Dairy industry strategy refresh 2017

The current and potential future local and global operating environment for New Zealand dairy

dairy tomorrow

The future of New Zealand dairying.

Desktop review and environment scan since adoption of the Strategy for Sustainable Dairy Farming 2013-2020: Making Dairy Work for Everyone

Executive Summary

Recovery from the Global Financial Crisis, which was the backdrop to the 2013 Strategy, has been slow but the economic outlook seems more stable, if modest. The New Zealand economy has been relatively resilient throughout this period with strong commodity returns – particularly in dairy - propping up economic performance during the recession. Buoyant commodity prices were short-lived however as the dairy industry faced one of its worst price crises in 2014/15 and 2015/16. It may take several seasons for the industry to fully recover.

Considerable uncertainty exists in the global arena. The perception of economic risk has lessened, while environmental and social issues carry more weight in the future global outlook. The new US administration and Brexit alongside rising protectionist and nationalist movements around the world have created significant concerns for the future political and trade environment.

The global food industry is picked for a revolution not only because of fundamental shifts in technology, supply chains and consumer behaviours but also because it will need to change to meet the need to nutritiously feed a growing population within the planet's environmental constraints. Trends in the global food industry outlook include: high public scrutiny and food trust issues; more complex and integrated food supply chains; shifting centres and preferences in global demand; consumers driven by health, ethical, social and environmental concerns with access to technology to seek and disseminate information; a focus on compliance and additional voluntary standards; environmental challenges; and a technological and information revolution that could affect how food is produced, sold, marketed and communicated about.

The dairy industry globally is generally considered well-placed in the long term to take advantage of these trends but considerable challenges exist for it. Foremost is the recovery of producers and processors from the 2015 dairy crisis. Volatility in prices and shifting supply and demand forces will continue. Long term demographic changes that will grow the middle class in the developing world are seen as a positive indicator of future demand growth for dairy. The world market will be increasingly competitive as new dairy exporting entrants emerge and dairy faces increased competition from substitute products. Producers in all countries will face the challenge to produce within higher environmental and regulatory settings. New Zealand's competitive advantage may be eroded by support policies adopted by other countries and loss of trade preferences in FTAs. However further opportunities of positioning pasture-based dairy products as natural, safe and nutritious need to be explored.

Within New Zealand significant challenges exist for the dairy industry in the environment and natural resources sphere. Water issues are the most pressing with significant public concern over the role of dairy in the deterioration of water quality. Animal welfare remains an area of significant reputational risk for New Zealand, although the regulatory regime and policy settings have been strengthened. New Zealand dairy companies are increasingly focused on food defence, with product integrity and food safety scares having recently tested our systems and institutions. Biosecurity is a risk for New Zealand farms and the industry is likely to shoulder a greater burden of cost for readiness and response in future. Indications are also for greater industry funding in other areas such as Research, Science and Technology. Policy settings towards climate change may pose a risk for the industry, while private action on carbon foot-printing is becoming part of business practice internationally.

Productivity, competitiveness and efficiency challenges exist for the industry and the dairy downturn has put a focus on ensuring industry resilience to price volatility in future. Technology adoption may improve productivity potential, particularly within environmental and regulatory constraints. There has never been a stronger mandate for improving dairy productivity and efficiency. There is latent potential in wider adoption of existing tools, while investment may be required to discover new breakthrough technologies, including those which unlock sustainable industry growth.

1.0

Introduction

1.1 PURPOSE

This desktop review provides an overview of issues and trends for the current and future operating environment for the New Zealand dairy industry. Based on the most recent information, policies and statistics, this scan captures issues relating to sustainable dairy farming in New Zealand, from the farm to the marketplace. To support the refresh of the Strategy for Sustainable Dairy Farming 2013-2020, Making Dairy Farming Work for Everyone (the "Strategy"), the review considers the questions "what has changed since 2013?" and "what issues are relevant going forward?"

1.2 SCOPE

Because the Strategy context and background supplement provided a comprehensive overview of dynamics and issues facing New Zealand dairy farming competitiveness and responsibility, the focus of this document has been on developments since 2013. The analysis is current to mid-May 2017.

This document forms part of the 'context' element of the refresh process. It is one of a number of documents and should in particular be read alongside "The story so far" which describes the implementation of the Strategy. This review attempts to highlight key issues, risks and possible scenarios for the future and, where supported by the literature, indicates how New Zealand dairying might be placed to respond. It does not answer questions of how the industry should respond.

1.3 METHOD

As a starting point, the desktop review sought primarily to update the context provided in the Strategy to reflect the current environment. The environment scan involved a review of a wide range of secondary sources from New Zealand and overseas to identify the key issues affecting the New Zealand dairy industry in recent years. The Refresh Working Group provided a preliminary list of resources and documents and these were expanded through further internet research. Social media and media reporting has provided insight into current sentiment and feeling. Some information has been sourced from internal DairyNZ documents. A separate reference list and inventory of resources reviewed has been collated.

1.4 STRUCTURE

Section 2 updates the global and local context for the New Zealand dairy industry with information current to May 2017, testing what has changed since the Strategy was developed in 2012/13. It also provides an overview of possible future trends for both the global food and dairy industries. Section 3 profiles the dairy industry in New Zealand at present, and Section 4 describes significant current and emerging issues for New Zealand dairy with indications of where these might lead in future. The final section provides an overall analysis of key political, economic, social and technological issues.

2.0

The economic,food and dairy trade outlook

The setting of the focus and objectives of the Strategy drew strongly on the economic and social context of the time it was developed (2012/13). The Strategy situates itself in a post global financial crisis (GFC) international economic climate. It references global priorities and trends in the international dairy market. This section revisits those contexts, updating key indicators and provides a forward-looking view on trends for the food and dairy industries.

2.1 THE GLOBAL AND NEW ZEALAND ECONOMIC SITUATION

The **global economy** has moved on in an important way since the Strategy was developed: economies have shifted from managing the immediate aftermath of the GFC to implementing macroeconomic and fiscal policy settings to promote economic growth. Despite accommodative policy settings, recovery in the global economy following the GFC has been much slower than anticipated, especially compared to that following previous economic downturns. Global growth in 2016 reached a post-crisis low of 2.3%[1] and the outlook remains subdued. Overall growth for OECD countries is expected to average around 2.1% through to 2025[2].

There is heterogeneity in the performance of major trading partners. Counter-balancing a soft economic outlook in Japan and the European Union (EU), the United States (US) growth predictions of 2.4% (to 2025) is more positive. Asian economies are experiencing stronger growth than the rest of the world. China's growth rate has been relatively robust (GDP growth at 6.7-6.8% in 2016, with predictions to average 6.2% to 2025) albeit with questions about whether this will be sustained. India is anticipated to grow at 7.6% in the next 10 years[3].

Although global interest rates are starting to rise, largely on the back of US Federal Reserve tightening its monetary policy stance, interest rates in the EU and Japan are proving slower to normalise. The future cost of capital will be uncertain as the pace of growth in major economies and inflationary pressures are unpredictable.

The **New Zealand economy** slowed but fared better, in relative terms, than others through the GFC. This was largely due to high dairy returns smoothing the impact on the rest of the economy. Following the crisis New Zealand enjoyed over five years of low but steady growth at a macro level, with growth captured in all regions of New Zealand[4]. Performance across the economy offset the impact at a macroeconomic level of the dairy price downturn in the 2014-15 season, which was estimated to mean a $5.5 billion reduction in total dairy farmer revenues (equivalent of 2.3% of nominal GDP) .[5] The labour market has been relatively buoyant with strong employment growth (at 3%)[6]. Wage growth is anticipated to continue.[7]

The Budget Policy Statement 2017 outlines a reasonably positive economic outlook for New Zealand[8] including predictions for stronger performance than that expected in other developed economies such as the EU, US, Australia, UK, Japan and Canada. Treasury forecasts are increasingly optimistic: anticipating real GDP growth to average 3% over five years.

The New Zealand exchange rate has long been considered over-valued and has declined from its highs against the US dollar in 2012/2013. The normalisation of the global economy will likely depreciate the New Zealand dollar further with stabilization expected to occur at around 68.5c against the US dollar[9]. A lower exchange rate and recovery of (demand from) export markets may benefit New Zealand's export sector, although commodity pricing will continue to play a significant role in determining export returns to New Zealand.

In New Zealand interest rates have been at a record low but are expected to lift. This is long anticipated and has been delayed by lower than expected economic performance and low inflationary pressures. Normalisation of interest rates overseas and at home will impact the borrowing ability of New Zealanders.

There is **increasing unpredictability** in the global geopolitical, security and economic environment. In 2016, electoral outcomes produced some fundamental shifts in international economic and political systems, driven in part by growing inequality in developed countries. The long-term implications of the new US Administration and of Brexit on the global economy are an unknown. Negative global market reactions to electoral outcomes experienced in 2016 have been short lived but reflect nervousness within the international financial system. This comes against the backdrop of a more complex international security environment.

There is growing unease over the future state of the international trade environment; caused in large part by the rise of protectionist sentiment in the US and Europe. It is important to note that global measures taken to stimulate economic growth have not extended to removing barriers to trade; indeed the OECD notes a rise in non-tariff measures. The US's signaled retreat from plurilateral trade initiatives and desire to renegotiate better bilateral frameworks may present bilateral opportunities and risks. The future trading relationships of the UK and EU may take some time to become clear. In both cases, there may be a period of uncertainty and transition while new trading arrangements are negotiated and implemented.

For several years the multilateral trade system has been trying to re-establish momentum, given the slow rate of progress in the WTO Doha Development Agenda round of negotiations. The Nairobi Ministerial Declaration in 2015 generates some hope, having secured a commitment to end agricultural export subsidies. Short term prospects for fairer global rules governing the trade in agricultural commodities however remain bleak.

Debate over the 2018 Farm Bill is likely to draw out the US position on key agricultural policy issues, while the EU has begun work on what its Common Agricultural Policy will look like post-2020. Large developing importing countries (China, India, Indonesia) have also been pursuing agricultural support policies for self-sufficiency and import protection reasons[10].

Implications for New Zealand's trade and economic agenda are uncertain. The New Zealand Government's Business Growth Agenda (BGA), which was refreshed in 2015, has recommitted to the high-level goal to increase the ratio of exports to GDP from 30% to 40% by 2025 with a focus on adding value to volume, encouraging high value companies and future proofing New Zealand's trade strategy. For its part, the Ministry for Primary Industries (MPI) has adopted a goal to double the value of primary industry exports in real terms between 2012 and 2025 (i.e. from $32 billion[11] in June 2012 to over $64 billion by 2025) as part of Our Strategy 2030[12].

However, progress on these goals has been slow[13]. Lack of surety in the international trade system is a concern for a small open export-oriented economy like New Zealand and the existence of new risks to the economic and trade agenda has been acknowledged[14].

The New Zealand Ministry of Foreign Affairs and Trade has released a new trade strategy, looking out to 2030[15]. It reaffirms that New Zealand will continue to seek beneficial bilateral and plurilateral agreements e.g. UK post-Brexit, the EU-NZ Free Trade Agreement (FTA), China-FTA upgrade, Regional Comprehensive Economic Partnership, and the Trans-Pacific Partnership. As a significant proportion of New Zealand dairy exports face tariffs[16], such trade liberalisation will continue to be of direct benefit to the industry. Complementing these efforts, Trade Agenda 2030 strongly foreshadows and invests in removing Non-Tariff Barriers to trade.

2.2 THE FUTURE OF GLOBAL FOOD SUPPLY AND CONSUMPTION

The global food industry is changing and may look very different in 15-20 years' time given shifts in how food is both made and consumed. Indeed some commentators have called for an **overhaul or revolution in the food industry**. For example, a World Economic Forum (WEF) report concludes that "today's food systems require a fundamental transformation to meet human needs within planetary boundaries in 2030"[17].

Foremost, **world population growth** will have significant implications for food demand and supply[18]. Some earlier estimates suggest that to feed a population of 9.1b in 2050, world food production would need to increase 70% over 2005/07 levels[19]. Population and demographic change will **shift centres and preferences of global consumer demand**. The shift of global power to emerging markets and their growing middle classes is well underway[20]. Their changing diets and increased wealth means rising demand for protein (meat, dairy). Growing income disparities however mean the global food system will need to deal simultaneously with "the triple burden of malnutrition" (undernourishment, micronutrient deficiencies and over-nutrition)[21].

World population growth will be concentrated in urban centres. **Urbanisation and the rise of mega-cities** will influence patterns of agriculture production and food supply and distribution. Implications include the growing role of retailers, increased reliance on imported food, changing dietary needs associated with urban lifestyles (e.g. ageing and less mobile populations, desire for more convenience foods). There may be growing tension between urban and rural needs: agricultural land will be lost to urban sprawl and urban communities less connected to production, exacerbating political divides[22].

Food waste is a growing concern. It is estimated that a third of food produced for human consumption is lost or wasted through production inefficiencies in developing countries and during consumption in developed countries. Focus on the ethics of food waste and resultant lost nutrition is likely to rise with greater awareness of the scale of the issue and its environmental cost (e.g. contribution to water use and climate change)[23].

Within mature markets, including established middle classes in the Asia-Pacific, **traditional consumption patterns around food are changing** in different ways. Consumers are no longer driven solely by traditional drivers (taste, price, and convenience) but are placing greater weight on factors such as health and wellness, safety, social impact, experience and (above all) transparency[24]. Consumers are looking for foods meeting **multiple health objectives or characteristics**. A 2015 Datamonitor Consumer report predicts that diets focusing on a single element of nutritional content such as carbohydrates or sugar have peaked and will be scarce within five years[25]. Clean labels ("no preservatives"/"no additives") and natural products are increasingly being sought[26]. Demand for **naturally functional foods** is expected to rise, particularly where they have added health benefits (e.g. digestive aids)[27]. The functional foods industry is also looking at its role in the personalisation or **customisation of food** to an individual's health needs ('nutrigenomics'), for example to respond to metabolic disorders such as diabetes or osteoporosis[28]. The trend for product specific characteristics extends to **demand for products meeting specific production standards**, for example organic production or halal slaughter. Consumers are predicted to pay more for products meeting their changing expectations[29]. How quickly these patterns will evolve in emerging markets is unknown and will depend on the pace of development.

Several notable future food trends focus on this **increased public scrutiny over food[30]**. Confidence in producers, processors, retailers and regulators has been damaged through successive food safety, integrity and fraud crises[31]. Sustainability and ethics in food production and processing are also concerns for consumer 'food trust'.

Growing attention is being paid by consumers and governments alike to the **interactions between food production and human health**. This has been seen recently in the concern around the build-up of antimicrobial resistance in humans and debate over the role that agricultural practices play in exacerbating the problem is an example. Regulatory and voluntary responses, including globally coordinated efforts, have resulted, and the OIE and World Health Organisation have partnered in the "One Health" initiative to take an integrated focus.

Social media platforms are providing consumers tools to gather and spread information and concerns over food. The speed and democratisation of information creates new challenges for food companies in terms of messaging and public relations[32]. As such, **crisis response and reputation management** have become essential capabilities for food business across the entire supply chain, necessitating a culture of transparency. The ability to provide high trust in their products (e.g. through traceability) and to respond to food safety or integrity incidences are a potential competitive advantage and essential risk management tool for food business.

The ability to provide trust in the food business effectively however is more challenging in a world of **increasingly complex global food supply chains.** Food is moving across borders more than ever as competition for market share drives a search for competitive inputs and higher returns. Product composition will likely become even more multi-layered. Globalised food supply chains bring increased risk and lack of oversight and make product assurance, security and traceability more difficult, with a vulnerability to increased food fraud and tampering. This makes **food defence** (protecting products from intentional adulteration) an even greater risk for food companies.[33] Blockchain technology is signalled as an approach to supply chain management that can help track and provide assurance on the flow of goods through the system.

The shift to **more integrated supply** chains may mitigate against risks associated with more complex food supply and processing arrangements. This may be motivated not only by desire to have greater control over all elements of the food production and supply chain, but also to capture value throughout it. For countries facing potential production deficits, investment throughout the food chain (including by state actors) may be viewed as a means to ensure supply given potential **food scarcity challenges** in a growing world.

Regulation may expand as governments seek to ensure appropriate oversight of food safety and public health concerns and to act on issues of public interest. Food scandals have prompted a higher regulatory and compliance focus in several countries. In the US, the Food and Drug Administration has expanded powers and can hold all involved in the supply chain responsible. China is introducing tighter registration regulations on imported infant milk formula as well as tightening regulation for domestic production. International and domestic regulation will be used as a tool to achieve environmental outcomes.

Recognising the need to respond to customer and **consumer concerns**, the food industry is moving in the direction of compliance plus, implementing voluntary third-party verification processes, labelling and auditing processes. There is a perceived competitive advantage in doing so (noting however that as regulatory regimes differ, compliance plus in one country may be a minimum standard in another). Mandatory and voluntary compliance schemes are likely to require all participants in the value chain to provide more timely and more accurate information across a broad range of variables (such as animal welfare, use of chemicals on farm, information about labour standards, environmental practices).

Global food production will increasingly run up against **environmental and resource challenges**, such as climate change/greenhouse gases, water withdrawal and land degradation. Concern to mitigate global warming will likely see countries taking international and domestic commitments to reduce emissions (with possible implications for agricultural business), while the impact of climate change on the supply of water and soil and land condition will require adaptation in food production systems.

There is heightened awareness of the environmental impact of food production and public demand for more urgent action is already driving **voluntary efforts by the private and non-government sector** on sustainability issues (see the next section for discussion on how this issue is evolving in the international dairy industry). In January 2017, 25 leading global companies announced a new alliance to work to accelerate transformational change in global food systems through 'FReSH' (the Food Reform for Sustainability and Health program, under the leadership of the World Business Council for Sustainable Development and the EAT Foundation). Sustainability and meeting global nutritional requirements within planetary boundaries are a key focus.

Consumers groups, local industries and (to some extent) governments have sought to promote and implement "**buy local**" schemes for perceived environmental and social benefits. At the same time, there have been significant international efforts to develop consensus around a more robust lifecycle analysis approach to inform consumers of food's environmental footprint. The potential for these types of campaigns will continue.

The fourth **technological revolution and science** are introducing new tools to the food production and supply system[34]. The world is dealing with **vast, unprecedented and expanding amounts of data** - 90% of the world's data has been created in the past two years[35]. Technology means massive data flows and transactions are also happening at speed and through multiple media. Tapping into "**big data**" (normally large and structured data sets) and **advanced analytics** (the tools to derive value from the data) is seen as a major opportunity in the food industry[36]. Companies have swiftly moved to take advantage of data and analysis at the consumer goods end of their businesses (gathering data on consumer preferences and habits), but there exists great digital potential in food production to extend this approach right across the supply chain: from farm to fork, including in making efficient transport and distribution choices. In processing operations, it will enhance the prediction and management of supply and demand flows through real time data analysis and permit automated scheduling of plant maintenance.

Opportunities and risks will also come from further development of **bio-innovation** and **gene editing**. These technologies may progress more quickly in countries already experienced with genetic modification.

Precision agriculture will likely play a greater role in future global agricultural production[37]. Looking forward precision agriculture at its best will combine big data and advanced analytical capabilities with robotics and automated technology[38]. Fine-tuned agricultural practices can improve productivity, as access to larger data sets and analysed information concerning farm variables (such as soil and climate) may optimise farm decision making, reduce inputs and waste and improve environmental outcomes. Farmers will make decisions with accurate real-time data and early warning systems supported by investment in automatic farm systems and technology. The global agricultural robotics industry is likely to expand.

Digital technologies in more advanced countries will support consumer and market driven challenges on issues such as food safety and the desire to understand more about the origin and environmental footprint of food[39]. Several start-ups are investigating consumer technologies to scan, probe or otherwise diagnose food products to provide immediate information on the product and its impact on the consumer (e.g. calorific value, safety).

Technology, in the form of traceability tools, data collection and analysis will support flows of information and provide evidence for verification/assurance programmes and to enhance companies' ability to react to incidents.

Competition in the food industry is predicted to increase with greater fluidity at the retail/market end of the value chain. The number of companies is expected to decrease and their lifespan is predicted to be much shorter in future. The challenge will be greater in markets where growth has stagnated. At the consumer end, **e-commerce** will further revolutionise the food retail business.

2.3 TRENDS IN THE INTERNATIONAL DAIRY MARKET

Global dairy trade is currently in the process of recovering from the 2015 downturn ("the third dairy crisis"), when several dynamics in the dairy market (including strong climate and price driven production in New Zealand, the lifting of production quotas in Europe, high stocks in China and Russia's ban on dairy imports) forced a sharp decline in dairy prices.

Notwithstanding some of the more revolutionary trends noted in the previous section, commentators forecasting on a more business as usual outlook generally predict that **the medium to long term price outlook for dairy is reasonable**, and certainly better than for other agricultural commodities[40]. The future for dairy consumption is generally seen to be positive. **Dairy is considered well placed to take advantage of several predicted favourable trends in food preferences and nutrition.**

In the short term, a rebalancing of supply and demand is expected to prevent further falls in prices. Over the next decade, (nominal consumer) prices are expected to rise between 15% and 45% in all key dairy products (taking into account inflation, however, growth will be more modest)[41]. The price increases are anticipated to stay below recent peaks. Cheese is expected to retain a premium[42].

The longer-term outlook will continue to be shaped by the interaction of supply and demand underpinned by a range of global and local factors not limited to climatic conditions, input costs, regulatory imperatives, consumer preferences, population and demographic change and political developments. Policy distortions influence how supply and demand will meet in the market.

On the **supply side**, world milk production is projected to increase by 177 million tonnes by 2025, or growth of 1.8% per annum over 10 years[43], mostly in developing countries and to meet domestic demand. The countries with the highest milk surpluses are New Zealand, Australia, the US, EU (particularly Germany, France, and Ireland), Argentina[44]. There are no major swings in supply arrangements predicted over a 10-year outlook: dairy export trade will remain centralised to a few suppliers, and the top three exporters by commodity are unlikely to change in the decade to 2025. New Zealand is expected to account for more than 40% of world trade in butter and whole milk powder[45] but international forecasts note that the potential for milk production growth is uncertain because of constraints on physical growth and potential environmental regulation[46].

EU exports for all major dairy commodities are expected to increase by almost 60% between 2013-15 and 2025[47] and will be the principle exporter of SMP and cheese. There is however **considerable uncertainty over how Brexit will influence supply out of Europe**: the UK is the second largest dairy import market and a major destination for EU exports. The UK's departure from the EU may leave a significant deficit in the Common Agricultural Policy budget which may not be filled by other member states. The full impact of these issues on global supply will depend on how they are handled in the UK-EU exit negotiations and agreement, and the future affordability of UK domestic or EU policies to incentivise or dampen production.

US production and exports are rising but supply into the international dairy market is much more attached to other commodity prices and the cost of production. Some suggest the US industry will be well positioned to build share in global dairy markets and capture growth in cheese, SMP and whey. The US industry is facing geopolitical uncertainty in the proposed renegotiation of the North American Free Trade Agreement (NAFTA) with Canada and Mexico, its largest markets. There is uncertainty about recovery in the dairy industry of Australia, farmer confidence and resilience to climatic variation[48].

Countries with the highest milk deficits are China, Italy, the Russian Federation, Mexico, Algeria, Indonesia[49]. Domestic supply trends in key markets are important insomuch as local availability affects the competitiveness and demand for imports. Chinese domestic production has been variable recently but production infrastructure and capability exists and will therefore be a determinant in future demand for imports. Russian domestic production has grown following restrictions on the import of dairy products and an increase in subsidies.

Population growth and in particular the "nutrient transition" in developing countries will likely favour the dairy industry[50]. Global per capita dairy consumption was estimated at 111.3 kg in 2015 and is estimated to increase 12.5% by 2025[51]. Annual growth in demand for dairy products is predicted in both developed (0.5%-1.1%) and developing (0.8%-1.7%) countries. Consumption growth is anticipated most rapidly in Asia (China, Indonesia) but also in the Middle East, Latin America, the Caribbean and North Africa[52]. China is expected to remain the largest importer of milk powders over the next 10 years. Viet Nam, Algeria and Nigeria are also predicted to emerge as major importers[53].

Dairy has a key role to play in achieving nutrition and public health outcomes[54]. Most national dietary guidelines recommend 1-3 servings of dairy a day which approximates to 500ml of milk/person/day. This is based on the significant contribution it makes to meeting the body's needs for a variety of macro and micro nutrients. Other scientific studies show that dairy protein is also of the highest nutritional quality, as well as highlighting a range of other health benefits from milk. Recent studies in the US and Australia have demonstrated the role of dairy consumption in reducing national healthcare costs.

Dairy's natural advantages will align with several key food trends noted earlier, and this includes specific health qualities/benefits derived from dairy nutrition which can meet the needs of different population segments (the elderly, babies and children, maternal health). There has been a growing global trend toward helping consumers identify healthy foods, both from a regulatory perspective as well as private labelling schemes (such as traffic light labelling), some focusing on key content such as fat, salt and sugar, while others focus on a more holistic assessment of the nutritional value of the whole food product.

The predicted **demise of the low-fat diet** driven by growing suspicion over sugar and a returning preference

for full fat taste, may favour dairy product consumption. There has also been increased scientific research challenging previous assumptions relating to the health impacts of dairy fat[55]. This is expected to result in demand for cream and butter[56]. There is scope to reposition dairy products based on dairy's natural whole food qualities[57]. Dairy may be able to take advantage of "**snackification**" trends (single servings etc.) from urban consumers.

However **dairy-free consumption is also growing** in both developing and developed markets. The "dairy alternatives market" is picked to significantly grow in value with Asia-Pacific picked as the largest and fastest growing market[58]. Drivers for the dairy alternatives market are both philosophical/ideological, for example consumer awareness and the anti-animal production movement (relating to sustainability and animal rights and welfare concerns), as well as health and nutrition considerations (particularly among millennials) including growing incidences of lactose intolerance and milk allergy and preferences for a vegan diet.

Environmental, ethical and health concerns have opened commercial opportunities to develop **synthetic dairy**. Synthetic biology – or '**cellular agriculture**' in respect of developing non-animal food products – is a new wave biotechnology and successful efforts to generate synthetic milk in the laboratory may soon evolve into the development of other dairy products, including those with specific characteristics (such as lactose free)[59]. Muufri, a US start-up, is expected to bring initial products to market in 2017[60]. Dairy alternatives' selling point is also freedom from food safety or chemical residue (from farm practices) concerns.

There is globally a continued **strong trend toward the development of sustainability frameworks that are relevant for the dairy sector** both at the governmental and industry level. Most of these have strong links to the United Nations (UN) Sustainable Development Goals (SDGs). The role of dairy in meeting SDGs has been recognised by the IDF/FAO Dairy Declaration of Rotterdam in 2016, specifically:

- the essential role of dairy products for balanced, nutritious and healthy diets;
- the major contribution that dairy makes to countries' economies, income, employment and livelihood; and
- the key function of the dairy sector in the management of terrestrial ecosystems and the need to address environmental degradation and climate change, and to support biodiversity.

The **Dairy Sustainability Framework** has been developed as part of the Global Dairy Agenda for Action, and aims to provide 'overarching goals and alignment of the sector's actions globally on the path to sustainability'. The Framework is focused on 11 sustainability criteria, each with a high-level objective (See Box 1).

- Greenhouse Gas Emissions: GHG emissions across the full value chain are quantified and reduced through all economically viable mechanisms.
- Waste: Waste generation is minimized and, where unavoidable, waste is reused and recycled.
- Water: Water availability, as well as water quality, is managed responsibly throughout the dairy value chain.
- Soil: Soil quality and retention is proactively managed and enhanced to ensure optimal productivity.
- Soil Nutrients: Nutrient application is managed to minimize impacts on water and air, while maintaining and enhancing soil quality.
- Biodiversity: Direct and indirect biodiversity risks and opportunities are understood, and strategies to maintain or enhance it are established.
- Market Development: Participants along the dairy value chain are able to build economically viable businesses through the development of transparent and effective markets.
- Rural Economies: The dairy sector contributes to the resilience and economic viability of farmers and rural communities.
- Working Conditions: Across the dairy value chain, workers operate in a safe environment, and their rights are respected and promoted.
- Product Safety & Quality: The integrity and transparency of the dairy supply chain is safeguarded, so as to ensure the optimal nutrition, quality, and safety of products.
- Animal Care: Dairy animals are treated with care, and are free from hunger and thirst, discomfort, pain, injury and disease, fear and distress, and are able to engage in relatively normal patterns of animal behaviour.

Box 1 Dairy Sustainability Framework Sustainability Criteria

The evolution of global standards and simultaneous consumer requirements for information about how their food is produced will continue to drive a need for transparent, consistent and robust assessment methodologies. Recent examples include:

- The International Dairy Federation (IDF) *Guide to Water Footprint Methodology for the Dairy Sector* (released in early 2017 following a guide to Estimating GHG emissions for Dairy products);
- Livestock Environmental Assessment and Performance (LEAP) guidelines on quantification of environmental performance (including GHGs, water consumption, water quality and biodiversity) for the livestock sector; and
- Several International Standards Organisation (ISO) standards for environmental life cycle analysis, including *Water footprint – principles, requirements and guidance* (ISO 14046) approved in February 2014.[61]

The Dairy Sustainability Framework in 2016 adopted the first two common **indicators for sustainability performance**, and a number of other major dairy producing countries are moving toward national level frameworks and indicators for assessing the sustainability performance:

- The **Australian dairy industry** has developed a whole-of-industry Sustainability Framework which aims to enhance livelihoods, improve community and animal wellbeing and reduce environmental impact. A reporting framework helps dairy companies respond to customer requests for information on product and supply chain sustainability[62]. It reflects and incorporate the 17 UN SDGs.

- **The US Dairy industry** launched a Stewardship and Sustainability Framework[63] in July 2016 as a voluntary resource for the industry to track and communicate progress around stewardship and sustainability. It has a range of indicators of sustainability at the farm level including energy and GHG intensity, water use and farm animal care.

- **Dairy farmers in Ireland** are participants in Origin Green, a national independently verified sustainability programme coordinated across government, the private sector and food producers by the Irish Food Board[64]. It seeks to take advantage of Ireland's grass fed dairy cows and food safety system.

Other variables will affect supply and demand for dairy products in future. Oil prices[65] have dropped since 2014 due to slow demand and record supply. OPEC's late 2016 agreement to slash production may be indicative of an ongoing international political appetite to manage oil supply (and increase prices) in future – and the impact on agricultural commodities is unclear. The long term outlook is for oil prices to increase due to restricted supply and increasing demand. Grain production and supplies are a major variable in the costs of milk production, particularly in the US, and are also influenced by changing policies with respect to biofuels. Policy change and regulatory measures in major dairy producing countries can enable or hinder production, for example to implement nutrient limits under European environmental regulation, the Netherlands is introducing wide ranging measures and will cull an estimated 200,000 of the national dairy herd[66], negating recent growth in the industry. Local climatic events and climate variability will impact supply, and the impact of climate change cannot be discounted or predicted. Major events in the global industry such as a significant outbreak of Foot and Mouth Disease would also be enormously disruptive.

2.4 THE OUTLOOK IS UNDERPINNED BY UNCERTAINTIES

Significant unknowns underpin the discussion so far on the future global, food and dairy fortunes. The trends identified are useful in developing a sense of potential opportunities and challenges for New Zealand's dairy industry and serve as possible signposts for the future. Other analyses have been undertaken to identify risks, future scenarios and uncertainties for the industry.

The *WEF Global Risks Report*[67] provides a current view on short term risk and longer-term trends. A clear pattern in the 2016 and 2017 versions of this report is the elevation of the risk perceived around environmental issues in a way not seen before. Extreme Weather, Major Natural Disasters, and the Failure of Climate Change Adaptation rated in the top five for impact in 2017. Economic risks have a much lower status on both likelihood and impact, but rising income and wealth disparity is recognised by respondents of the risk perception survey as the most important trend in determining global developments in the next ten years. There is a strong suggestion that reforms to market capitalism should be on the agenda as anti-establishment populism (as perhaps evidenced in electoral trends through 2016) suggest economic growth alone is no longer sufficient. The report also identifies future challenges in protecting and strengthening international systems for cooperation.

A further WEF report[68] identified two critical uncertainties for future global food systems:

- whether food demand shift would be resource intensive (to meet growing population food needs under globally difficult circumstances) or resource efficient (where environmental impact and healthy choices drive demand); and
- whether markets will become increasingly connected (more complex, technological and transparent) or disconnected (with local supply dominating and disconnected consumers).

Specific to the New Zealand dairy context, a *Dairy Industry Scenarios* analysis[69] considered possible futures for the dairy industry over a ten-year horizon. The idea that the future world for dairy is one where disruption is inevitable is clearly signalled and the framework developed encourages planning in a context where no one outcome is certain. Sixteen "uncertainties and disorders" are identified in the economic, environmental, social and political operating environment that might influence milk value, milk volume, costs or volatility or complexity in the industry. In each of the four possible 10-year scenarios identified, a shift from the status quo is deemed necessary, requiring investment, change and improved technology throughout the value chain. The latter is proposed as New Zealand's biggest challenge. This work also noted the need to be agile and find solutions where farmers, processors, marketers, funders, government, NGOs and society all play a role.

3.0

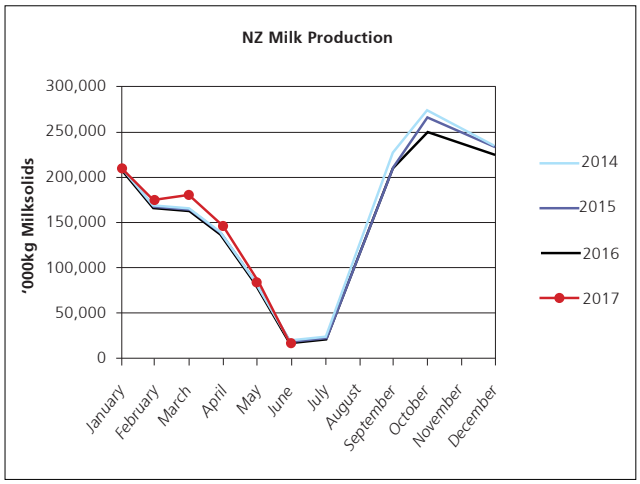
The New Zealand dairy industry in 2017

Since the Strategy was developed in 2013, several forces have been at play for New Zealand dairying. Closest to the farm gate, the industry has had to deal first hand and in a fundamental way with its competitiveness and profitability, and experience of the full extent of the market's highs and lows has been a challenge for resilience across different farm systems and dairy operating models. Dairy's broader role in the New Zealand economy has been in the spotlight and while its economic contribution has perhaps been better understood, there has been some revival of the debate over whether New Zealand's fortunes should be tied so closely to a commodity-based industry rather than more value-added exports[70]. Concerns about the industry's environmental impact have deepened with moves for tighter regulation thereof (particularly in respect of water but also on issues such as climate change). Both industry and regulators have been responding to these concerns and the challenge posed over dairy's license to operate. We deal with the latter question in Section 4 of this document as an issue for the industry itself.

3.1 OVERVIEW

Milk production in New Zealand remains highly seasonal as a result of being pasture-based. Collecting and processing all milk produced across such a sharply seasonal production curve requires world leading logistics and processing capability.

Box 2 provides a snapshot of the dairy industry as it is today with some indications of trends and changes since the Strategy was developed. An overview of the dairy processing sector is provided in Box 3. The profiles indicate that, notwithstanding delays in growth from the 2015 drop in prices which are yet to emerge, the industry has continued to expand.



Source: DCANZ

- Dairy earned over $14.6 billion in export dollars in the year to June 2017 (up from $13.4 billion in 2012);[71]
- Dairy export revenues have grown at an average rate of 7.2% per year since 1990;
- Dairy remains the largest of any goods sector in New Zealand, responsible for 29% of New Zealand total goods export revenues;
- Dairy has an estimated contribution of $7.8b (or 3.5%) to GDP[72] (it was $5b in 2012[73]);
- The industry employs around 50,000 people (35,000 on farm and 13,000 in processing);[74]
- Total effective milking platform hectares was 1.73 million in 2016/17 (up from 1.33 million in 2000);[75]
- 4.86 million cows were milked in 2016/17 (up from 4 million in 2007/08);[76]
- Milk collected and processed reached a record (1.89 million kgs of milksolids) in the 2014/15 season and eased slightly to 1.85 million kgs of milksolids in 2016/17 (a 10-year growth of 41%);[77]
- Export revenue from dairy is expected to rise in 2018 to NZ$17.4 billion.[78] This is just short of the 2014 peak at NZ$17.8 billion.

Box 2: Profile of the Profile of the New Zealand Dairy industry[79]

As Box 3 highlights, New Zealand's milk processing sector is diversifying in several ways, including the number of players, organisational structures and strategic direction. New Zealand owned cooperative structures are still the dominant industry arrangement, of which Fonterra is still the largest processor in the sector.

The Dairy Industry Restructuring Act 2001 (DIRA) promotes the efficient operation of dairy markets in New Zealand and regulates the activities of Fonterra. Under current changes proposed to the DIRA, a review of the state of competition will commence in the 2020/21 season and five yearly thereafter. It would also remove the requirement for Fonterra to supply milk to large predominantly exporting companies to provide a signal that the current regulatory regime is not permanent and to incentivise entry into the farm gate market and a focus on high value products rather than primary processing.

Danone Nutricia has two manufacturing plants in New Zealand producing early life nutrition products.

Fonterra is a Cooperative headquartered in Auckland and the largest dairy processor in the world, producing dairy ingredients, value added dairy ingredients, specialty ingredients and consumer products.

Miraka, based in Mokai, is owned by a group of Māori trusts and incorporations producing ingredient and consumer powders and UHT products.

Open Country Dairy is a privately owned company based in Auckland and manufacturing dairy ingredients.

Oceania Dairy is a wholly owned subsidiary of the Inner Mongolia Yili Industrial Group (Yili) based in North Otago, producing infant formula, a range of milk powders and anhydrous milkfat.

Synlait is a publicly listed company based in Canterbury, producing infant and adult nutritional formulations, functional food ingredients, and specialised products.

Tatua is a Cooperative based in the Waikato producing specialised dairy ingredients and dairy foods.

Westland Milk Products is a Cooperative based throughout the West Coast and in Canterbury, and producing a range of infant nutrition products, dairy ingredients and consumer brands.

Yashili New Zealand Dairy is based on Pokeno and is a subsidiary of the Yashili Group of China producing infant milk formula.

Box 3 Dairy processors in New Zealand[79]

Companies in the added-value market are already trying to capitalise on the advantage of milk sourced from pasture fed cows and other New Zealand dairy attributes. Dairy companies are also actively responding to market signals from customers and consumers in operating on a compliance plus basis, with regular audits from third parties or customers.

3.2 THE DAIRY DOWNTURN

The 2013 Strategy was developed during a period of healthy returns for the New Zealand dairy industry and on the precipice of an unprecedented dairy payout. The Average Dairy Company total payout in 2012/13 was $6.18/kg milksolids rising the following season to an all-time high of $8.47 in 2013/14[80]. High returns consolidated dairy's place as a major dynamic in the New Zealand economy: a $1 rise in Fonterra's payout was estimated to boost New Zealanders' incomes by about $270 per person[81].

The following year, 2015, saw a substantial decline in milk prices internationally: the IFCN world milk price indicator dropped by 33% in a year and by 60% between February 2014 to May 2016[82]. For New Zealand dairy farmers, the "dairy downturn" translated into payouts falling to $4.69 and $4.30 in the 2013-14 and 2014-15 seasons respectively. The latter payout was the lowest in real terms for dairy farmers in 20 years[83]. Half of dairy farms faced negative cash flows and many farmers experienced negative cash flows over three seasons[84]. Latest industry statistics confirm dairy farmers have posted their lowest season of profitability in 53 years of recording dairy farm finances[85]. Farmers made significant cuts to running expenses but the lack of cash operating surplus has seen them take on a substantial amount of debt in 2014-15 and 2015-16 seasons. Dairy farm debt is estimated at $40.8b[86].

The milk price downturn put a sharp domestic focus on the competitiveness, profitability and resilience of New Zealand dairy farmers. The Break Even Milk Price (BEMP) is a key measure in assessing impact. A low proportion of New Zealand farmers typically operate on a BEMP below $5.00[87]. High prices during good seasons have seen farm business models evolving to a higher BEMP, based on assumptions of higher payouts and a shift towards greater use of supplementary feed to maximise production. But fluctuations in milk commodity prices, debt servicing and repayment commitments, inconsistent weather and low cash surpluses carried over for several seasons have made the BEMP more difficult to hit for many farmers[88].

Given the high dependency of a farm's profit on the payout received and the higher (more expensive) BEMP for most farms, profitability unsurprisingly was impacted across several measures during the dairy downturn. For owner-operators, farm profit per hectare in 2014-15 decreased by more than 50% from the previous season's record ($3,295), to $1,537 per hectare (in 2011-12 this was $2,624)[89]; business profit before tax fell by over 75% between seasons from $1,981 (2013-14) to $478 in 2014-15. Sharemilkers suffered a 65% drop in their operating profit per hectare in 2014-15. Over the past few years farm equity has been declining due to lower livestock and milk company share values, alongside increased liabilities as the result of taking on more debt.

The 2014-15 season price drop brought severe stress and pressure onto farmers and their business models. At an individual farm business level, financial strategies included revisiting costs of production, delaying maintenance and upkeep, and refinancing or taking on more debt. For some more financially vulnerable farmers (newer entrants, investors or sharemilkers) who had borrowed heavily to enter the industry; and those running high input and high cost systems), payouts well below break-even across two seasons led to some exits.

At a national level, the dairy downturn was also felt. Dairy export returns declined by 21% in the 2015 season (note however that returns in 2014 were up 35% on the previous year). While such a fall (of $3.3b between 2014 and 2016) may once have had a discernible economic impact, the decrease was compensated for by a growth in non-dairy exports of $5.9b[90].

3.3 DAIRY IN THE NEW ZEALAND ECONOMY

Counterintuitively, perhaps, given the seriousness of the drop in dairy prices and implications for farmers, figures over several seasons highlight very little change in the relative or absolute importance of the dairy industry for New Zealand (See Appendix 1 for an overview of current dairy industry statistics). It remains the largest industry in several key indicators. Further, the dairy industry is picked to continue to play a dominant role[91]. Looking forward, this placing is most closely challenged by a buoyant and growing tourism industry[92]. The New Zealand government has signalled its desire to help diversify the economy as part of the BGA and committed funding to this end in the 2017 budget[93].

There is a changing profile of dairy within New Zealand with dairy now having a much more prominent role in the South Island than previously. Canterbury is the second largest dairy region in New Zealand and Southland the third. Herd sizes are growing faster in the South than in the North. This has been important as it has helped some regions to survive downturns in other industries because of the GFC[94]. Dairy's role in traditional areas like Waikato will continue but without the same level of employment growth given the flattening of FTE:stock numbers.

Dairy plays an important role in supporting regional economic activity including in providing jobs (up to 1 in 5 in three regions). New Zealand dairy processors are also significant capital investors in the regions. They have committed more than $2 billion in new dairy processing technology and equipment over the past four years, and this expansion has mostly taken place in the regions, using local labour and intermediate inputs.[95]

Dairy has had a significant role in changing land use in New Zealand. Relative dairy industry profitability drove significant conversions from, especially, the beef and sheep industry. Maximising returns from land use is now seeing the dairy industry in some regions of New Zealand face a greater challenge from the horticulture sector. Urbanisation is placing pressure on agricultural (including dairy) land and on land values.

3.4 NEW ZEALAND DAIRY OUTLOOK

New Zealand has sought to protect its position as a small and remote trade-dependent nation with a policy of market diversification and liberalisation in trade through FTAs and the WTO. Asia accounts for over half of New Zealand dairy exports[96]. A diversified trade profile supports the resilience of the industry and preferential arrangements with many countries have placed New Zealand at an advantage relative to others.

New Zealand dairy is generally considered well-placed to take advantage of world population growth and resultant demand trends[97]. Continuing growth in Southeast Asian markets (particularly Indonesia, Viet Nam and Malaysia) is likely to be positive for export potential. Africa (12%) and the Gulf Cooperation Council (GCC) countries markets are next in significance to New Zealand (9%) by value[98]. These countries (e.g. Sub Saharan Africa) with limited potential to meet growing demand through domestic supply present further growth opportunities.[99] China is likely to continue to be a major force in global dairy demand. New Zealand has been a significant supplier to China for key commodities (85% of the butter import market in China and 95% of the Chinese WMP import market[100]).

In respect of competitiveness, taking cost of milk production as an indicator, New Zealand has generally retained its position as among the world's most competitive producers[101]. New Zealand's projected relatively weak currency (alongside that of Australia and Argentina) may help with the industry's competitiveness over the next 10 years[102]. However, country specific or global factors may easily change the state of play, affecting competitiveness and enabling competitor exporters to capture market share. New Zealand exporters are facing significant competition from subsidised products in many markets, distorting normal supply/demand flows. Favourable trade preferences can be short-lived as other FTAs concluded with third parties level the playing field, and in markets where New Zealand does not have an FTA, its products can be at a significant disadvantage.

Further expansion and increased production within the New Zealand dairy industry is uncertain. Some land-use projections indicate that after a 37% (500,000 ha) expansion in dairy farm land between 2002 and 2012, land devoted to dairy farming will remain largely static at around 1.9m until 2025[103]. The outlook is most likely to be very modest gains in milk production, rather than growth on a scale seen previously. Recent decreases in production since 2014-15[104] may reverse. In the longer-term and without significant science investment to enable it, industry growth could be constrained by environmental regulations, declining use of supplementary feeds, and de-intensification on farms to lower systems with a pasture-based focus. Incremental growth is likely to come from genetic gain, improved productivity and new technologies that enhance productivity and efficiency. If mitigation options emerge then there is potential for greater growth. Conversion of further land to dairy is already constrained by regulation in some parts of New Zealand.

New Zealand production continues to depend on climatic conditions. The impact of climate change, events and variability on dairy production and on water availability will likely be significant factors in coming years.

4.0 Current and emerging issues for New Zealand dairying

This section outlines a more detailed state of play on significant existing and emerging issues for the dairy industry in New Zealand. We focus on issues in five key areas: industry economics and prosperity, industry systems, people, environment and natural resources, and innovation and technology, and how they are being influenced by three key forces: industry assurances (product integrity and biosecurity), communities, and reputation and brand. Many of these issues align with and overlap with objectives in the Strategy and its sustainability pillars of responsibility and competitiveness.

4.1 ECONOMICS: PROFITABILITY, COMPETITIVENESS AND RESILIENCE

The economic situation for the dairy industry was described in broad terms earlier in this report. New Zealand dairy farmers and processors are still in recovery from price volatility in the 2014-15 and 2015-16 seasons. The situation for profitability will depend largely upon milk price payouts over the next few seasons. Costs are likely to increase as milk revenues improve. Affordability of new investment on farm will depend on the pace and scale of recovery. This may have implications for the progress of broader industry initiatives and the response to new regulatory imperatives (which, as discussed further in this section, have not waned).

Responses to the tight economic environment resulted in some productivity gains on farm: while the number of cows decreased 3.1%, milk production contracted only 2.1% from the peak in 2014/15%[105]. Looking forward, productivity will continue to be a driver of growth in the industry. New Zealand milk production efficiency is ahead of the rest of the world on some indicators already, such as emissions efficiency/kg milksolids.

For dairy farming, the low-cost system and farm system resilience was tested during the downturn in dairy prices. Significant revisiting of business models has taken place across New Zealand farms, with a particular focus on reducing costs such as those associated with imported feed. Industry leaders have urged farmers to lock in changes made during the downturn, which enable them to operate at a lower BEMP to take better advantage of improving milk prices[106].

Debate about industry resilience has also focussed attention on the more vulnerable participants in dairying, namely herd-owning share milking (HOSM), contract milking and variable order share milking. There have been some exits from the industry throughout the dairy downturn. These have posed short term risk to farm businesses and a long-term risk to capability as volatility has further challenged the traditional progression system

already threatened by the high cost of entry. For example, the number of lower-order share milkers have declined from 1,229 to 720.[107] A 2016 report[108] examining the impact of volatility on progression in the industry suggests a need for further understanding of the risk and returns for progression pathways and some refinement of the structural arrangement historically used.

New Zealand remains among the most competitive milk producers internationally and this reflects both New Zealand's natural advantage for pastoral farming and the development over the years of a mature export industry that enjoys economies of scale. To a certain extent, in refocussing attention to core elements of New Zealand competitiveness (lower cost and resilient farm systems), the dairy downturn may have improved conditions for competitiveness in the short term. The dairy industry outlook provided in section 2 however suggests a tighter and more competitive international environment for New Zealand dairying due to unpredictability in the trading environment, the prospect of competitors gaining market preferences and greater government production support. However, the ability of the industry to grow and invest will depend on access to capital which may be more constrained given higher debt levels and the likelihood of interest rate rises in future.

4.2 PEOPLE: CAPABILITY NEEDS AND SAFE WORK ENVIRONMENTS

Capability needs

A 2014 review[109] of capability needs across the primary industry sector, found that if the dairy industry is successful in meeting growth aspirations, total employment in the industry could rise from 48,827 (2012) to 51,100 in 2025[110]. Put another way, the industry will need to find a further 2,300 workers and ensure the right skills mix to meet its own definition of success. The analysis echoes earlier DairyNZ estimates (from 2011), that 1250 agriculture-related graduates would be needed annually to meet industry baseline needs and support growth with the requisite level of skill.

The report breaks down the requisite training needs of the dairy workforce in 2025: training of 25,700 to replace skilled workers lost to natural attrition (this is no easy task given the degree of specialisation of skills already required on farm, across different job types and in an increasingly complex employment, technological, ecological environment), 8,300 more workers overall with qualifications and 6,000 fewer workers without post-school qualifications. There are significant changes in what these workers do and where in the industry they will work. On-farm work numbers are projected to remain close to current levels (around 38,000) and the strong (33%) increase in numbers employed in processing seen over the past decade will continue with a further 1,300 new jobs in processing predicted between 2012 and 2025. Greater specialisation in skills is needed to support productivity and profitability across (but especially up) the dairy value chain including through specialised product development and to keep current with changing social and consumer demands. The report describes the attributes required of the dairy workforce as being:

- More market/product-oriented skills in consumer branding, food/nutrition science, process engineering, food service marketing and product innovation and cultural/language to address barriers to doing business in emerging markets;
- A business/management-orientation through risk management, food safety and quality assurance systems;
- Higher levels of production-oriented skills including whole farm systems, information management, resource use, financial efficiency, soft skills and managing local/migrant staff and contractors;
- Increased science/technical support skills particularly researchers on resource use efficiency, reducing environment effects and agriculture resource economics; and
- More accredited rural professionals/providers to transfer new techniques and knowledge to farmers.

Competition within the agriculture sector and against other sectors for talent is high, and the dairy industry has challenges in recruiting (for example hours and scheduling). To the extent that remuneration is an important indicator of attractiveness, the Rabobank/Federated Farmers *Farm Employee Remuneration Report, 2016*[111] indicated that dairy salaries remained relatively stable throughout the 2014/15 season downturn, but with decreases reported in the value of extras pushing the total package values down. This report highlighted a decrease in the number of average weekly hours worked on dairy farms and an increase to 94% of the number of workers covered by a signed employment agreement, suggesting perhaps that the efforts to improve on farm work conditions and employment relations may be having a positive impact.

While the Business Growth Agenda expressly seeks to use immigration settings to attract the best people to

fill skill shortages across different sectors and regions[112] , future policy settings around temporary migrants are unclear. The reasons why the industry looks offshore to meet workforce gaps are well documented, and subject to debate. There is less formal understanding about the social issues associated with influxes of immigrant labour into New Zealand rural communities.

Work Environment

Proving a safe work environment (particularly on farm) is identified as an issue in the industry's attractiveness as a workplace. When the Strategy was written, the dairy industry had the third worst accident rate for injuries per person employed in New Zealand, with 35 fatalities between 2005 and 2010.

Workplace Health and Safety issues have been a priority issue for the New Zealand Government and for industry in recent years as a new regulatory framework has been established to address weaknesses in the system highlighted during the Pike River mining accident. The Government has set a goal to reduce workplace death and serious injury rates by 25% by 2020. In 2013 WorkSafe was established as the Crown's workplace health and safety regulatory body, and new Health and Safety Law came into effect in April 2016.

Industry organisations have been working hard to support compliance with the new legislation and have been clear about the expectation that all industry participants meet minimum standards. A dedicated body, Safer Farms, has been established to support industry in this. Recent statistics suggest there is still much room for improvement. According to ACC's list of claims by industry in 2014[113] , dairy farming was the largest source. Pan-industry fatalities[114] puts agriculture responsible for 117 out of 304 workplace fatalities in the period since 2011.

There has also been growing awareness of farmer wellbeing, and support for farmers and their families has increased during the dairy downturn. Figures cited suggest 27 New Zealand farmers committed suicide in 2015, compared to 22 in the previous year and 19 in 2012/2013. On farm stress is also linked to domestic violence concerns and broader family wellness. This highlights that the health and safety debate on farm is not just about the employment environment for employees but equally for farm owners and operators (and sharemilkers and contract milkers) and their families. These remain urgent and important issues for the industry, as indicators of the duty of care to its people and part of its reputation.

4.3 ENVIRONMENT: STEWARDSHIP AND NATURAL RESOURCES

Freshwater

New Zealand freshwater quality and the role of dairy farming is perhaps the major area of public discussion and challenge to the industry. New Zealand water policy has significantly transformed in recent years, led by the development of the National Policy Statement (NPS) for Freshwater in 2011 and a 2014 revision which incorporated a National Objectives Framework that set bottom lines for water quality[115]. The passage of the Environmental Reporting Act (2015) provided a further supporting framework, requiring reporting on New Zealand's environmental performance. The 2017 Clean Water consultation aims to further develop and refine freshwater policy[116].

The intensification of water policy development in recent years has been triggered by the need for a more cohesive approach across central and local government, where implementation has been inconsistent and fragmented. It is also because easy solutions to New Zealand's water quality and quantity concerns have been elusive and some catchment level processes fraught. The difficulty in reconciling competing economic and environmental or conservation interests with respect to water, and the need for trade-offs between public expectations, economic drivers and recreational considerations are highlighted by the Chief Science Advisor to the Prime Minister[117]. Further, the problem of defining what is a good outcome varies by waterway and catchment, based on a local physical conditions and social, economic, recreational and cultural values attached to it[118].

Making broad statements about the overall state of New Zealand waterways is difficult: there is massive variation in the quality and quantity of freshwater resources[119]. New Zealanders however have a much clearer and comprehensive picture about the state of New Zealand waterways and areas for concern today owing to new environmental reporting requirements and several significant commentaries from a range of actors[120]. There exists broad agreement among their authors that many New Zealand waterways are under stress, with rapid intensification of dairy and land use change to dairy singled out as a significant contributing activity in recent years, along with industrial use and urban expansion[121]. In a 2013 report, the Parliamentary Commissioner for the Environment (PCE) added that the scale of dairy expansion (ie total land use change to dairy) was also to blame[122]. Nitrogen persistence in waterways and total Nitrogen trends are highlighted as problematic.

Investment in water quality science, including within the dairy industry, in recent years has also built understanding and capability. Broader dairy industry initiatives and efforts to address water throughout the years has been acknowledged[123]. The development and progress under the Sustainable Dairying Water Accord agreed in 2014 is viewed as a positive step with its annual reporting providing transparency on progress with measures taken by the industry. Dairy farmers are estimated to have spent $1b on environmental initiatives between 2011 and 2016, with the majority of investments (70%) on effluent system upgrades. Public investment in water issues is also increasing with several funding mechanisms targeting water research.

There is strong sentiment among New Zealanders on water quality and active NGO and public engagement on the issue. Many (including from within the industry) have seen government reforms not going far enough and many do not see industry action as sufficient.

Challenges in addressing water quality include the complexity of finding science based and equitable catchment level solutions, the costliness of mitigations and legacy impacts. The OECD suggests that economic instruments, such as the Taupo N market cap and trade system, should be encouraged and that New Zealand is well placed through OVERSEER to manage diffuse pollution.

There is also consideration of developing new policy with respect to water allocation[124]. In 2016 the Government established a Water Allocation Technical Advisory Group to identify and develop options for the allocation of fresh water and discharges to increase sustainable economic and social benefits to New Zealand within environmental limits[125]. New Zealand's waters are not evenly distributed and the country has the highest rate of water use in the OECD (in large part due to hydroelectricity generation and irrigation). OECD view is that the current irrigation framework does not systemically consider broader social and environmental costs, while the benefits accrue only to users[126].

Climate change mitigation and adaptation

Climate change and greenhouse gas (GHG) emissions remain high on the international and domestic agenda. New Zealand has set an international target to reduce emissions by 30% below 2005 levels, by 2030. Meeting this target will not be without difficulty and difficult decisions that will affect the dairy industry. It is well known that New Zealand has a unique GHG emissions profile for a developed country. New Zealand's GHG emissions are also rising. By 2014 there was an increase of 6% over 2000 levels (23% above 1990 levels). New Zealand GHG emissions per capita is among the five highest in the OECD[127].

New Zealand has been able to meet its earlier Kyoto Protocol targets through the use of sinks and international credits, but this is unlikely to be sufficient to meet new commitments. The Government has not at this stage indicated in detail how its commitments to the INDC will be met (i.e. absorbed across the New Zealand economy) or how the transition to a low carbon economy to meet the objective of "50-by-50" (a 50% reduction in GHG by 2050, a government objective announced in 2011[128]) will occur. There is uncertainty about the role that agricultural emissions will play in meeting commitments, and a decision on whether agricultural emissions should be incorporated into the ETS remains deferred under legislation.[129] If agricultural emissions are formally excluded from New Zealand's international commitments, there will be pressure on other parts of the economy already subject to carbon taxes to further reduce emissions or buy credits.

One argument mounted is that more pressing action is needed on CO2 (because of the quantity of this gas) and Nitrous oxide (because of its longevity).[130] Reducing nitrous oxide emissions to zero creates a direct trade-off between food production reliant on nitrogen inputs and the climate. A further complexity is the challenge of achieving greenhouse gas mitigation without compromising other policy aims: for example whether interventions to reduce nitrous oxide emissions from cows getting into the atmosphere may mean more nitrogen leaching into waterways.

New Zealand has been seeking international rules and standardisation around the treatment of agricultural emissions. The Paris Climate Change agreement expressly recognises the challenge of reducing biological emissions whilst meeting food security and addressing hunger[131]. But it is it not clear whether special agreement on the treatment of emissions from food production is possible. New Zealand is one of the most greenhouse gas efficient producers in the world (emissions per kilogram of milksolids produced).

Options to reduce GHG emissions within agriculture have long been argued to be difficult because mitigation technologies are not available, are potentially costly, have not been tested in a variety of practical on farm environments. New Zealand has been a leader in global

GHG research, having led the establishment of the Pastoral GHG Research Consortium and New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC). The PCE has highlighted the difficulty in finding one 'silver bullet' addressing biological emissions[132] but notes that a combination of mitigation options used together may be effective[133]. PCE raises the prospect of going beyond increasing emissions efficiency per cow to also reducing stocking rates[134].

In 2016 the Government established a Biological Emissions Reference Group made up of government and industry representatives to build a robust and agreed evidence base on the opportunities available now and in future to reduce biological greenhouse gas emissions (methane and nitrous oxide) in New Zealand's primary industries.

There is increasing evidence of climate change risks becoming a key factor in global business decision making and investment. The private sector is responding to public sentiment. It has been reported that 63% of American Fortune 100 companies have set clean energy targets[135]. In 2016 the New Zealand Superannuation Fund announced that it would "build carbon measures into our portfolio construction methodology to target reduction in the Fund's exposure to both fossil fuel reserves, and carbon emissions."[136] The Fund cited climate change related risks as including the physical effects of climate change and regulatory action designed to address these risks.

Biodiversity

The *Our Fresh Water 2017* report states that of the native New Zealand freshwater species reported on, around three-quarters of fish, one-third of invertebrates, and one-third of plants are threatened with, or at risk of, extinction.

Biodiversity has typically had less focus in New Zealand relative to climate change and water quality issues, although efforts on those issues are both driven by and have impacts on New Zealand's biodiversity, such as riparian planting and retiring of land into forest (eg QEII Trust), as well as measures to address pest control (including the new target of achieving a Predator Free NZ by 2050).

Regulation and resource management

In 2017 the Resource Legislation Amendment Act (RLAA) was passed to reform the Resource Management Act (RMA) and related legislation. This is the most comprehensive package of reforms to the RMA since its inception 26 years ago.

The Government's objectives for the changes were to "deliver substantive improvements to the resource management system to support more effective environmental management and drive capacity for development and economic growth. Amendments aim to provide stronger national direction, a more responsive planning process, a streamlined resource consent process and better alignment with other legislation."[137]

More consistency across legislation and in implementation across the country is desirable given the significant focus of activity on water takings and effluent discharge at regional council level in recent years (driven by policy development in new 10 year plans as well as plan changes and variations designed to address environmental issues). Farmer respondents in a Federated Farmers survey[138] cited regulation and compliance costs particularly those relating to health and safety and resource management issues such as freshwater, as their second biggest concern (14.3%) after 'commodity and farmgate prices' (37.8% of farmers).

4.4 ANIMALS: WELFARE AND PUBLIC HEALTH

Animal Welfare

The issue of dairy farming's duty of care to its animals is no less important now than at the time of writing of the Strategy. Recent high-profile animal welfare concerns demonstrate that it will continue to be an area for the industry to understand, manage and demonstrate leadership. Central to maintaining a reputation for being world class at animal welfare is having a current, relevant and practical policy framework. By remaining ahead of emerging issues and continuing an evidence based approach, New Zealand engages in domestic and international discussions in a way that manages the risk that external forces (the public, customers/consumers, international standard setting bodies or trade partners) will dictate how New Zealand manages animal welfare.

In 2013 the New Zealand Animal Welfare Strategy was developed which recognised the responsibility to meet the needs of animals and not do harm, and gave a strong nod to the reputational risks associated with animal welfare. A review of the Animal Welfare Act has enhanced the regulatory toolbox available to ensure animal welfare compliance in New Zealand. The development of regulations to enhance the enforceability of the existing suite of Codes of Welfare and their minimum standards of welfare is now into a second tranche.

The welfare of domestic and farmed animals remains an important issue for the New Zealand public. This is a trend seen internationally[139]. In 2015, an expose on the treatment of bobby calves in the dairy industry took the discussion of New Zealand's animal welfare practices in the dairy industry global. The practices highlighted were widely rejected by the industry and reinforced the need for the dairy industry to be working with all parts of the supply chain (transporters, slaughter houses). Concerns raised over bobby calves prompted a swift response from the Government who fast-tracked the development of regulations to help address the issue.

Bobby calves and cases of breaches of animal welfare protections seen periodically in the news (e.g. recent prosecutions over tail breakages) highlights the risk to an entire industry of the actions of a few in information fast and reputation driven market.

The National Advisory Committee on Animal Welfare has been reviewing the Dairy Cattle Codes of Welfare to capture issues associated with long term or permanent dairy housing. This is a rare feature of New Zealand farm systems, but the review process has had to balance concerns around public perception over housing and animal welfare in such systems, with the desire to retain a consistent policy approach to animal welfare regulation: that this be evidence and outcomes focus, rather than prescriptive on methods.

The OIE Chapter on Terrestrial Animal Health is the foundation for **international animal welfare standards.** Other international standard setting bodies and industry organisations are increasingly active in this area. In December 2016, the ISO in collaboration with the OIE and international food manufacturing organisations released an animal welfare standard intended to ensure welfare of animals in food/feed production through the guidance and management tools for meeting OIE standards[140]. It is designed to help integrate animal welfare principles in discussions between different parts of the food value chain and to enable operators in the food supply chain demonstrate their commitment to animal welfare management.

Traditionally the five freedoms have underpinned animal welfare considerations and policy, but there has been a more recent shift towards consideration of the behavioural needs of cows: i.e. shifting the focus from animal welfare (the removal of negative influences on a cow) to animal wellbeing (ensuring cows have positive experiences that meet behavioural needs for example).

Europe is often seen as a market with a more front-footed and regulatory approach to animal welfare and indicator of possible future international trends. New EU regulations on animal welfare went through the European parliament in 2013 and research funding investment has been made in developing the EU Welfare Quality programme[141]. This programme developed an on-farm animal welfare assessment system, based on four general welfare principles and 12 criteria for good welfare with specific measures per species, and finally an overall unit score. It looks at animal welfare aspects at all parts of the production system (birth to death, transport, climatic conditions, housing requirements etc.). The USDA has also recently announced a programme to Assess Animal Welfare Standards and Programs for compliance with ISO.

The question of labelling requirements relating to animal welfare has been circulating in the EU for some time but to date only mandatory labelling for table eggs has been implemented. Voluntary labelling programmes exist for other products.

Animal and public health

Having healthy animals is central to the farm business and to milk supply, and it underpins animal welfare and farm profit objectives. There has been increasing attention to farm practices, such as the use of veterinary medicines, that might have human health implications. For example consumer concerns over hormones in food have seen some in the US food industry opt away from dairy products from animals treated with recombinant bovine somatotropin (rBST) in the US.

An increasing area of attention has been anti-microbial resistance (AMR), whereby microbes survive or grow during antimicrobial treatment. According to the International Dairy Federation, new AMR mechanisms are emerging and spreading globally, threatening our ability to treat common infectious diseases, resulting in prolonged illness, disability, and death of humans and animals. The misuse and overuse of antimicrobials is accelerating this process.

The International Dairy Federation (IDF) has released a new factsheet - Guidance on antimicrobial resistance from the dairy sector providing a global dairy position on AMR and giving recommendations for the prudent use of antimicrobial agents to dairy farmers, veterinary services, food processing companies, pharmaceutical companies and regulators. It states that limiting the development of

AMR requires the implementation of global strategies by public health, veterinary and environmental authorities in all countries of the world.

4.5 INNOVATION: RESEARCH, SCIENCE AND TECHNOLOGY (RS&T), INFORMATION AND AGRI-TECHNOLOGY

Investment

New Zealand's innovation potential is high[142]. Historically however levels of public and private research and development (R&D) investment in New Zealand have been relatively low within the OECD[143]. The dairy industry recognises the importance of RS&T across the supply chain and invests at the industry good level and through companies. DairyNZ has traditionally spent about 28% of its levy on R&D for farm profit and productivity, and R&D is central to other areas of DairyNZ work. There is high support from levy paying farmers for this R&D focus. Dairy companies invest in new product development, food safety research as well as in the infrastructure to bring the R&D to market. There is little data available about the level of private investment in R&D undertaken in dairy farming businesses.

The dairy industry has had several successful past and ongoing partnerships with the Crown and other industry groups. These partnerships have enabled the dairy industry to leverage industry money as much as $1-for-$1 (although the New Zealand Government has now capped co-funding ratios at 60(Industry):40(Crown)). The nature of future industry-Crown partnerships is likely to shift under changes to the central science system and the establishment of several new initiatives which are centralising government funding.

The National Statement for Science and Investment (NSSI) was released in 2015 to create a simpler, longer term, stable and predictable central science system. It creates a new balance between ideas-led and industry/market-led research. While it continues a commitment to maintain investment in the agriculture sector[144], the Crown is likely to fund a lower proportion of more and larger projects, and there is an explicit view that industry levies should fund closer-to-market research including that which supports and extends existing business models. The Ministry for Primary Industries has an R&D budget of approximately $130 million per annum for investment in industry and mission-led science.[145]

A significant amount of Crown funding has been aligned to the National Science Challenges initiated in 2012. These collaborative research mechanisms were established to address complex issues of national importance across several themes[146]. It is expected that the few early starter Challenges will deliver against initial objectives by 2025[147].

The New Zealand Food Safety Science and Research Centre was launched in 2016 to coordinate and deliver food safety science and research for New Zealand. Its establishment as a crown-industry funded partnership was a result of a recommendation from the Government Inquiry into the Whey Protein Concentrate contamination incident. The Centre's industry funders are dairy companies (through the Dairy Companies Association of New Zealand), meat companies (through the Meat Industry Association) and Zespri.

Under the revamped science system, the government has committed to further growing public science funding (to 0.8% GDP) and incentivise further private investment[148]. But the new policy frameworks provide certain indicators about the future of funding in areas of interest to the dairy industry. Research supporting primary industry productivity and competitiveness (especially on farm) appears to have dropped in priority as the Government defines its future role as a principal investor in "generating new ideas" research. There is a clear expectation that industry increase its investment as Government co-funding arrangements are reduced over time in favour of discovery-led research. There will be more competition for contestable funds as mechanisms managed by MBIE are reformed and consolidated across sectoral and disciplinary boundaries. Aligning with BGA goals, there exists a preference for investment in R&D further up the value chain in the development of new, high value products, or adding greater value to existing ones. The OECD has noted the increased focus on science to solving environmental challenges[149].

Technology

On farm innovation and technology is predicted to be the driver of future productivity growth in New Zealand dairying in a natural resource constrained farming environment. At the same time there is a feeling that the availability of farm management tools today is not a limiting factor to lifting productivity across the sector[150]. There are multiple facets to technology use and advances in the dairy industry. On-farm agricultural technologies include farm infrastructure (milking systems, irrigation, effluent management), the use of software, information and data based systems to support farm decision making at a more granular level (precision agriculture) and which support the overall farm operation (information

technology, computers, databases, Geographical Positioning Systems (GPS), Geographical Information Systems (GIS) and mapping systems, employee management software, farm financials etc.). Technology such as OVERSEER may be used by farmers and rural professionals or service providers to support farmer responses to nutrient limits or other resource constraints. Increasingly all parts of the farm business are connected, necessitating a whole of farm system approach.

The adoption of large scale on farm technology in New Zealand is not as prevalent as overseas because of the nature of New Zealand low input farm systems. A 2015 case study on farms having adopted automatic milking systems (AMS) suggested this technology had been installed in only around 20[151] farms in New Zealand. Wider scale installation of robotics in New Zealand was considered delayed by questions over their suitability and financial viability in mainly pastoral farm systems, and cost was the most significant limitation to broader adoption. Benefits were found to include increased production per hectare and per cow, benefit to cows, and change in the nature of work with less rigidity around milking schedules.

In 2011 a study into opportunities and challenges for precision dairy farming was undertaken to identify a future research agenda. It found that technology had significant potential but that in its infancy, the benefits of precision dairy were constrained by technology and management adaptation and capability on and off farm to unlock the benefits[152]. The focus of industry good research into precision dairy to date has varied across different elements of the farm system, including on milking production and technology, milking efficiency on rotary platforms, fertilizer application pasture growth and quality, cow tracking and behaviour and precision irrigation. New Zealand dairy farmers are already using new technology on farm to respond to environmental challenges and demonstrate responsible farm practices, for example to help manage nutrient issues[153] and better direct agri-chemical spraying[154]. Adoption of this and other technologies varies widely across farms and is far from universal.

Notably other countries are investing significantly in the potential of agri-technology. The UK for example launched a new agri-tech strategy in 2013 with £160 million funding, including to support industry-led proof of concept development of near-market Agri-Tech[155]. New Zealand's National Science Challenge "Science for Technological Innovation" includes a focus on agri-technology.

The dairy industry is generally one that is comfortable with information and data with early adoption of farm and national level data through herd testing and the dairy core database. Dairy farmers use LIC and Ambreed as services to support data collection and understanding. The Strategy identifies challenges with the implementation of new information systems and their interoperability with other systems/databases. On farm, issues with internet connectivity and speed of connection may also prevent greater adoption of information technology, including those technologies designed to support real time decision making and exploit access to data[156]. Privacy and linkage of data sources for farms are also issues. It is not clear that the industry is maximising the use of information collected about it.

The future use of **Genetically Modified technology** in New Zealand remains uncertain. GM technologies may present both risks and opportunities for New Zealand primary industries. The industry has adopted a strategy to keep the option open through research and partnering overseas.

4.6 ASSURANCES: BIOSECURITY AND PRODUCT INTEGRITY

Biosecurity

New Zealand's global connectedness brings with it risks in the form of unwanted pests and diseases arriving in the country from the growing import of goods and increasing tourism numbers. Biosecurity for New Zealand is defined as the exclusion, eradication or management of pests and diseases that pose a risk to the economy, environment, culture and social values, including human health[157]. The biosecurity system operates overseas, at the border and within New Zealand. On dairy farms, biosecurity is about protecting against the impact of animal and plant pests and diseases by reducing the risk of their introduction and spread.

For the dairy industry, breaches in New Zealand biosecurity are an ongoing concern. Recent experiences with new pests and diseases (notably theileria orientalis in cattle and velvetleaf, an invasive plant pest) have reminded of the management and financial impact incursions can having on animals and pastures.

The costs of a biosecurity incidents affecting New Zealand's pastoral industry can be significant for dairy and for New Zealand at large. A large incursion of Foot and Mouth Disease (FMD) has been modelled to decrease GDP by 7.8% (NZ$13.8b)[158]. The first year of a large

FMD outbreak would lose the dairy industry NZ$8.84b in export earnings. FMD would cause significant disruption to New Zealand dairy exports as well as deplete production capability while the disease was being eradicated and reduced earnings during recovery.

The likelihood of FMD entering New Zealand is low (but potentially increasing with increased travel and trade connections in countries where FMD is endemic), and there is a higher likelihood that the industry will need to deal with threats of a less catastrophic nature which affect farm production and systems. The spread of a new strain of theileria (a blood borne disease of cattle that causes anaemia) in spring 2012 had a significant cost to the industry mostly due to decreased milk production. Bovine Viral Diarrhoea (BVD) costs the dairy industry approximately $50 million per year[159]. Annual production losses from Johnes disease are estimated at $40-88m[160]. As well as economic costs are the social impacts and stress related to dealing with these issues.

New Zealand pastures are also vulnerable. Threats are varied and management options more complex than for animal disease. Pasture pests like red clover casebearer moth are estimated to cost farmers more than $600 million each year[161]. The dairy industry has sought to control pasture pests with investment in biocontrol and on farm tools (e.g. pesticide use to control grass grub for example). In addition to insect pests, the New Zealand Biosecurity Strategy 2025 notes that a new plant species establishes in the wild in New Zealand every 39 days. This includes new invasive plant species that pose a threat to pasture. Incursions of giant buttercup and velvet leaf are examples. Many plant pests are deemed to be not-eradicable, creating the need for long term pest management strategies or adaptation on farm. In a business environment with intense pressure on on-farm productivity and profitability, the collective impact of plant and animal health and biosecurity issues can be significant.

An MPI-led FMD preparedness programme has driven improvements in NZ's biosecurity capability and readiness. Industry has had a significant role in this programme, which was developed in response to the New Zealand Auditor General's findings in 2013 of significant inadequacies and serious weaknesses in the system in the biosecurity system. In an update to this report, the Auditor General subsequently found a much-improved state of preparedness[162].

Overall investment by the dairy industry in biosecurity issues has been increasing. The industry is committing more to TB control under new TB Strategy agreed in 2015 designed to eradicate TB from New Zealand. New funding under the DairyNZ's biosecurity programme will raise response capability throughout the industry and develop a decision-making tool for the optimal allocation of resources and prioritisation of organisms that pose threat to the industry.

NAIT (an industry-owned animal traceability system operating in partnership with the Crown) which went 'live' in 2012 as a compulsory system for cattle and deer. Alongside the goal of improving consumer confidence, it exists as an important tool in New Zealand's disease management and biosecurity system. NAIT's value has been demonstrated management of endemic diseases (such as in the forward/backward tracing of TB infected animals) as well as to help ascertain disease exposure and control the spread of new diseases. Whole of lifetime traceability and animal movement information promised by NAIT may be useful for trade partners and customers demanding evidence of e.g. freedom from disease and capacity to trace back to source. The New Zealand dairy industry is unique due to the reliance on stock movements, for example young stock and winter grazing.

Momentum on the dairy industry becoming signatory to the Government Industry Agreement (a Crown-Industry framework for how biosecurity readiness and response is undertaken through) has gained, and it is likely that within the coming years the dairy industry will have the opportunity for greater decision making and visibility over parts of the biosecurity system that influence the risk profile and impact for dairy farmers and processors. It will also become responsible for sharing costs for readiness and response.

MPI's *Biosecurity 2025: Protecting to Grow New Zealand* establishes Strategic Directions and targets that include developing system wide priorities for biosecurity science; increasing transparency of information on organisms; having greater participation (of the public and of business) in managing pest and diseases; enhancing New Zealand standby capacity of trained people to assist in a response; and increasing by at least $80m public and private investment in biosecurity science.

New Zealand's biosecurity risk profile will change over time as new and emerging risks are identified or are exacerbated. The industry should not rule out but plan for risks associated with bio-terrorism. The intersection between biosecurity and climate change is highlighted as an area for investment and knowledge.

Product integrity

In August 2013, New Zealand experienced a significant food safety scare in the suspected contamination of three batches of Fonterra WPC. While international product testing soon confirmed that no contamination had taken place, voluntary disclosure about risks and the precautionary recall of infant formula tested various aspects of New Zealand's private and public food safety and product integrity assurance systems.

The crisis response was complex: and involved managing consumer concerns over the safety of their infant formula, public and media reaction and overseas trade responses. Subsequent reviews and audits of the response identified areas for improvement. One of the key messages from the scare is that the greatest risks to industry lie ahead and active identification of emerging risks from the farm to consumers should be undertaken and invested in (for example the need for new detection methods and increasingly complex business planning incorporating the role and impact of social media). Industry capability in food safety regulations was identified as an area for improvement and that insufficient investment in food safety research could be addressed through the establishment of a Food Safety Science and Research Centre (this was launched in 2016 and has been discussed in the R&D section). Improvements in forward and backward traceability interoperability between information systems along supply chains was highlighted as a further area for improvement[163].

Reviews were affirmative of the regulatory system operating for food safety in New Zealand and that the deliberate risk and outcomes based-approach to assurance was not just appropriate, but world leading[164]. New Zealand's reputation for having trusted institutions, good governance and an open and transparent approach to issue management are part of this mix.

These values were also tested during the late 2015/ early 2016 threat to contaminate infant formula with 1080 unless the use of this pest control poison was stopped. That such a threat was made for business gain demonstrates the food safety system and New Zealand agriculture (its livelihood and reputation) can be vulnerable to malicious intent. This led to a re-examination of potential risks across the dairy value chain, in addition to work already underway globally on frameworks for food defence, including to address food adulteration. MPI launched a work programme on food defence following the incident. Notably dairy processing operations are considered to be easier to secure than farms.

Globally the technology available for testing food, including to ensure its safety and quality, is increasingly more sophisticated, enabling greater precision and detectability of all manner of a product's componentry, including contaminants and residues. While providing greater comfort to consumers, this technology also needs to be accompanied by efforts to educate and inform consumers about the outcomes of such testing so that they understand food risks, as well as ongoing work to align testing methods and standards to ensure that there is not unjustified disruption of trade. It also has important implications for practices behind the farm gate.

International food safety standards are well developed through bodies such as ISO and CODEX. An ISO standard for the food supply chain was adopted in 2015. Recognising that users along the supply chain are facing new food safety challenges, the standard is currently under revision. Among other issues, including redefining risk, the revised standard will take a "farm to fork" approach to preventing, reducing or eliminating food safety hazards throughout the food chain[165]. New Zealand is very active in efforts to promote food safety in the IDF and Global Food Safety Initiative. Commercial opportunities for private verification and assurance schemes are opening out of food integrity concerns, as evidenced by the growth of companies who work with food producers to provide scientific traceability of food products through global food chains. New Zealand food and beverage companies are taking up these schemes to counter food fraud.

Various motives may exist for the New Zealand agriculture industry to be the target of potential "bioterrorism": New Zealand's nearest experience with this to date, a 2005 threat to release FMD on Waiheke, was found to be a hoax.

4.7 COMMUNITIES: LOCAL AND NATIONAL STAKEHOLDERS AND THE LICENSE TO OPERATE

There is an active and ongoing debate occurring in New Zealand as to whether economic growth can be sustained on the current trajectory without seriously compromising New Zealand natural resources. Both the Parliamentary Commissioner for the Environment and Chief Science Advisor to the Prime Minister have highlighted the challenge of balancing economic, social and environmental values with respect to water in particular. In a review that gives particular attention to water resource management, the recent OECD Environmental Performance Review of New Zealand

warned that New Zealand's growth model is reaching its environmental limits[166]. It sees the country facing a trade-off between continued reliance on agricultural exports and environmental and climate change goals and recommends New Zealand decouple growth from natural resource use.

Recent DairyNZ public perception surveying notes that New Zealanders have a strong positive feeling towards the industry connected to their sense of pride in being a kiwi. Performance on environmental matters and animal welfare are detractors where the industry is viewed as falling short of expectations.

4.8 REPUTATION: BRAND, INSTITUTIONS

A theme emerging across a number of issue areas in this section (animal welfare, food safety, product integrity) is that there is a strong association between the success of what New Zealand exports with New Zealand's brand, assurances, institutions and policy settings. Research shows that products demonstrating New Zealand origin may have market value. A Lincoln university survey for example suggests that dairy and lamb exporters could gain NZ$307m in returns from China, India and the UK by 2020 through labelling of products as New Zealand-made and for meeting food safety and animal welfare standards[167]. This premium would increase to over $480m if food safety, animal welfare, and biodiversity enhancement certifications were combined. In China, consumers were prepared to pay a 49% premium for New Zealand food and as much as 74% extra for food safety standard assurances[168].

A challenge may be verifying claims and securing that premium given the increasingly complex global food supply chains.

New Zealand's reputation for producing safe, reliable, quality dairy products has been built up over decades of international trade and is second to none, underlining the critical importance of efforts and investment to protect it.

Analysis and conclusions

5.0

This report has described the current state of affairs for New Zealand's dairy industry as part of a global industry and issues it is facing at home. A forward-looking scan has identified some possible trends for dairy and food in the future as well as risks in the global economic outlook. In such an uncertain and changing future, this section analyses the key political, economic, social, environmental and technological factors across all elements of this report to draw out some key signposts for the industry.

5.1 POLITICAL

Globally there is a higher level of uncertainty about some of the fundamentals that have governed international relations and ways of operating since the end of WWII. The new US Administration has challenged global approaches on key issues like trade and climate change. The UK decision to leave the EU will re-shape global political and economic forces in ways that are not yet certain.

New Zealand has been a beneficiary of a rules-based trading system with an orientation toward the removal of trade barriers and discrimination, as well international institutions that provide for a consensus-based approach to global challenges. The risks go beyond potential barriers to trade, increased support policies for competitor industries and capital flows – New Zealand relies on having a voice on matters that impact it as a country.

In the meantime, national and international rule-making and regulation are continuing to try and keep pace with economic, social and technological developments. The Report outlines many areas that are the focus of new policy globally and domestically that impact on dairy.

Globally governments are focused on environmental issues such as climate change, water and biodiversity, as well as addressing food safety and security, food defence from fraud or criminal activity, public health, agricultural policy, sustainable production and consumption and animal welfare. Greater regulation in these fields is accompanied by growing private standards and verification programmes which are becoming minimum requirements for food companies. For New Zealand dairy this means being able to adapt to new requirements and greater market complexity.

Domestic policy has been and will continue to be a major influencer of dairy, from new biosecurity policy and regulations on health and safety, animal welfare, and resource management, to future policy directions for public investment in agricultural research and development, water allocation, climate change and the ETS. These paint a likely picture of greater constraints on dairy production in New Zealand, higher regulatory standards and compliance costs and less public investment than historically. Farmers will need to continue to adjust to increasing public pressure, scrutiny and compliance.

5.2 ECONOMIC

Slower economic growth and declining growth in trade, rising global wealth disparities and high debt levels in the developed world characterise the global outlook and give rise to concerns about confidence in future demand growth. This is somewhat offset by demographic changes that anticipate a growing middle class in the developing world, and especially Asia, hungry for high quality food products and animal protein in particular. There is room for per capita consumption of dairy to grow, and expectation that it will in Asia, the Middle East, Latin America, the Caribbean and North Africa.

The need to be globally competitive is driving more complex global value chains, including for food products, as well as more concentration in retail and consolidation of the big brand food companies. Dairy continues to be thinly traded with only a handful of major exporters and importers, and while New Zealand exports dairy to many countries, around half our dairy exports go to Asia. Given the likely outlook for global demand growth, New Zealand's connectivity to Asia is important to preserve, including to keep pace with changing Asian consumer expectations.

New Zealand's economic outlook is considered to be generally stable, but for farmers and the dairy sector the story is one of dealing with ongoing price volatility in global markets and resulting unprecedented volatility in farm-gate milk prices. Most recently historically low milk prices have put some farmers and progression pathways under pressure and pushed up farm debt levels. This is igniting debate on the farm systems and farm capabilities that best support resilience to volatility. There have been efforts to emphasise the advantage and resilience of low cost pastoral systems and to create market advantage in selling products from cows grazing on New Zealand's green pastures.

New Zealand's economy is still closely linked to natural resource utilisation, and is still heavily reliant on dairy as the largest industry. Dairy's regional presence also makes it a key driver of regional jobs and economic growth. The economics of dairy over the last decades have driven significant growth at the aggregate level, particularly in the South Island that is now home to 60% of the national herd, and has the largest herd sizes. This Report highlights the current public and policy debate about the ongoing linkage of the country's economic growth to land-use and natural resource utilisation, as well as its social, cultural and environmental aspects.

Economic reliance on natural resources has mobilised government and industry action and cooperation toward protection of New Zealand's favourable biosecurity status, with a significant focus on TB and FMD risk management and preparedness, as well as building tools such as NAIT. However there have been pest and disease incursions that continue to harm the dairy sector and other land-based sectors, highlighting the need for vigilance and continuous improvement of systems and processes.

The industry itself has changed significantly with local and international newcomers, with different business models and product mixes, competing for milk. It is not yet clear what long-term impact on the nature of dairying in New Zealand a more diverse processing sector will have. The more than $2bn invested in further processing capacity in the last four-years, much of it for value-added products, would indicate strong confidence in the value and competitiveness of New Zealand dairy products on the world market.

5.3 SOCIAL AND CULTURAL

Changing attitudes toward food and its attributes will drive changes in how food is produced, what is produced and how it is transformed into food that is consumed. The future world will likely have more people, greater inequality, more diverse nutritional needs and wants and larger cities. This presents multiple challenges of feeding a growing world population, delivering food to mega cities, reducing food waste and ensuring food security, whilst pursuing parallel objectives to sustainably managing finite global natural resources.

A greater focus on food for health and nutrition, convenience, and ethical and religious factors presents opportunities for niche products that dairy's natural goodness and New Zealand production methods may be able to take advantage of. Product innovation and a better understanding of nutritional attributes through

science e.g. the health impact of fats, will develop more food designed to meet the needs of particular segments of the population e.g. aged, children, and open the door for more comprehensive personalisation of food. The world food industry has challenges managing population and demographic trends with public health policy objectives particularly concerns regarding over-nutrition, under-nutrition, micro-nutrient deficiency, in a world with growing inequalities. There may be some risk to dairy consumption from the development of dairy alternatives and synthetic food.

Food fraud and tampering, food safety and product integrity scares have contributed to higher expectations of transparency and assurance required to gain trust. Social connectivity and technology empowers consumers to by hyper-connected and to scrutinise all aspects of food production. The future of food includes greater focus on metrics, verification and audit throughout the supply chain to deliver the transparency that will be demanded by consumers.

A more complex food products business will require a different, more highly qualified and more specialised skill base throughout the dairy value chain. There are obstacles to meeting skills shortages through immigration. Industry attractiveness in New Zealand remains problematic and progression pathways on farm have been made vulnerable by the dairy downturn. Concerns about health and safety issues on farm remain high and there is a shift in focus to farmer well-being and mental health.

Animal welfare remains high in the public interest - not just in NZ but globally as evidenced by ongoing international standards development, and the immediate condemnation of any animal cruelty or mistreatment by the public and the wider industry including farmers. There is also evidence emerging of a potential shift to focussing more on animal well-being and natural animal behaviours. New Zealand's approach to having world leading, evidence based standards, supported by practical implementation and a progressive enforcement model will continue to be important.

New Zealand public concern about impact of dairy on water quality, with its environmental, social and cultural dimensions, is high. New Zealanders generally understand the economic contribution that dairying makes but sentiment about environmental issues, and water in particular, is more front of mind than economic benefit for many. This is impacting on farmers' connection with their communities, the industry's license to operate and the ability of the industry to attracted great people to work in it. Continued urbanisation is exacerbating the urban-rural social divide.

5.4 TECHNOLOGICAL

Significant latent productivity potential in both developed and developing countries increases the imperative within New Zealand to invest in productivity and efficiency gains. The adoption of new technologies, exploitation of growing data sets in precision agriculture applications, further optimisation of cows, grass and farm systems (e.g. through robotics) will be necessary to achieve these gains.

It is not clear yet what the next new generation technologies for agriculture or food production may be. Investment in breakthrough ideas and technology will be essential for a significant industry step change or find a silver bullet for any of the environmental and resource challenges that farming faces. The outlook for partnering in agriculture RS&T in New Zealand is however less certain, with expectations from partners for higher levels of private and industry investment. Not since deregulation of New Zealand agriculture in the late 1980s has there been such a strong imperative and need for continued productivity gains.

Information technology, big data and analytics will support industry's response to consumer and customer information, audit and verification requirements. Information will be connected across supply chains as part of a new business approach to risk management. Real time data will support on farm decisions, supply chain and production management, and inform consumers at the point of sale. Development of interfaces to make data interact across the dairy industry in New Zealand is underway, and while the industry has a long history of collecting and using information (e.g. EID) the implementation of new data systems can be challenging and the collection, manipulation and value derivation from data may be under-utilised.

Within the laboratory, innovative product development will bring new foods with new and sought-after qualities to market. Biotechnology advances have increased the viability of synthetic dairy food production.

5.5 ENVIRONMENTAL

Environmental and natural resource challenges as well as the perception of risk attached to climate change and natural disasters are overtaking economic concerns in the minds of global policy makers and business

leaders. Voluntary sustainability frameworks, supported by performance measures and indicators, are being developed at an international and national industry industry level, reflecting corporate responsibility goals and a desire to respond to consumer expectations about sustainable food.

While water scarcity around the world is set to increase, New Zealand is water rich and this has been and will continue to be an advantage in agricultural production. However, the degradation of waterways due, at least in part, to rapid growth of dairy, has put the dairy industry's action to mitigate its impact in the spotlight, sparking a debate about how much production growth is sustainable. Policy frameworks are in place to set limits and empower regional councils to manage issues in a more consistent way at a catchment level. Voluntary industry action through the Sustainable Dairying Water Accord has made some progress and water quality results, while variable, are encouraging at least in terms of Phosphorous levels. Nitrogen continues to be a challenge and further deterioration is likely before the benefits of mitigation efforts are felt (due to its longevity in the ecosystem).

While some tools are available to help manage nutrient issues in waterways (Overseer, Taupo N market cap & trade), further solutions may require greater research, science and technology solutions and new partnerships with other land and water users. Transparency expectations will require greater evidence of on farm mitigation efforts and performance across other environmental indicators, such as waste, soil quality and biodiversity. How water in New Zealand will be allocated in the future is still to be resolved.

Climate change concerns in particular are an increasing factor in business planning, impacting on investment decisions and increasingly incorporated within business risk management frameworks. Within New Zealand climate change implications are likely to be disruptive for the dairy industry, both in terms of policy responses to mitigate against further global warming given the role of biological emissions within New Zealand's greenhouse gas profile, and in terms of adaptation to climate change related climate variability. Biological emissions are not captured in the current Emissions Trading Scheme but the outstanding question of how New Zealand will meet its UN FCCC obligations (and relatedly if agricultural emissions will be brought into the scheme) will likely carry both compliance costs for farmers as well as risks if there is not sufficient clarity or tools to enable farmers to pursue more emissions efficient production (such as an on-farm point of obligation). The lack of availability of tested mitigation opportunities remains a concern for the industry which has invested in R&D to find solutions.

[1]World Economic Prospects: Weak Investment in Uncertain Times, The World Bank Group, January 2017.
[2] OECD/FAO Agriculture outlook 2016-2025, OECD, 2016
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