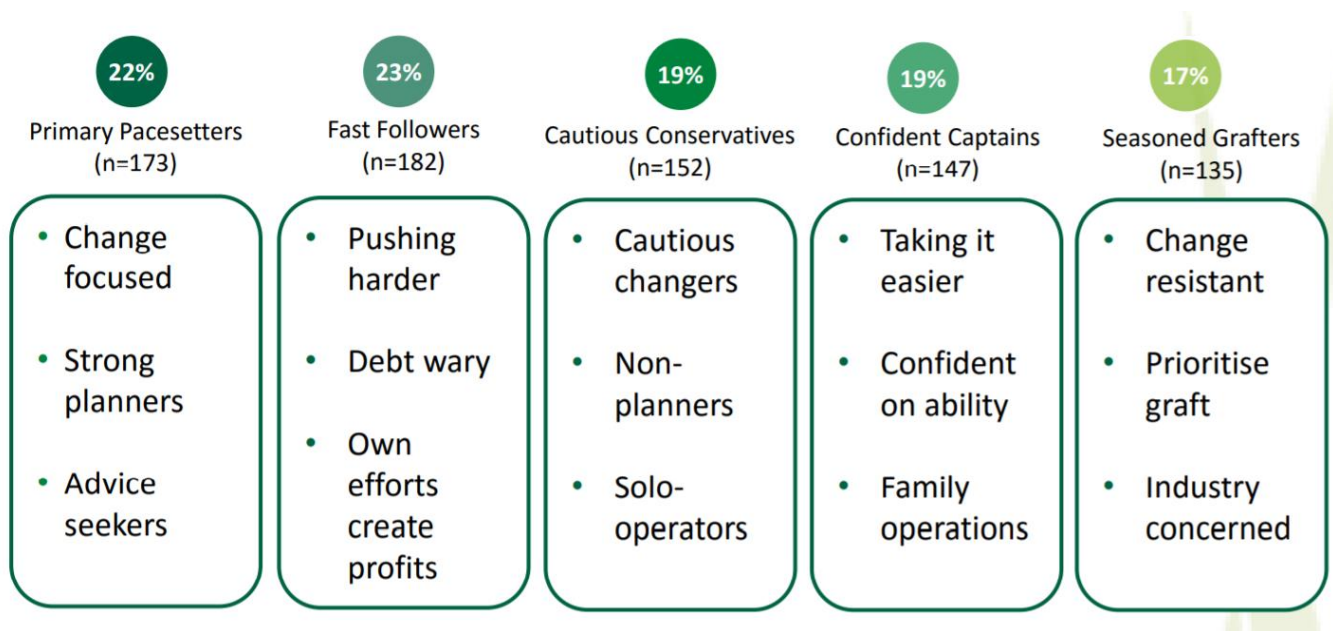


Figure 3: Overview of Segments found in the RMPP Sheep and Beef Farmer Segmentation Research developed through farmers defining features in their approach to change (UMR, 2015)

The 'Primary Pacesetters' is skewed towards younger farmers but there are also many older farmers who are pacesetters. These farmers learn from other farmers, spouses, and/or other families, and small group sessions led by farmers and technical experts. Fast followers are one of the younger segments. They generally have the drive and energy to keep the focus on their performance. They will take calculated risk where there is proven evidence. They are more debt wary than primary pacesetters but believe what they do on-farm will have the strongest impact on profits. Unlike the first two, the Cautious conservatives are less likely to engage with spouse and family and rather not attend off-farm events to learn. They are more likely to gain insight and knowledge from one on one sources like vets or other farmers. They usually do not have written plans, goals, or budgets, but manage to stay in farming and get through bad years. Confident Captains are all about the lifestyle and are generally confident in their ability to make new farming practices work with minimal support. They rely on their gut feelings to make decisions. They learn through other farmers, spouse and/or other family and veterinarians, however, are not going to push themselves hard. Finally, the Season Grafters generally are the older farmers, with more than half over 60yrs old. They are Career farmers, so

have been in it and develop their methods and see physical work as the most productive. They believe that profit is influenced greater by off farm forces, however, will not engage with innovation and the latest technology. They are unlikely to be monitoring performance. (UMR, 2015)

Although these studies had slightly different characteristics drawn, they had similar patterns and features. The UMR research showed that often farmers will use their closes relations when making change, but as the age increases and the length of time farming increases, the motivation to change decreases. Waters, Thomson, & Nettle, 2009 depends on the situational context but found also found that it was the younger farmers that were more willing to change, but contrary to UMR, long time farmers that used consultants and advisors (often had a long term view of the future) were also open to change. These open to change and Primary pace setters (UMR research) have a much higher percentage compared to Rogers and shoemaker but could be due to being an early study and reflect how the attitudes and behaviours around farming have changed.

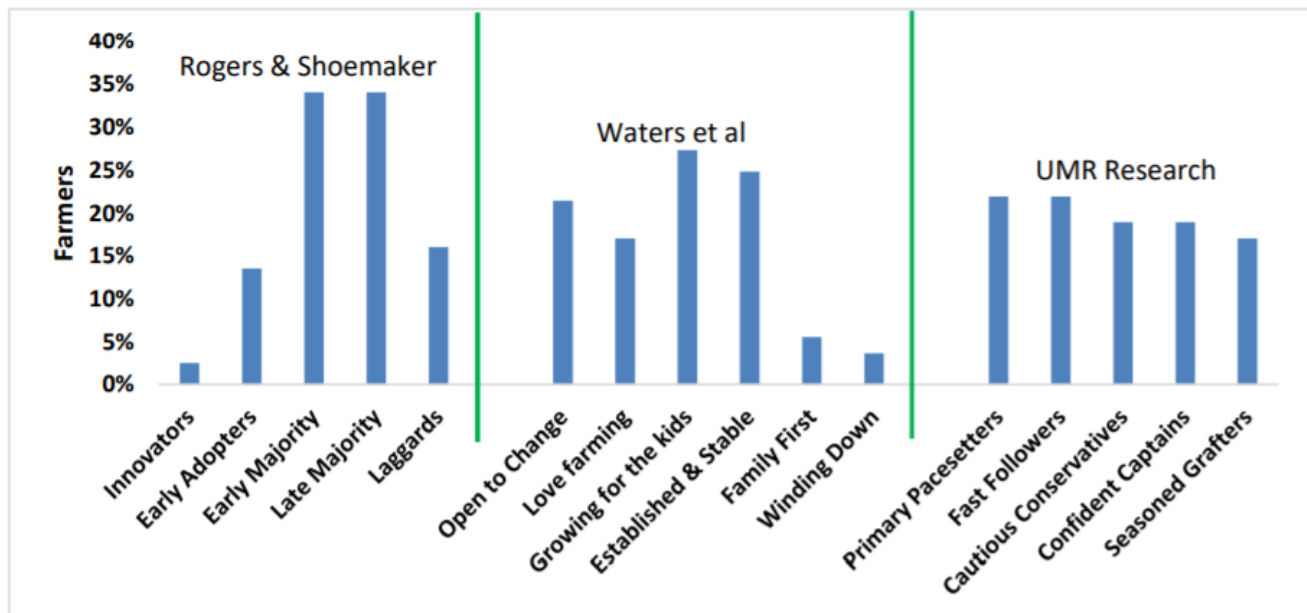


Figure 4: Different categories of adopters

The segmental analysis does not align farmers with a category that they will stay in but can be used for extension services where the diffusion of innovation can be targeted. In both the latter studies, it emphasises the dynamic and evolving behaviours that farmers can move through and adapt to depending on the situation or context of the change. This can be summarised with the following statement from Thomson, 2008 in Walters *et al.*, 2009.

**“Farmers are motivated by a diverse range of drivers and constrained (and enabled) by a range of social, cultural, economic, and physical factors. Farmers will therefore react in different ways to external drivers of change and will respond differently to encouragement, incentives, and legislation aimed at influencing their farming practice.”**

Consequently, it is perceived attributes of an innovation that determine its rate of adoption to a greater extent than the characteristics of the adopters.

### 3.4 The current market of alternative proteins

There are various forms of alternative proteins on the market, all being created or developed slightly differently. Below are currently the main categories:

#### 3.4.1 *Cultured/cell-based meat*

'Cell-based meat (often referred to as clean meat or cultured meat) is genuine animal meat that can replicate the sensory and nutritional profile of conventionally produced meat. It's comprised of the same cell types and arranged in the same three-dimensional structure as animal tissue. It isn't imitation or synthetic meat; it's actual meat that is grown from cells outside of an animal.' (Cameron & O'Neill, 2019)

Cell cultured meat is made by taking a small sample of cells from the animal desired and putting them in a nutrient-rich environment where they can 'cultivate' and form muscle and connective tissue. It is analogous to the yeast cell growing process for beer.

There are currently no companies in New Zealand in this category and the majority are in the United States (8 companies).

#### 3.4.2 *Insects, novel protein*

Traditional insect consumption has been in Asia, Africa, and South American, but there is now more movement in the Western world due to the potential as a protein source. The insects are high in protein and have high reproductive rates as well. Insects are efficient food converters as they can convert organic waste into high-quality proteins.

Although in the Western World insects are not being consumed whole, they are being processed into food and food ingredients like flours. The common insects used that have high protein are Cockroaches, Beetles, Flies, Beetles, Bees, Wasps, Ants, Termites, Caterpillars, Dragonflies, Grasshoppers, locusts, and Crickets. (Schlüter, 2015)

In New Zealand, there are currently 3 companies researching/producing insects. Prescient Nutrition grows larvae of the New Zealand black soldier fly intended to become a useful protein in animal feed.

Otago Locusts was New Zealand's first food-grade insect farm. It sells sustainably farmed locusts as food for human consumption. And lastly, Rebel bakehouse, which has a cricket farm that manages to produce enough crickets to supply the annual requirements for flour for the bakehouse. (van Dijck & Palfreyman, 2020)

#### 3.4.3 *Plant based or ingredient based*

There are two main forms of the plant-based alternative protein. There are plant-based ingredients mixed to form a product or there is the extraction of the protein molecules from plants that are used to form a new product. The beyond burger is an example of the first process and the impossible burger is made by the second process.

In New Zealand, Sunfed uses plant pea protein to create plant-based chicken and bacon. Another New Zealand company Olive and Ash has developed Vince, which is a vegetable-based mince using plant ingredients. New Zealand Bean Supreme also use vegetables to produce their plant-based options such as burger patties and sausages.

Fermentation is another form of ingredient based. It uses controlled microbial growth to convert carbohydrates and proteins into other molecules. These molecules include other carbohydrates, alcohol, fatty acids, and proteins, which can then be extracted and used as ingredients for other food products. The specific molecules produced are a result of complex interactions between the substrate (what the organisms are given to use as food), the microorganism (both the general category such as yeast but also the specific variant), and the environmental conditions used for the fermentation

There are some others as well like algae and bacterial proteins.

The aim of these proteins is generally the need for sustainability, to be cost-efficient, a reliable source, and good for consumer and animal health.

### 3.5 Global Context

Globally, the gross global productivity (GDP) from agricultural may seem small at 3%, however, it is remarkably significant socially, environmentally, and culturally. 40% of this GDP comes from livestock, which employs 1.3 billion people and provides livelihoods for 1 billion that are mostly concentrated in low-income countries (FAIRR, 2020).

The current supply of protein to the world is dominated by vegetal sources being 57% followed by meat at 18%, dairy 10%, fish/shellfish 6%, and others making up 9%. Livestock products provide one-third of humanity's protein intake.

There have been efforts since the 1960s to reduce the environmental impact of existing protein sources in terms of GHG, land, water, energy use, biodiversity, socially, and public health (Henchion, Hayes, Maria Mullen, Fenelon, & Tiwari, 2017). Agricultural uses 70% of the freshwater globally. It also contributes 9-14% of the GHG emissions globally based on inside the farm gates activities. Combined with the food system (which includes land use, storage, transport, packaging, processing, retail, and consumption), it is between 21-37%.

There is declining biodiversity globally as well, which has been affected by the presence of livestock which is through the impact on the main resources such as soil and microenvironments. Conservation International has identified 35 global hotspots for biodiversity and 23 of them are reported to be affected by livestock production. (Steinfeld, et al., 2016).

Therefore, plant-based protein is increasingly becoming seen as a desirable sustainable option. This has been advocated through the E.A.T lancet report as the 'planetary health diet'. Also, in 2016, China issued a national nutrition plan that stated the intake of animal protein per person must reduce by 50%. The Netherlands Nutrition Centre recommends targeting a 50:50 ratio of animal and plant protein (van Dijck & Palfreyman, 2020). Whilst Denmark, Sweden, and Germany considered a tax on red meat to fight climate change (Beef & Lamb NZ, 2018).

Every country is going to have different targets and recommendations, which reinforces the importance of the different social and cultural values around the world. This will lead to various approaches to introducing and developing alternative proteins. This is also why, as mentioned earlier, the Paris agreement has been set up which involves 190 countries committed to reducing and mitigating GHG.

### 3.6 New Zealand Context

New Zealand may be a small player on the international stage; however, the agriculture industry contributes significantly to New Zealand tradeable economy. The farming sector produces a wide range of horticultural, dairy and meat products which mostly go overseas but also consumed locally. Over 350,000 New Zealanders, or one in seven people, are employed in the sector which generates over \$46.4 billion in export revenue and accounts for 11% of New Zealand's GDP.

New Zealand is the world's largest exporter of dairy products and sheep meat, making dairy products and meat contribute almost 40% of the value of annual goods exported. In 2018, New Zealand had 27.4 million sheep, beef at 3.8 mil, dairy cattle at 6.4 mill, deer 801,000, goats 88,800, and pig 621,000. (Beef + Lamb New Zealand, 2020).

In the year 2018-19, New Zealand was the third-largest producer of wool in the world, producing 9.3% of world production. The main crops grown are Wheat at 41,400 ha, Barley 79,700ha and, Maize at 17,300ha. New Zealand's horticultural sector export value is about 2.86 billion, with kiwifruit being the leading fresh fruit export. The land used for kiwifruit is 15,000

hectares. The Agriculture, Forestry, and Fishing industry make up 13.5 billion dollars of our GDP and the agriculture industry provides around 86,700 jobs. (Granwal, 2020).

New Zealand's GHG profile is unique compared to the rest of the world but has similarities to Ireland. Globally, New Zealand only contributes 0.2% to worldwide emissions. The emissions from agriculture make up 48% of our total reported emissions. The methane emitted from ruminants makes up 71% of the emissions. This is unusual for the rest of the world as generally, their emissions are majority from energy and transport. The emissions have been stable from 2012, even though dairying has been replacing sheep which are high contributors to GHG. Compared to dairying overseas when producing one litre of milk, New Zealand on average only creates 40% of the emissions. It is similar for Beef and Lamb, so New Zealand tends to have lower emission per kg of product produced. However, even with these figures, New Zealand has committed to the Paris agreement to keep the increase in global temperature below 2°C. To do this, New Zealand has pledged to reduce emissions by 30% below 2005 levels by 2030. The Zero Carbon Act has now been legislated to develop the targets (Agfirst, 2019/20):

- Net emissions of carbon dioxide and nitrous oxide to reduce to zero by 2050
- Methane to reduce to 10% below 2017 levels by 2030, and 24-47% below 2017 levels by 2050.

The environmental concerns globally and in New Zealand are an increasing concern. They will influence the freedom to operate in all sectors, but particularly the agricultural industry. Looking at mitigations and solutions to help lower the environmental footprint of New Zealand products is an opportunity for New Zealand to lead in this space. Considering the place of alternative proteins in the Agri-industry in New Zealand could be one of the many opportunities to grow whilst maintaining environmental standards and increasing social and cultural acceptance. Meanwhile, delivering products to meet evolving consumer demand.

### 3.7 Consumer Context

Consumers have significant influences over the direction of the food and the agricultural system. Not only through their direct vocal concerns, but through the power of purchasing. They can express their preferences and values which help shape decisions producers and retailers make. Consumers are demanding more from their products. It no longer only matters what the product is but what it contains, where it was made and came from, how it was made. Also whether it is tasty, aesthetically pleasing, and at the right price and more so now, how they buy it. These attributes are then influenced by the person's geography, cultural norms, government policy, and socio-economic factors. (Global Agricultural Productivity, 2018).

#### 3.7.1 Demographic and Income

As previously described, the global population is growing, therefore there are rising global incomes as well enabling consumers to buy high-value foods, as described in Benetton's law. Rising incomes create greater socio-economic development, so as a result there are more shopping venues for consumers and supermarkets where there may not have been before.



This is happening in sub-Saharan Africa, where there have been supermarkets built in places where consumers usually shop at small local stores. However, now supermarkets have lower prices and larger selection. The rise in incomes and expanding the middle class has shown in China as well with the exponential growth of poultry, pork, and dairy. (Global Agricultural Productivity, 2018). The growth is predicted to be more substantial in developing markets like India and Africa and will gain more and more economic and political power and influence along with a new generation of millennials.

### 3.7.2 Millennial Generation

"Millennial's social values, holistic wellness goals, prioritization of experience over product, new eating patterns, and their sheer size are driving change." (Beef & Lamb NZ, 2018)

Millennials account for 27% of the global population and are living in the world's largest countries with 58% living in Asia. In volume, the millennials outweigh the U.S baby boomers (77mil), Gen X (61mil), and millennials (92mil). Also they are a third of the population of China (400mil). The Chinese millennials also have the highest spending share, therefore have significant influence.

The millennials have a more holistic view and health to them is the commitment to eating right and exercising. Experiences are very important to millennials, so they put a value on new experiences over possessions. For example, they are more likely to shun the pub in favour of a healthier option. They are also more likely to look for higher protein products for benefits of muscle gain, aiding sports, and a generally healthy lifestyle. However, the average population in the U.K (28% of the population) do not see meat-free foods as an important source of protein compared to meat (87% of the population). (Mintel Group Ltd, 2019)

Sustainability is also a high priority for millennials, and it will determine what they buy. (McCracken, 2018). In fact, 51% of millennials in the Nielsen Global Survey of Corporate Social Responsibility and Sustainability, 2015, highlighted sustainability as a reason to pay more.

### 3.7.3 Purchasing Power of working women

It is now common to have the 'chief purchasing officer' in a house to be a woman. In the U.S, 90% of women are the primary shoppers in their households. They are responsible for 85% of all consumer spending in the U.S (Global Agricultural Productivity, 2018).

Also many women now are the breadwinners in households, with 40% in the U.S and 52% in Australia (Roy Morgan, 2017).

Not only are women having greater financial power though, it also leads to greater power in decision making when it comes to purchasing which can be more so based on their preferences. Women are also more likely to reduce/limit intake of meat, 42% compared to 36% of men. The red meat/poultry remains a great part of British diets, with 91% of men consuming these products whereas women's consumption is 86%. (Mintel Group Ltd, 2019). Women are more likely to adopt the flexitarian eating style, whereas men are more prone to identifying as carnivores.

Women initially were more on board with plant-based proteins compared to men, but now they are catching up quickly and are just as likely to try a plant-based burger when eating out. However, men are still more likely to see meat as the best source of protein and have superior nutritional value. This could be why women are more open to beans and grains as well as compared to men. (Mintel Group Ltd, 2020)



### 3.7.4 Diet and Health

There are many reasons for looking at adopting a plant-based diet and aside from a big concern for the environment, health, and wellbeing top the list. Part of the health perspective is it is starting to get more support from the medical industry (Beef & Lamb NZ, 2018). There is increasing evidence being brought forward about the risks of consuming red meat, with the healthcare industry promoting less meat through nutritional guidelines. The British medical journal has stated that people who ate the most red meat were 26% more likely to die of nine diseases than those who consumed the least. The Journal of General internal medicine has stated that plant protein may help you live longer while the American College of Cardiology and Mayo Clinic has also said plant-based diets are better for heart health.

As well as the professionals promoting the plant-based diet, there is a documentary called 'Eating You Alive' that claims you could reverse chronic health problems such as heart disease, diabetes, and obesity by eating plant-based foods. Also, Texas firefighters 28-day save-your-life plan that lowers cholesterol and burns away the pounds is a plant-based diet. (Beef & Lamb NZ, 2018).

According to the E.A.T lancet summary report, transformation to healthy diets by 2050 will require substantial shifts. This involves *'doubling in the consumption of healthy foods such as fruits, vegetables, legumes and nuts, and a greater than 50% reduction in global consumption of less healthy foods such as added sugars and red meat (i.e. primarily by reducing excessive consumption in wealthier countries)'*.

Therefore, the change in diets and health cannot be ignored, but used as an opportunity to present solutions.

## 4. Findings and Discussions

### 4.1 Consumer Driven Diet Change

Listening, Inspiring, and Co-creating are the values that Deloitte has found are key to closing the consumer gap (Deloitte). The traditional path to the consumer has evolved and is always changing, so businesses need to keep up but have been generally been slow to react. The outlook on the world has been changing and has been accelerated by the change caused by environmental concerns, population growth, crisis, and the fourth revolution. People are constantly adapting to these changes and alternating the way they live to overcome challenges or create a new normality. Food is a way of life, therefore becomes central and is not void from evolution. The issue or challenge though is to keep up with this constant change and demand to ensure the consumer gap is not widening.

Plant-based diets have risen into the spotlight due to the perceived health benefits and seen as a better ideological fit in terms of sustainability and lower consumption of resources. Plant base food was named a top trend in 2016. Vegetarian, vegan and related categories are estimated to be 10% of the global population. However, the growth of meat is still expected to increase by 12 % by 2029. This is mainly caused by developing nations such as Africa and Asia with increases in poultry and beef meat. Although this is still great growth, it is slowed considerably from 3% average annually to 0.6%. (OECD/FAO (2020), 2020). This shows that change in consumer preferences is happening and producers need to listen and adapt.

The flexitarian movement is having one of the greatest impacts where consumers are limiting or reducing their meat intake. In America, 7.3 million people are vegetarian, with 22.8 million being flexitarian. (Beef & Lamb NZ, 2018). In the Mintel Group Ltd, 2019 findings, the established trend is now driving the growth of meat-free markets. In 2018 in the U.K, 25% of adults agreed eating less meat is better for the environment and in 2019, this rose to 34%. People reducing or limiting their meat intake in the U.K went from 28% to 39% between 2017 and 2019. This has created an increase in meat-free options. Although, the UK population remains meat-eaters, with 88% of the population eating red meat and poultry. The Chinese consumers are focused on nutrition and more than 82% of the population are willing to pay more for foods that they know are higher quality, nourishing, and lacking undesirable ingredients. This is much higher than the global average of 68%. ( Global Agricultural Productivity, 2018). The Chinese are unique, as veganism hasn't caught on yet. Therefore it is still desirable to be a high vegetable and high meat-eaters, as they see meat as a quality source of protein. 67% of Chinese consumers agree they cannot get enough protein from just a plant-based diet and 80% agree that meat is essential for a balanced diet. Therefore, the Chinese are much more skeptical of the quality of the plant-based product ingredient, processes, and additives. They are very concerned about the transparency of the product which aligns with the article written by Olayanju, 2019 from Forbes. It said consumers are looking for brands that are transparent but also share their values. The consumers are influencing the food labeling, food products, and marketing claims. China's imports of beef are responsible for 69% of all the beef growth over the last 26 years. Therefore, have a huge influence on the markets. The Chinese adoption of western cuts has lead to increased premium exports. This is also similar in the Middle East's but is a newer market. Egypt doubled its import of beef between 2013-14 while Saudi Arabia increased its imports from 2% to 7% between 2010-2015. (Beef & Lamb NZ, 2018).

So while there is still definitely a market for meat and has been on a continuous upward trajectory driven by population and income increases. There are factors now that are having a greater effect although, are not homogenous among the global population. As indicated above, there are differences in consumer's individual purchase patterns, but also between nations and cultures. Whilst in developing countries meat demand will continue to increase as income grows, the developed countries show a decline in the influence of income and price on the meat demand. This is evident in a population like Japan, a high-income country where there are increases in food expenditure per individual and there is a trend going from preparing fresh food to purchasing convenient food and eating out. The Japanese government expects this trend to continue especially among the older and single-person households. (OECD/FAO (2020), 2020). The top 5 countries expected increase/decrease in per capita of consumption by different meat types can be seen in Figure 5, in the appendix. This shows that there is mostly a balance of increase and decrease across the beef and pork, but with a reasonably steady consumption of sheep meat. There is a clear increase in poultry compared to a decrease. However, this is limited to 10 countries for each meat type.

So to remain competitive and align with consumers, we need to listen to consumers demand and develop/create products that match that demand. Meanwhile, having the ability to remain adaptable to change.

## 4.2 Current NZ Alternative protein Farm systems

### 4.2.1 Case Studies -Quinoa

The UN named 2013, the international year of Quinoa. *Chenopodium quinoa* (keen-wah) is known as the mother grain of the Incas. Quinoa has a higher protein content than the cereals and has high lysine content in contrast. Quinoa comes from the *Chenopodium* family which also includes sugar beet, beetroot, and spinach. It grows in a variety of situations and is a low input/maintenance crop. It also is relatively disease-free, especially compared to cereals. It can have a compound called Saponins which are soap-like compounds that the Incas used for washing. Although this compound can act as a natural insect repellent, it can cause gut issues and is not desirable. It was bred out in the 90's, however not all seed is Saponin free, but the Saponin seed can be sourced. (Guy). Currently, 90% of the Quinoa grown in the world is in South America.



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#### Case Study 1

##### Farm details:

Summer dry/Semi finishing country, Altitude 500-800m, Cold winters, Snowfall possible, 750mls rainfall, volcanic ash soil, 600ha, 500ha effective, 100ha lease, 50ha flat, 100ha rolling, 12 ha native bush, 20ha pine trees, 3600 Composite breeding ewes, 1150 replacement hogget's (breeding), 6000 lambs docked (70% prime, rest store), 140 breeding cows, 10-20ha Kale, 20ha lucerne

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Case study 1 is an intergenerational family farm that first trialed Quinoa in 2014. The farm is predominately sheep and beef breeding/finishing farm. The couple driving the operation had a farming and non-farming background. Both completed university and ended up in a position in the Agri industry or related before coming back to the farm. They have been on the farm since 2015. Key drivers for incorporating Quinoa into their farming system was sparked when traveling and was a healthy plant alternative that has huge growth potential. It was allowing an opportunity to take it from paddock to plate or the consumer themselves. Quinoa was the first crop grown on-farm for human consumption.

### *Case Study 2*

#### **Farm Details:**

Summer safe/semi finishing country, 390ha, 360ha effective, 20 ha lease, Hill country with 80ha of flats, 12 SU/ha, 1200 ewes, Breeding Angus cows, dairy grazers, bull finishing, 20ha crops, brassicas for winter, quinoa 10-20ha.

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Case Study 2 is also an intergenerational family farm as well that planted their first paddock of Quinoa in 2015. This farm is predominately hill country so is mainly sheep and beef with dairy grazers. 80% of the lambs are finished. The Quinoa journey started with discussions around the future of the farming operation and the desire to be farming sustainably whilst providing nutritious, natural food. Like case study one, Quinoa was the first crop grown for human consumption on the farm.

#### *4.2.2 Case studies- Hemp*

Hemp is one of the oldest domesticated crops known to humankind. There is archaeological evidence that humans were using hemp as long as 8,000 years BC. Hemp plants consist of three main parts; seed, stalk, and leaf, all of which have a wide range of uses. Hemp seeds are known for their nutritional properties and mildly nutty flavour, with the crop often cold-pressed to produce a nourishing oil for health or cosmetic purposes. The plant can also be harvested for both seed production and fiber. Often confused with Marijuana, as they are both from the cannabis species. However, hemp contains negligible amounts of psychoactive properties (THC) and you will not get high. Some studies show Hemp can sequester carbon faster than trees while enriching the soil as they grow. To grow, trade-in, or process industrial hemp as an agricultural crop an individual, body corporate, or partnership needs to be licensed under the Misuse of Drugs (Industrial Hemp) Regulations 2006.



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### *Case Study 3*

#### **Farm Details:**

Semi-summer safe, Great grain district, Free draining soils, 250m altitude, 785mls rainfall, 320ha total, 295ha effective, 170ha arable, 25 ha tulips, 5 ha lilies, 35ha brassicas, 16ha pine trees, lucerne, 200 ewes, 100 hogget's grazing, 100 dairy grazer, sells store lambs.

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Case study 3 has been farmed 3 generations now and is a mix of arable (Wheat/Barley/Canola/Sunflowers/hemp) and sheep and beef. The couple took over the farm in 2008, 14yrs ago. They were previously in non-farming activities. The farm has long daylight hours in summer and usually reliable rainfall. In 2018, the discussion was had to venture into Hemp farming because they loved the idea of growing a crop that was widely beneficial for people's health. It also meant they could control the process and have access to the consumer. Growing crops already meant a slight advantage. However, the licensing process to be granted permission to grow Hemp had to be done before they could proceed further with the idea, which is much different from the other crops grown.

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### *Case study 4*

#### Farm Details:

Flat, crop land, 1200 dairy grazers, 250 cattle fattening, lambs, crop; wheat, Barley, maize, peas, seed grass and oats.

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Case study number 4, another family farm that has a fluid farming system. The couple have a strong farming background with one growing into farming and the other growing up on a lifestyle block and teaching. They have very good cropping land, allowing the flexibility and opportunity to grow various crops and utilize animals in winter for grazing in between crops. They were approached by the Hemp Farm to grow and having been open to new ideas, started growing Hemp in 2017. Growing a new crop was not too daunting to this couple, however, there are still challenges around new ideas such as infrastructure and machinery. They could see the benefits though and were encouraged by the sustainable and environmentally positive crop. Also, like Case study 3, the licensing to grow Hemp was one of the initial challenges.



Throughout all the case studies, there were common themes that stood out clearly. It has highlighted the key motivation and/or drivers, the barriers, challenges, and changes and/or benefits that have been gained.

A distinct attribute of people from all the case studies was that they wanted to be an early adopter. But more so, they wanted to have control of their produce from the paddock to the consumers' plate. Having the ability to pick and choose the opportunities themselves and learn the processes that occur beyond the farm gate such as packaging or storage of the product were important. The study found that knowledge was key for empowerment and kept the people-driven. The more understanding they had with the crops, the greater the ambition. Having the ability to diversify was especially evident in the quinoa scenarios, as one was able to produce a human food product for the first time. Also, both have taken on the whole production system enabling control and the journey to the consumer. Having this ability come across very powerful and satisfying for the farmers:

*“enjoyment & satisfaction of the feedback we get from people and how it is helping them...it leaves the financial side for dead; it really does.”*

Entering alternative protein crops has not always been a financial decision. The opportunity to provide healthy and sustainable food that gives farmers access to the consumer came across as just important or more. However, looking at the gross margins and understanding the price and costs involved is still seen as crucial. Fitting into the farm system was incredibly important as well because it mitigates some of the challenges or changes that need to occur and in some, the crops were described as complementary and symbiotic. Therefore, in the early stages of choosing a crop, this was a top consideration.

In every study, the research before growing the crop was huge. Some engaged a business consultant; some went overseas to engaged experts and some had contact with local associations for the crop. The common and most used research was the internet which was used to source information, but also to find contacts and networks over skype, phone, and emails. The future of farming was thought about and the market trends were front of mind when researching and selecting a crop. Therefore, they were making informed decisions.

‘WANTED TO  
BE AN EARLY  
ADOPTER’

‘OPPORUNITY  
FOR  
PADDOCK TO  
PLATE  
CONTROL’

‘WANTED TO  
DIVERSIFY  
BUSINESS TO  
REDUCE RISK’

‘DON’T WANT  
SOMEONE  
ELSE  
CLICKING THE  
TICKET’

For the Hemp growers, the licensing created a long process (months of waiting for acceptance) before a seed could go in the ground. This is because the government has greater control of growing Hemp due to its relation to marijuana and being in the cannabis family. This meant, not everybody would persist and a comment from an interviewee was "If it were easy, everybody would be doing it. "

There is a lot of uncertainty and risk involved with a new idea or product and one interviewee said " not everything read is right until it's tried." Even those that take the path have doubts and may not have done it, had they known the long hours or costs involved. Many barriers can present during the process of a startup. Some of the challenges or barriers common in these studies were the hidden/unknown costs (e.g. Freight being so high), lack of expertise, technical aspects of the crops( such as weed control with being spray-free and avoiding contamination of allergens such as gluten), limited resources and lack of knowledge around the available resources. Also time or lack of, for getting funding grants and not enough time spent on governance and planning. By-products for the Hemp now is an issue as well until new infrastructure is built in Canterbury to process the fiber. Developing a startup is daunting because you do not know what you don't know, and one interview described " it is a minefield until you get your head around everything." The early adopters are the people that face these challenges or barriers, which get less as the development advances. A huge tool in developing a startup though is knowing the market, which was clear for these farmers as the depth of research carried out involved getting to know the markets and the opportunities that were present. One interviewee said:

*"farm systems will follow value and value will follow markets."*

It was evident that the drive and demand of quinoa and Hemp was a trigger that created change in these studied farm systems. The hemp industry in New Zealand is now already becoming 'normalised quite quickly....as it is becoming a serious and viable crop'. A factor that is helping this is the environmental benefits with low input (like quinoa) and a positive carbon footprint. For one of the case studies, this was a huge driver for decisions made towards the farm system. Due to the recent restrictions and consenting that is going to be occurring with winter grazing, a interviewee said "it is easy to get out of the heifers than to risk being dragged through the courts for pugging." Having the opportunity to be able to adapt and develop an alternative crop, has enabled the thoughts to change around the farming system for a better, sustainable, and more secure future. The environment changes that are occurring 'will drive people thoughts

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UNTIL YOU GET  
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AROUND

and practices', indicted by the above change and said by an interviewee.

The people involved in these studies showcased the personalities and values of the 2.5% of the population that are innovators. A few of the comments and statements made during the interviews reflect this.

'Have to be prepared to change.'

'Trail Blazers.'

'Fumbled our way through it, at the start, it was headache after headache, hurdle after hurdle, but they were overcome and now we're in deep.'

'Learn by doing and along the way.'

'We would find a way, somehow.'

'Prepare to fail but build up resilience along the way.'

These are the leaders of these industries and paving ways for others to follow. The learnings are great with one saying 'we had huge growth in a range of skills and knowledge' and 'what we thought we thought our abilities were and what we thought we would be resilient to and what we are now – quite different.'

Even though these are case studies are two different alternative crops in New Zealand agriculture, the underlying principles of starting/developing an idea into a product can be learnings for the future. They have proven that it is not necessarily easy but coming from cropping/farming and non-cropping/non-farming backgrounds, farmers can adapt and change where there is desire. Skills can be learned, and knowledge gained. Greater expertise and support could speed the progress up. The absolute key to come out of the case studies though is that the market for the new product needs to be sought first and that is when the potential opportunity becomes reality and can grow. Therefore, with the right research focus in New Zealand in the alternative protein space, we can tap into the potential markets. Where the crop fits the New Zealand Agri-system/s, is sustainable financially and environmentally and we have the right people involved supporting the innovators and early adopters we can ensure success.

### *4.2.3 Industry Input/Views*

Being on the other side of the farming fence gives people a different perspective and views on the agricultural industry in New Zealand. To gain insight into some of these perspectives and views, there were 3 interviews had. These people gave insights from their position as a research profile, business developer role, and a farmer/business developer & owner.

A strong theme resonating with all 3 interviewees was the need for a plan for the future of food production in New Zealand. There is a need for 'a protein strategy', 'defining what the future



might look like', and a 'New Zealand brand'. New Zealand has relied on the image of a clean and green country, but the confidence in that was low. One of the previous farmers had mentioned that 'farmers rely on the industry organisations to tell our story and that does not always work that well or not always very effective.' The importance of having a food provenance story that can capture the rest of the world to want a New Zealand product and have demand greater than supply is a goal that most industries are striving towards. Therefore, there are common goals that always beg the question of greater collaboration. 'Pulling the parts of the value chain together to have these conversations' is hugely necessary but needs a nudge to make it happen. We need to 'create an environment that accelerates that collaboration'. A possible tool mentioned to encourage this was, to get the government to invest in these sectors, so they can pave the way for private investors that will see less risk and an opening. To do this the government collaboration with farmers needs to be greater to help stimulate activity. For example, in the Netherlands, there is a coalition with farmers and the government to give greater support around the crop of Fava Beans. With greater collaboration with the government, there will be a better understanding of the two, therefore the story can be strengthened.

The collaboration is needed among the farmers as well though, as 'more trust between farmers' could be gained. There are leading farming corporations in New Zealand that are looking into alternatives and testing them, therefore there is an opportunity to create greater trust from farming cooperates into the neighbours or family farms. As one of the farmers said it '100% should be a collaborative effort, to come together and have power in numbers.' The issue is that innovators and early adopters hold their cards close to their chest because the value can be in the innovative or early adopters' stages. However, the extent to which they can reach may not always be as great. Therefore, we need to encourage or open the chance at that point to collaborate and use the 'New Zealand Brand' and competencies of New Zealanders to make a bigger stake in the markets.

Both the farmers and the industry figures agreed that 'consumers are more concerned about food safety and quality.' Also, we need to become more 'consumer-centric'. Contrasting this is 'people don't want to change.' Although farmers may be seen to be like this, there have been many changes over the years which farmers have adapted through. However, for New Zealand to maintain a viable export market, the products need to align with the consumer demand, as identified in one of the case studies. 'Farm systems will follow value and value will follow markets' was a comment from a farmer interviewee. New Zealand has strong ties in the commodity markets which has held up for many years. However, the thoughts are that we have commoditised our 'proteins' (meat and dairy). Therefore, they are alongside all the other proteins where consumers have now got endless options (meat, dairy, plants, insects, etc.) as to how they fill their protein requirements. Another common theme was 'that commodities are still huge opportunities, but we must be smarter about how we go about doing it.' The developing world still requires high volumes of meat and dairy as the protein is favoured for nutrition, but the developed world can have greater choice. Going forward, using the idea of protein in a diet and/or nutrition context is seen to be where value can be added or attained. Also, whether it be an ingredient-based market or whole food market, the key is to find 'what does the world or consumer need that we can do better than the rest of the world.'

Another similarity between the industry figures was to have the ability to reward the producers. Ensure that they are supported and recognised.

Whether being a farmer or in an industry role, there are many ideas, thoughts, and perspectives that can be utilised in collaboration to enable a better outcome.

### 4.3 Collaboration

‘the situation of two or more people working together  
to create or achieve the same thing’  
-Cambridge dictionary

Technology and knowledge have enabled greater collaboration across the globe as well as over the neighbour's fence in New Zealand.

The Innovation scan report has identified the first step in the collaboration process being information gathering and knowledge curation so that potential collaborators have a basic understanding of the level and type of activity in their area of interest (Palfreyman & van Dijck, 2020). The MPI strategic intentions report 2018-2023 has also stated to support primary sector businesses to innovation, a fund has been made, and is specifically seeking applications that prioritise product value over volume and those that support collaboration and greater information sharing. Therefore, it is clear the need for collaboration. However, to implement collaboration, can be challenging.

When collaborating, people working together must be open to sharing, otherwise, progress will be slow, and the process may not be successful. The Ministry for the Environment, 2012 had 5 enabling principles for the success of collaboration ( Ministry for the Environment, 2012).

1. Inclusive
2. Transparent
3. Deliberative
4. Accountable
5. Adaptive

To summarised these, all forms of knowledge should be represented with all stakeholders having equal access to the information with regards to the process or collective. The process should involve discussion and questioning without coercion or domination, so everyone is heard and treated equally. The collective should be held accountable for actions taken or outcomes whether indirectly or direct. Having the ability to develop new rules and ignore old ones by having the capacity to analyse and learn from information is also key.

Many collaborations are happening in New Zealand that is enabling greater success and increased ability for small and medium-sized enterprises. For example, the Kiwi quinoa company is developing an integrated supply chain in New Zealand with the support of the Dutch agricultural expertise through its commercial partnership with The Quinoa Company(TQC). From this collaboration, Kwi quinoa is a sublicense partner and has developed New Zealand's first local quinoa production chain using TQC varieties. Another

New Zealand successful collaboration is with Massey University and John Cockburn, owner of Breadcraft and the Rebel bakehouse brand. With the expertise of Massey University and a local cricket expert, they set up a pilot farm. Starting with a handful of crickets they created a sustainable business where the crickets feed on surplus bread from production. The cricket supply is enough to supply flour for the Rebel Bakehouse annual requirements. John is also now looking at scaling up to provide cricket flour to consumers as an ingredient.

A larger collaboration has occurred called Protein2Food which has 19 partners and is aiming to develop high-quality food protein through optimised, sustainable production, and processing methods. These collaborations show the potential that can occur when people that have similar goals, can achieve much greater than they would by themselves.

The ability to collaborate in the plant protein space is huge in New Zealand as we have the research capabilities and opportunity to develop our own 'trade secrets' through process and protocols, which will enable greater prospect into the plant protein production.

### 4.4 Shifts and Activities required

The food industry is rapidly evolving. Olayanju, 2019 wrote in Forbes that transparency, plant-based food, health, and wellness are the top consumer demands. Therefore, the food industry needs to react and develop products and services to satisfy these needs. To develop these, shifts and activities are required to enable change. Below are just some of the changes that will need to occur to help the New Zealand Agri industry embrace the opportunity in the alternative protein space.

#### *Plant based proteins a threat*

Many people in the agri industry currently see plant-based protein products as a threat to the meat and even dairy sectors. As found earlier in the report, there is still going to be an increase in meat demand and plant-based proteins is a diversification of the protein diet rather than a total replacement. However, there is a need to ensure that New Zealand can inject greater value through the meat and dairy industry to remain competitive by retaining and growing the story of health and wellness, sustainability and transparency in the market.

#### *Alternative proteins are not real food or not as good as the real thing*

Following the view that alternative proteins are a threat that can also create negative perceptions against plant-based products. They may not always stack up against the nutrition or satisfaction of meat products, but the transformation of the plant-based industry is rapid and aided by the fourth revolution. Therefore, whether the alternative proteins are 'fake' or 'unappetizing', there will be improvements and advancements that ensure these factors can adapt to consumer demands. So, it cannot be used as an 'excuse' to ignore the consumer trends that are happening.

#### *Livestock is more than just-food*

The solution to environmental degradation and sustainability is not to remove farming livestock. They have built livelihoods and are part of the food chain that will contribute to feeding the population of 9.7 billion in 2050. The livestock's role may alter or change, however, considerations of jobs and businesses will need to be assessed to ensure we are not comprising the sustainability of business solely for the sustainability of the environment. As stated in the Paris Agreement, article 2:

*'Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, **in a manner that does not threaten food production**'*

(United Nations, 2015)

#### *Feedstock industry*

Relating to livestock farming is the business that exists to grow food for the animals. If stock numbers are lower, then the feed industry will have to adapt and change to mitigate the lower demand. These businesses will have to find alternatives such as growing feed for human consumption rather than for stock. Therefore, will need support to enable this transformation.

#### *Niche products to mainstream*

With fast-evolving global food production, products can more easily become mainstream. This is a risk of the plant-based proteins, as they will and already are part of the protein story. Therefore, when developing and investing in these products, continuous improvement and value add development will need to occur and be encouraged.

#### *Regulation*

There is risk in every industry, but it can be reduced with appropriate rules and regulations. Therefore, good regulation is necessary to protect the public from health risks and unsubstantiated claims. It is also important to assist innovation and value creation, however, needs to be developed from a neutral viewpoint.

#### *Research and development*

As with many new and growing sectors, science can lag. However, it is crucial to maintain a level of R & D to ensure that the innovation and creation are meeting the goals and attaining the attributes they set out to. For example, the cell grown meat has been calculated to have high energy requirements that create high greenhouse gas emissions that were initially not much lower than beef production based on the lifecycle assessment approach. Therefore, when technology or development is in its infancy stage, there is a high risk of lack of knowledge and proven science. Therefore, a cautious approach can be valuable.

## 4.5 Adoption

Roger's adoption curve illustrates the movement of adoption and the general trend across the population. The advice that comes from the curve is that time is best spent on the innovators and early adopters. Support them to create the change and develop an enabling environment for change. The early majority will then bring along or influence the fence-sitters, hence the need to give the early adopters the most attention, as they will be the ones setting the scene for others to follow. The main learning is to not focus on the laggards or spend energy on this group, as it is likely wasted and non-productive.

Although the curve is a general population trend, it does not mean people will stay on the same part of the curve their whole life or career. It is not based on personality traits; therefore, it is dependent on the situational context or change that is occurring as to how an individual

feels about it, as to where they fall on the adoption curve. For example, an individual that does not believe in global warming is likely to be a laggard in changes that will benefit the Greenhouse gases, however, if the change is one that will increase profit and production as well as reducing the greenhouses gases, the individual may fall into the early adopters. People that are skeptical of innovation may be individuals against change, however, it is not always the case, and can be that they are just against that change or idea being proposed. They can still be highly innovative individuals.

Therefore, in the case of alternative proteins, one may become an early adopter of insects as a source of protein but may be a slow adopter in the cell-based meat as a protein. This can be due to various reasons like seeing the insects as a more natural alternative compared to the cell-based protein. Consequently, the alternative protein sector would need to recognise that not all progressive and innovative people will be early adopters, but they are more likely to be if the outcome agrees with their beliefs. So, the focus should still be put on the early adopters.

### 4.6 Transformation Risks

Transformation can be defined as 'a marked change, as in appearance or character, usually for the better.' A significant transformation of the protein system is essential to meet the sustainable development goals and the Paris agreement. However, with transformation, there are risks. So, these transformations must be built with synergy and develop the agility to enable the outcomes to be flexible but beneficial or 'better'. Also, ownership and accountability of process and transformation are essential to progress.

## 5. Recommendations

Recommendations/Actions required that have been drawn out of this report are as follows:

- Keep monitoring to increase awareness of markets and consumer change
- Maintain and grow our reputation/ story of being food producers of high value and highly nutritious ingredients or wholefoods.
- Leverage our competencies of current successful sectors especially as meat and dairy innovators
- Seek expertise where knowledge or skills are low and empower people to become experts
- Encourage and develop coalitions with the government to provide incentives and/or support in areas where New Zealand can deliver the world's best produce.
- Reward and Support leaders paving the way for the nation and their peers
- Develop a New Zealand plant-based food strategy
- Create and develop a greater understanding and technical expertise in plant-based opportunities to enable greater diffusion of adoption to farmers.

## 6. Conclusion

The trend towards plant-based protein is clear and consumer's demands are paving the way for innovators to develop and meet market demands. There are various forms of alternative proteins, as well as various definitions. However, the movement from traditional sources of protein such as meat and dairy are increasingly becoming just options. Consumers in the developed world have an array of choices of consuming their protein requirements, whereas the developing world is still reliant on the traditional forms due to access, culture, production, and price.

The consumer demand is very dynamic with extremes like veganism, but the global trend is towards health and nutritious food that is more environmentally sustainable. Different cultures and countries have varied approaches and motives, but change is occurring. Factors such as increasing population, global crisis such as the bird flu, swine flu and/or Corona virus, environmental concerns, and the fourth revolution are accelerating this change. Change is required to meet sustainable development goals in the Paris agreement. This is keeping the increase in global average temperature to well below 2°C above pre-industrial levels, with an aim to limit the increase to 1.5°C (UNFCCC, 2015).

Only a certain proportion of the population will develop and implement innovation or change. This generation of people will be the risk-takers that will drive the progression to meet consumer demand. This will also be driven by their personalities, values, and motivations. The current market for alternative proteins is growing and adapting constantly to satisfy consumers. Technology is playing a huge role in enabling development of food production systems and food technology.

There are significant opportunities for New Zealand to take advantage of the trend towards plant-based foods and 'flexitarian' lifestyles. An environment where the alternative proteins

can thrive and co-exist or complement the commodity-based system in New Zealand should be developed. Also, deliberate actions should be taken to ensure New Zealand moves from being a commodity-based system to a system where products/produce can become high value, quality, and consumer demanded. It is realistic to see the traditional proteins and alternative proteins co-exist as the demand for food cannot be met by one or the other. They will have the opportunity to complement from farm systems to dinner plates.

To enable changes or shift to be made to enable the population of people in 2050 to be fed quality and nutritious food, adoption will have to occur, and transformation encouraged. The power in these will be determined by the extent and quality of collaboration and empowerment through the industry and people.

## 7. Further work

Further work should be done by interviewing a greater range of farmers and industry figures to gain ideas, thoughts, and perspectives to enable strategy to be developed or initiated. Greater focus on the New Zealand opportunities to grow the plant-based sector would be useful for farmers to gain guidance for their farm systems.

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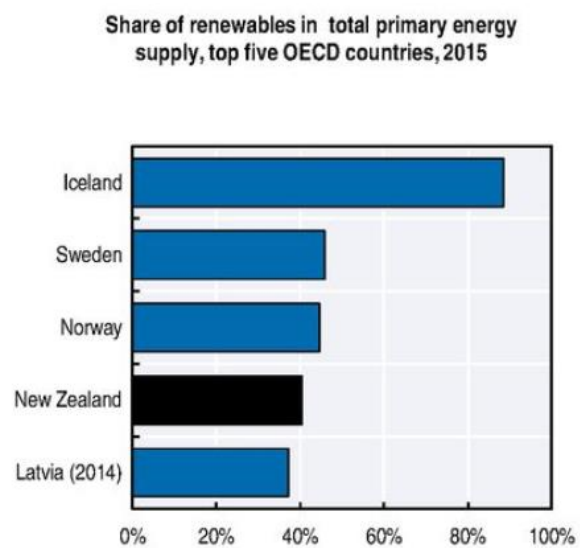
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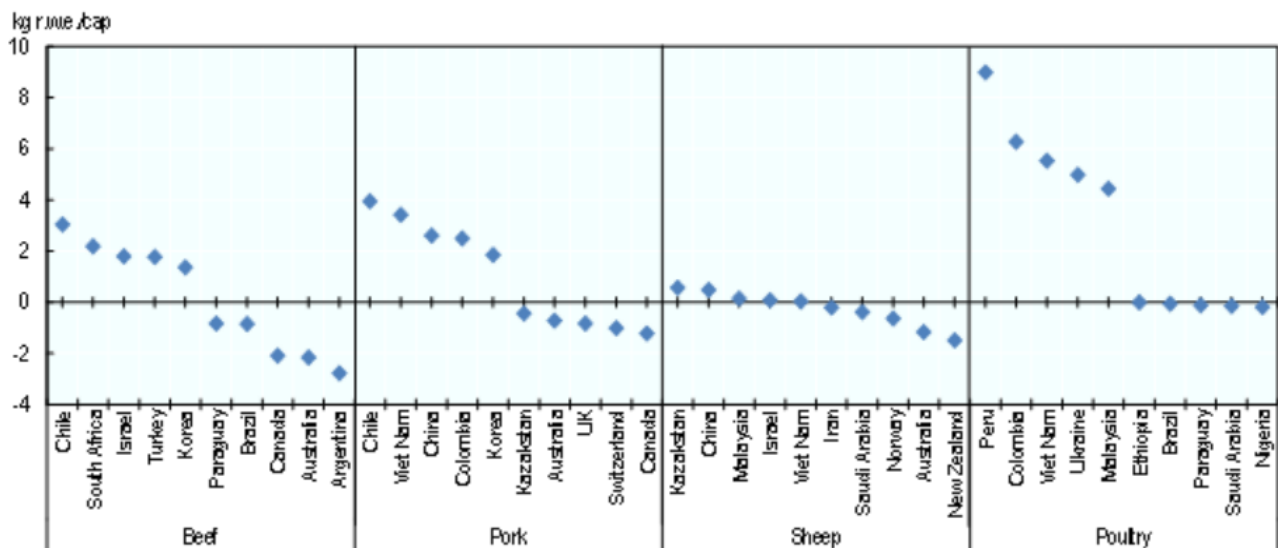
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## Appendix



**Figure 6.5. Top 5 countries increase/decrease in per capita consumption by different meat types**

2029 vs. average 2017-19



Source: OECD/FAO (2020), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database),

<http://dx.doi.org/10.1787/agr-outl-data-en>.

StatLink  <https://doi.org/10.1787/888934142539>

**Figure 5: Top 5 countries increase/decrease in per capita consumption by different meat types**

### Base Interview Questions used

1. What got you into farming?
2. How did you get on/end up on the farm you are on now?
3. What does your current farm system include?
  1. Land slope/soil type/area (ha)
  2. Animal classes and numbers?
  3. Crop types and areas
4. What are your goals for this system?
  1. Finishing/trading/cash crop etc
5. What are some of your personal goals that relate to the farming business? (e.g. lifestyle)
6. What has motivated you to develop this farming system?
7. What made you investigate/progress with an alternative crop/protein?

1. What were your goals for this crop at the beginning?
2. Did you have a structured plan for the crop?
8. What were the steps you took to get the first crop in the ground?
  1. Who helped/supported you?
  2. Where did you source information/knowledge from?
  3. What did you find difficult or challenging?
  4. How did you overcome these?
9. What do you think is holding others back from trying alternative protein rich crops?
10. If you could start over, what would you change?
11. What practical changes need to be made to gain more interest in alternative proteins?
  1. Farm systems?
  2. People's behaviour?
12. What benefits are you getting from having hemp?
13. Should more people be trying hemp?
14. Where do you see the alternative protein space growing from, family businesses?
15. How is the marketing, selling and admin side of the hemp being managed?
  1. Is there further opportunity to be had?
16. What crops do you think you will be growing in 10 years' time?
17. What farming system do you think you will have?
  1. Will there be more animals' vs crop?
  2. Trees?