Assembling indicators of market access risks for food exports
Report from the Indicators Working Group

pwc

Professor Caroline Saunders
Theme Leader, Our Land and Water National Science Challenge
Director, AERU
PO Box 85084
Lincoln University
Lincoln 7647
Christchurch

09 December 2019

Indicators and market access risk

Dear Caroline

Please find attached a report from the Indicators Working Group on using indicators for assessing market access risk. The report assesses indicators for identifying emerging market access issues in specific markets.

As per our contract received 4 July 2017, this content was originally produced as a submission to an international academic journal. The submission was not subsequently published, and Our Land and Water requested a re-formatted version for release. As a result, the structure of the report is that of a journal submission.

The purpose of the research was to identify and test indicators of the level of consumer interest in specific market drivers. The drivers were previously identified in research by your own unit, the AERU. It focused on trends in international markets that could affect the market access of New Zealand producers to consumers in foreign countries.

This report should be read in conjunction with the Disclaimer in the appendix.

We hope that this report can help Our Land and Water better understand the use of indicators for assessing market drivers.

Yours sincerely

Dr Bill Kaye-Blake
Chief Economist
Wellington
E: bill.h.kaye-blake@pwc.com
T: 04 462 7033

Contents

1 *Abstract*

International trade is important for New Zealand's economy, which exports a large amount of agricultural and food products. Maintaining this level of exports requires planning for future market access issues. The country faces consumer, gatekeeper and regulatory risks from new issues in overseas markets, and identifying the issues can help with this planning. Earlier work identified a number of potential drivers of market access issues (Saunders C. , et al., 2017). Data to create indicators for the strength of these drivers were obtained from a number of sources and used to assess the importance of seven market access drivers across five countries. The analysis compared the importance of the drivers across the indicators and the countries. The results suggest that there is little consistency across markets: different drivers are important in different places. Climate change and carbon prices are relatively important, although not in all markets. The findings suggest that a one-size-fits-all approach may not be appropriate for creating a marketing narrative for New Zealand exports. The research also demonstrates the difficulty of producing a holistic quantitative view of future export drivers.

2 *Introduction*

The value of international trade in food products nearly tripled in the ten years to 2015 (Food and Agriculture Organization, 2015) and reached almost US$1 trillion in 2014 (FAOSTAT). The basic model of comparative advantage, the Ricardian model, described trade based on different commodities, such as England trading cloth for wine from Portugal (Ricardo, 1817). However, international trade also includes countries importing and exporting the same commodity (Krugman, 1980), such as different types of wine. Product differentiation helps explain existing patterns of trade (Helpman, 1981; Besedeš & Prusa, 2006), and provides benefits to consumers (Krugman, 1995). As a result, it is important to understand the drivers of consumer demands for differentiated products.

New Zealand trades in agricultural and food products. Annual primary sector export revenue was forecast to be NZ$42.2 billion in the year to June 2018 (Ministry for Primary Industries, 2018), compared to total merchandise exports of NZ$54.9 billion in the year to April 2018 (Statistics NZ, 2018). The main primary exports are dairy products, meat, wool, forestry products, and horticultural products including kiwifruit, wine, and pipfruit (Ministry for Primary Industries, 2018). The primary sector makes up about six per cent of the country's gross domestic product (Statistics NZ, 2018) but also provides raw materials for the food processing sector and other manufacturing, increasing the significance of the primary sector. Access to export markets for food products and the drivers of consumer demand for food are therefore important for New Zealand.

Saunders, Duff and Driver (2017) assessed the international and domestic drivers that could affect land-use decisions or land-use practices in New Zealand, including some that related to consumer concerns or demands. The present research[1] extended that work by seeking to identify indicators of the level of consumer interest in these specific drivers. It focused on trends in international markets that could affect the market access of New Zealand producers to consumers in foreign countries. In particular, the research sought existing sources of data that allowed cross-section and time-series investigation of the size of consumer concern. This approach was chosen in order to explore a method for efficiently understanding the relative importance of consumer issues without conducting primary research. By identifying and measuring indicators for particular drivers, policymakers and industry groups can anticipate international consumer and market trends and adjust production approaches and marketing efforts appropriately.

---

[1] This report is a re-formatted version of a submission to an international academic journal. The authors of that submission were William Kaye-Blake, Kelly Stirrat, Matthew J. Smith and Ranui A. Ellison.

3   *Literature review*

To analyse the potential impact of consumer preferences on export markets, it was important to understand those preferences. Research in New Zealand over the last several years has sought to gather data on consumer preferences in the country's key export markets (Miller, Driver, Velasquez, & Saunders, 2014; Lees & Saunders, 2015; Saunders, et al., 2015; Guenther, Saunders, Dalziel, Rutherford, & Driver, 2015; Driver, Saunders, Guenther, Dalziel, & Rutherford, 2015; Saunders & Driver, 2016). Through both surveys and interviews, the research created a dataset of the relative importance placed on a set of food attributes by consumers in China, India, Indonesia, the UK, Japan and New Zealand (AERU, 2017). The research has used both attitudinal data and willingness-to-pay methods to assess the levels of consumer concern. These techniques can provide data on the relative importance of product attributes, across attributes, products, countries, and consumer segments.

Patterns of international trade are also affected by institutions and organisations involved, such as global supply chains and national governments (Food and Agriculture Organization, 2015). Consumers buy products from retailers, either the brick-and-mortar type or virtual, and these retailers are at the end of supply or value chains or embedded in networks (Chen & Paulraj, 2004; Saunders, et al., 2016). Those retailers influence the decisions that consumers make by acting as guides and gatekeepers (Anderson, 2007). They filter the products that are available to consumers and they recommend patterns of consumption based on the preferences and ambitions of those consumers (Earl, 1986). In addition, the market for food products is affected by government policy and regulations. Governments not only influence prices through tariffs and quotas, but they apply a range of other policies that affect trade directly and indirectly (Krugman, 1998). From the perspective of an exporting country, consumer preferences, gatekeeper behaviour and government regulations are all factors in shaping import demand for its products (Sanderson, et al., 2003). Consumer preferences create risks that consumers may choose to avoid purchasing certain products or product from certain countries. Gatekeeper behaviours entail risks that firms in a supply chain may stop accepting products or may impose onerous demands on suppliers, making it difficult or impossible for exporters to get their products to final consumers. Finally, regulatory risks involve changes to laws or regulations in an importing country that reduce or prevent access to its consumers. As result, exporting countries need to understand not only overseas consumers, but also the regulatory and commercial environment of importing countries. Gatekeepers and regulators may be responding to consumer concerns or to other pressures, and their reactions can serve to blunt or amplify consumer preferences (Sanderson, et al., 2003). These preferences, behaviours, and risks are also dynamic, so exporters need to stay informed about present trends and develop expectations about the future.

Saunders et al (2017) identified 32 possible drivers within three broad themes with respect to New Zealand's primary production, as shown in Figure 1. The present research focused on seven of those drivers deemed most relevant to international market access. Under the economic theme, those drivers were food safety and carbon emissions trading schemes. Under the environmental theme, the drivers were food miles or local food (locavore), climate change, and water quality. Finally, the social theme included the drivers ethics/fair trade and animal health and welfare.

Figure 1. International and domestic drivers likely to impact land use practices
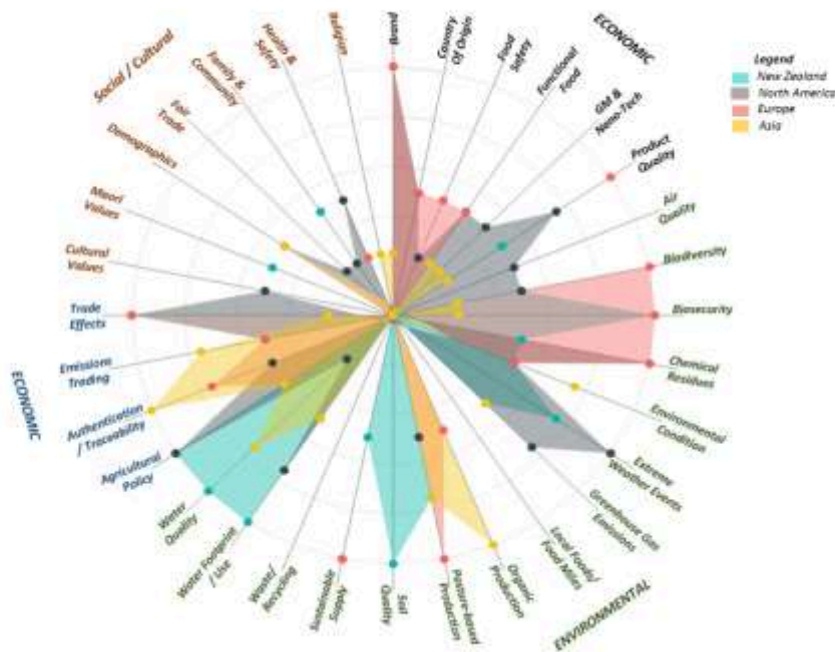
Source: (Saunders C. , et al., 2017)

3.1 Economic drivers

The economic drivers of food safety and carbon emissions trading schemes could affect New Zealand's access to international markets. Food safety refers to the conditions and practices that preserve the quality of food (Saunders C. , et al., 2017). Poor food safety practices are a public health issue, but also a consumer perception issue. If specific food products from New Zealand are perceived to be unsafe to eat, export markets may stop importing those products. As well, that perception could be 'contagious' and spread to all food exports from New Zealand. Globally, poor food safety practices cause over 600 million cases of illness each year (World Health Organisation, 2015). With the growing complexity of global food supply chains, there is less certainty over the safety of some food products, and greater opportunity for food scares (Whitworth, Druckman, & Woodward, 2017). As a result, the level of concern over food safety issues is likely to increase, which has the potential to limit New Zealand's access to export markets. In one example, Chinese consumers were found to be willing to pay more for food products with safety labelling, although the observed price premium was modest (Wang, Mao, & Gale, 2008). An issue identified in the research is whether consumers are sufficiently informed about food safety labelling, however (Wang, Mao, & Gale, 2008).

Carbon emissions trading is a market-based solution that provides economic incentives for reducing polluting emissions (Saunders C. , et al., 2017). There are currently 17 emissions trading schemes for greenhouse gases spanning 35 countries. In recent years, there has been a general increase in countries recognising the importance of committing to emissions reducing activities. Emissions trading is one of the mechanisms countries can use to incentivise emissions reductions. As more countries impose charges on greenhouse gases, it is possible that they may establish trade barriers for countries that do not (Reinaud, 2009). The price of carbon, therefore, becomes a consideration in trade decisions. One analysis found that 21.5 per cent of global CO_2 emissions were embodied in international trade in 2001 (Peters & Hertwich, 2008). The concern is that individual countries can reduce their own emissions from production by using international trade, allowing high-emission activities to happen in other countries and importing their products. However, it is not simply the case that traded products are associated with higher emissions than domestic products, as careful analysis has shown (Saunders, Barber, & Taylor, 2006). Thus, policies would need to be designed to adjust for the

carbon content of consumption as well as production (Peters & Hertwich, 2008). If New Zealand is not seen to be pricing carbon appropriately this could prove to be a threat to market access.

3.2   *Environmental drivers*

Local food, climate change and water quality are among the environmental drivers that have the potential to affect New Zealand's access to international markets. Research has drawn direct links between international trade and the effects of production activities on the environment. One study reported that 'a significant number of species are threatened as a result of international trade along complex routes, and that, in particular, consumers in developed countries cause threats to species through their demand of commodities that are ultimately produced in developing countries' (Lenzen, et al., 2012, p. 109). The research linked the import demand for products to environmental damages, in that case, species decline. The authors suggested that different consumer choices could reduce species loss by reducing trade in products with high environmental impacts.

Demand for local food is a complex driver that includes issues such as food miles, country of origin, and consumer ethnocentrism. Food miles refers to the distance food travels from the place of production to the place of consumption (Saunders C. , et al., 2017). As the awareness of the environmental impact of agriculture has become more widespread, the concepts of 'local foods' and 'food miles' have become powerful tools in shaping consumption choices. Given New Zealand's distant location relative to many trading partners, food exports can travel a long way to their destination. Increasing concern over food miles could, therefore, pose a threat to consumers in export markets purchasing New Zealand food products. Research suggested that food miles contribute a small portion of the total energy and greenhouse gas emissions associated with food production (Weber & Matthews, 2008; Saunders, Barber, & Taylor, 2006; Coley, Howard, & Winter, 2009; Saunders & Barber, 2008). However, the facts about energy consumption may not change consumers' perceptions about the importance of food miles, nor the potential for gatekeeper activity to restrict products from distant producers.

Country of origin (COO) refers to the location where a food product was initially produced or processed. It is typically associated with labelling to communicate the COO to the consumer. Grunert (2005) identifies COO in Agribusiness as a cue that acts as a proxy for other drivers including quality and food safety. It may also serve to signal food products that are locally produced. While there is limited information to suggest that COO labelling is a major consumer preference for primary products (Saunders C. , et al., 2017), widespread preferences within key export markets for products from specific countries of origin (Bremer, Mirosa, Kaye-Blake, Cong, & Harker, 2018) could impact New Zealand's performance in those markets. One trend relevant for the tendency to 'buy local' is consumer ethnocentrism. The definition of consumer ethnocentrism developed in the literature seems to focus on strong and blanket preferences for domestically-produced products (Shankarmahesh, 2006). That is, it is 'inelastic with respect to price or other product related attributes' and 'a general tendency … as opposed to a specific attitude' (Shankarmahesh, 2006, p. 148). Although it is considered distinct from COO preferences, consumer ethnocentrism is one type of consumer preference that prioritises local products over foreign products and could reduce market size for exporting countries.

Climate change refers to the anthropogenic shifts in global climate patterns, largely brought on by increased industrial activities involving the release of greenhouse gases. Increased awareness of the environmental impact of food production could influence consumers' food purchasing decisions (Saunders C. , et al., 2017). The nature of consumer concerns may not be well articulated, and could intersect with several other issues (de Boer, de Witt, & Aiking, 2016). Increases in greenhouse gas emissions are related to both production and consumption activities, and can be linked to industrial manufacturing, transport, and agriculture, all of which are part of the agri-food supply chain. Just within the agricultural production system, greenhouse gases can be linked to fossil fuels, such as diesel for tractors or petroleum for agricultural chemicals, and to biological emissions, such as methane produced by ruminants. How consumer concerns about climate change will affect the agri-food system is therefore uncertain.

Water quality refers to the physical state and purity of water bodies and water used in primary production. Researchers attempted to understand the salience of water quality in traded products by surveying consumers across six countries, including China, India, Indonesia, Japan, New Zealand and the UK (AERU, 2017). The survey asked participants to rank their concerns when shopping for food and beverages across ten attributes, one of which was the environment. As a subset of the environment, water quality was ranked the number one attribute in all countries surveyed, with 85 per cent of Chinese respondents and 80 per cent of British respondents identifying it as significant (Saunders, et al., 2016). The research demonstrated that water quality is the most significant consumer concern within the wider theme of the environment (Guenther, Saunders, Dalziel, Rutherford, & Driver, 2015). Water quality as an environmental concern could thus affect consumers' food choices, as well as gatekeeper behaviours with respect to the food supply chain.

3.3 Social drivers

Fair trade and animal welfare are two social drivers that could affect New Zealand's access to food export markets. Fair Trade is a movement, so its definition is not exact (Moore, 2004). However, it involves creating international trading relationships that support producers by improving prices and other business terms, and that also raise awareness among consumers in richer countries of the impacts of trade on producers in poorer countries (Moore, 2004). It denotes trade between companies in developed countries in which fair prices are paid to producers, or, the branding developed by international group Fairtrade International is applied (Saunders, Duff, & Driver, 2017). At an international level, some consumers have shown a preference for ethically produced and fairly traded goods. In 2012, the total value of fairly traded goods amounted to $1.4 billion in the US alone (Hainmueller, Hiscox, & Sequeira, 2015).

Fair Trade products appeal to a few different consumer segments (Moore, 2004; Ozcaglar-Toulouse, Shui, & Shaw, 2006). The exact motivations have changed over time, but the core motivations are ethical consumerism and 'green' environmentalism (Moore, 2004). To appeal to the ethics of these consumers, Fair Trade shortens the perceived separation or distance between consumers and producers (Moore, 2004). The aim is for a more meaningful and personalised transaction (Moore, 2004; Ozcaglar-Toulouse, Shui, & Shaw, 2006). The extent of the underlying consumer trust in Fair Trade as a concept and Fair Trade products can be measured by survey research (Castaldo, Perrini, Misani, & Tencati, 2009). Furthermore, the eventual purchase intention can be deconstructed into attitudes, personal behavioural control and self-identity (Ozcaglar-Toulouse, Shui, & Shaw, 2006), all of which are potentially measurable with indicators.

Animal welfare is a blanket term for the living conditions and or the psychosocial state of animals. For the purposes of this research it refers specifically to animals used in the food production process (Saunders C. , et al., 2017). Consumers tend to define animal welfare in terms of natural lives and humane deaths, meaning animals should be allowed to live as closely to how they would naturally as possible (Harper & Henson, 2001). Consumers both internationally and domestically have shown a preference for products that maintain or enhance the animal welfare, and are willing to pay for such products. Harper & Henson (2001) explain that 'consumers equate good animal welfare standards with food standards'. Guenther et al (2015) found that among food markets surveyed, animal welfare was one of the top five qualities that impact purchasing decisions. If New Zealand's food products are not perceived to support animal welfare, this could pose a threat to international market access for those products.

3.4 Use of indicators

Saunders et al (2017) found that the issues discussed above have the potential to threaten New Zealand's access to international export markets for food products. To measure the impact that these issues could have, the use of indicators is required. Indicators are commonly used to provide an understanding of the state of a phenomenon of interest, and are measured over various times and/or spaces to allow comparison and observation of trends (PwC, 2017). When using indicators to measure issues, it is important that the indicators chosen are fit for purpose. One scheme for assessing indicators identified six criteria for fit-for-purpose indicators (PwC, 2017). Valid indicators adequately reflect the phenomenon they are intended to measure and

are appropriate for their intended purpose and users. Indicators should be defined as clearly as possible and should use standardised processes that enable measurement to be repeated across different places (cross-sectional data) and time periods (time-series data). They should ideally use data that is readily available or can be collected with time- and cost-effective methods, enabling more data to be collected and increased uptake of indicators. Indicators should also be easy to communicate to or with their intended audience. They should measure actual performance towards outcomes as opposed to processes that may be far removed from any impact, although where this is not possible, relevant proxy measures can be a useful substitute. Finally, fit-for-purpose indicators should be accepted and supported by necessary stakeholders to ensure they are actually used and meaningful.

Two concerns that motivated the present exercise were seeking standardised indicators to improve spatial and temporal comparability, and relying on already-collected data rather than primary research, in order to have a time- and cost-effective approach to assessing the potential impact of these consumer issues. It is possible to find individual pieces of research that focus on one or another of the issues discussed, and many such pieces of research were cited above. They measure the strength of consumer preferences at a point in time and for particular places. Also referenced was one research programme that collected large amounts of consumer data across several countries and many issues (AERU, 2017; Saunders, et al., 2016), but the data have short time series and the method has not been used to develop other comparable data sets. To begin a process of estimating future impacts of specific issues based on indicators, standardised, accessible data from existing sources would be preferable.

4   *Method*

Saunders et al (2017) developed a list of drivers likely to affect New Zealand's primary sector (Figure 1), and the present research focused on seven consumer-related issues in some of New Zealand's key trading partners. The markets chosen for this research, and the dollar value of exports to each country in 2017 (Statistics NZ, 2017), were Australia (NZ\$8.4 billion), China (NZ\$10.4 billion), the European Union (EU) (NZ\$4.8 billion), the United Kingdom (UK) (NZ\$1.4 billion), and the United States (US) (NZ\$5.2 billion). For each driver, the literature was reviewed to identify any fit-for-purpose indicators that could be used to measure its potential impact. For several drivers, either there was no specific indicator suggested, or indicators were not used consistently available across the markets studied. In these cases, the descriptions of the drivers were used to identify potential candidate indicators, which were then reviewed for availability and validity. The indicator for each driver is noted in Table 1.

Table 1. Selected drivers and indicators

Driver	Indicator
Food safety	Number of outbreaks of foodborne illness per 100,000 population
Carbon emissions trading schemes	Carbon price under emissions trading schemes
Local food	Proportion of agricultural products subject to import duties
Climate change	Proportion of people concerned about climate change
Water quality	Proportion of people concerned about environmental problems
Ethics and fair trade	Total international revenue of FairTrade-branded products
Animal health and welfare	Rate of vegetarianism as percentage of population

To the extent possible, indicators were selected using the criteria of fit-for-purpose indicators (PwC, 2017), although some of the indicators do not meet all the criteria. In order to focus on time- and cost-efficient indicators, primary research was not conducted; instead, data was sought from a range of sources including

official statistics, government data, large-scale consumer surveys, market research data, and academic literature. Where possible, a time series of data was collected over the past ten years for each of the export markets. Due to data limitations and inconsistencies across data sources it was not possible to collect the same data from the same time periods for each market. Data was standardised as much as possible, in particular by seeking data collected with standard definitions and by focusing on the rate of change over time rather than levels of indicators.

Indicators for economic drivers were generally available. The indicator chosen for food safety was the number of outbreaks of foodborne illness per year, standardised per 100,000 population. Government data on this indicator was found for both the UK (Public Health England, 2017) and US; however, the US Centers for Disease Control reports only multi-state outbreaks (Centers for Disease Control and Prevention, 2018), which is a narrower definition than the other countries. Data from the World Health Organisation were available for Europe, while data for Australia were collected by researchers and published in an academic journal (Astridge, et al., 2011). No data source was found for foodborne illness outbreaks in China. The indicator to measure the impact of emissions trading schemes was the price of carbon under the schemes. The EU has a region-wide emissions trading scheme covering all 28 EU member states. The UK had its own scheme from 2002 until becoming part of the EU emissions trading scheme in 2005. Australia had an emissions trading scheme from 2012 to 2014, and replaced it in 2015 with an alternative carbon-pricing mechanism. For Australia, the prices of emissions reductions purchased through the Emissions Reduction Fund was used for the Australian carbon price. The US has two regional schemes and China launched a scheme in 2015 that covers six cities and seven provinces. For the US and China, the average value across the schemes was taken to give a single value for the market.

Indicators were selected for the three environmental drivers. The indicator chosen for local food was the percentage of agricultural product imports that incur duties for each market. Data for this indicator were available from the World Trade Organisation (World Trade Organisation, 2016). The climate change driver was measured by the level of concern about climate change. Data on public concern about climate change were available through government or academic surveys in each of the five markets examined, though data from China were limited (Stokes, Wike, & Carle, 2015; Yu, Wang, Zhang, Wang, & Wei, 2013; European Comission, 2017; UK Department of Business, Energy and Industrial Strategy, 2012 - 2018; Lowy Institute for International Policy, 2017; Leiserowitz, et al., 2018). The level of concern about the environment was chosen as a proxy indicator for water quality as there were no consistent measures specific to water quality in the markets of interest, and water quality is key to consumers' environmental judgments (Guenther, Saunders, Dalziel, Rutherford, & Driver, 2015). Data for Australia, China, the UK and the US were collected by National Geographic (2008; National Geographic, 2010; National Geographic, 2012; National Geographic, 2014), while EU government data was available for the EU (European Commission, 2014).

Two social drivers were investigated. The indicator chosen for measuring the impact of ethics and fair trade was the total global revenue of the FairTrade brand (Statista, 2018). This indicator was chosen as there were no consistent or reliable measures of concern about fair trade specific to the markets of interest. FairTrade International appeared to collect data on producers, but not on their markets (FairTrade International, 2015). The indicator chosen for animal welfare was the rate of vegetarianism in each market. It was chosen as animal welfare is often cited as a reason for choosing a vegetarian diet. Government statistics on vegetarianism were available for Australia (Australian Bureau of Statistics, 2013), while data for the US and UK came from industry bodies (The Vegetarian Resource Group, 2017; Vegetarian Society, 2013). Reliable data on the rate of vegetarianism in China was not found.

Analysis of the data considered two perspectives. One was an analysis by indicator, which assessed the importance of the driver across the countries in the analysis. The relative importance was assessed both as the current level and as the rate of change over a recent time period. As data were available at different frequencies for each indicator and each market, the rate of change was standardised by using compound annual growth rate. The second perspective was an assessment of each country across all the drivers, to investigate the relative importance of the different drivers in each market. For the country analysis, the focus was on the rate of recent changes, on the assumption that change is more disruptive for consumer, gatekeeper, and regulatory risks than any particular level of concern. Methods were considered for collapsing the two dimensions in the indicator

analysis into single scores for the country analysis, but the heterogeneity of the underlying data meant that any approach to creating a single scoring method across all indicators and countries was inconsistent.

5   *Results*

The results from the two summary assessments are presented below. The underlying data are available in the appendix. The results are presented in two figures. The first figure contains two-dimensional graphs for each indicator as a scatterplot of country results. The second figure contains seven-axis spiderweb diagrams for the countries, with one axis for each indicator.
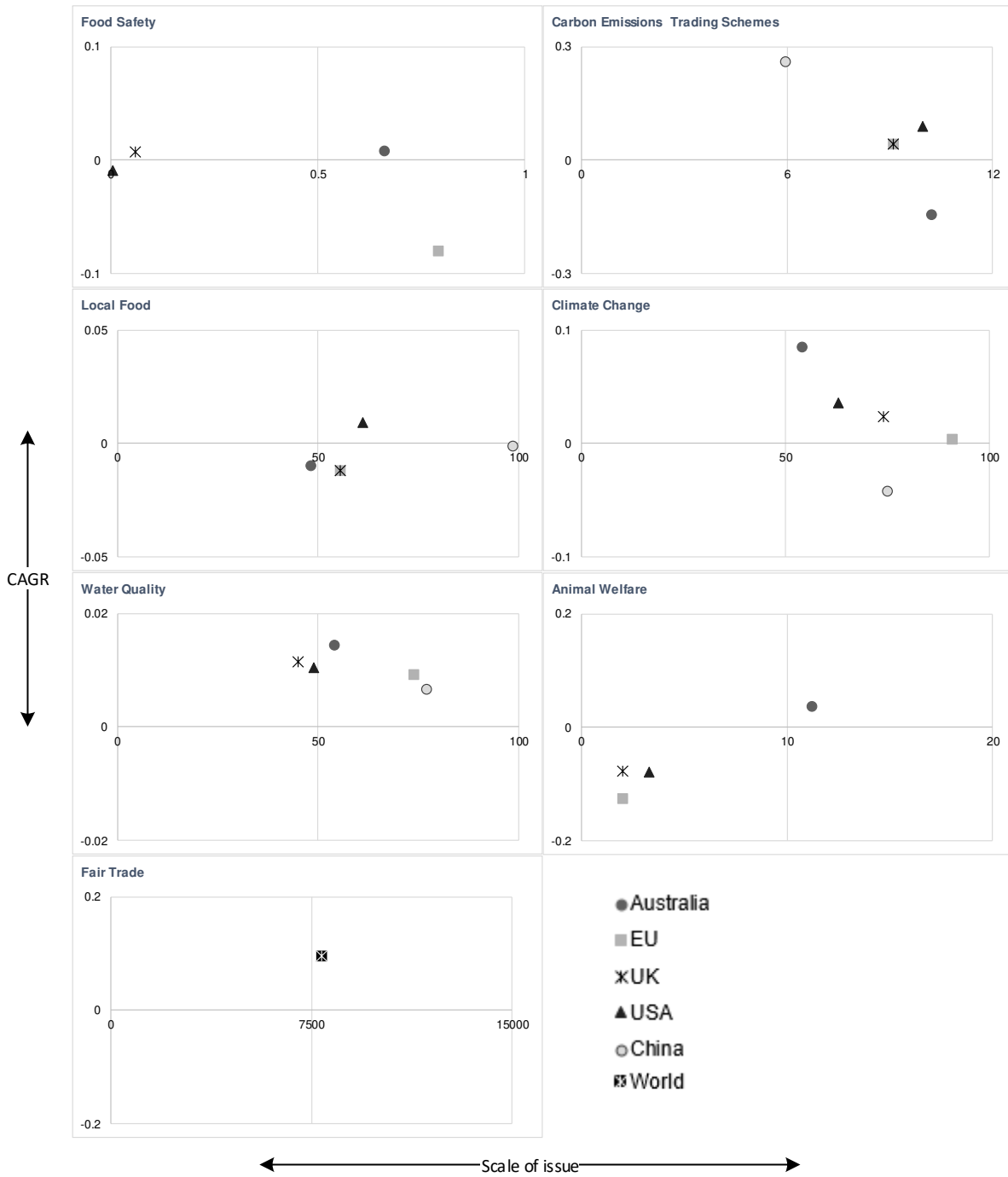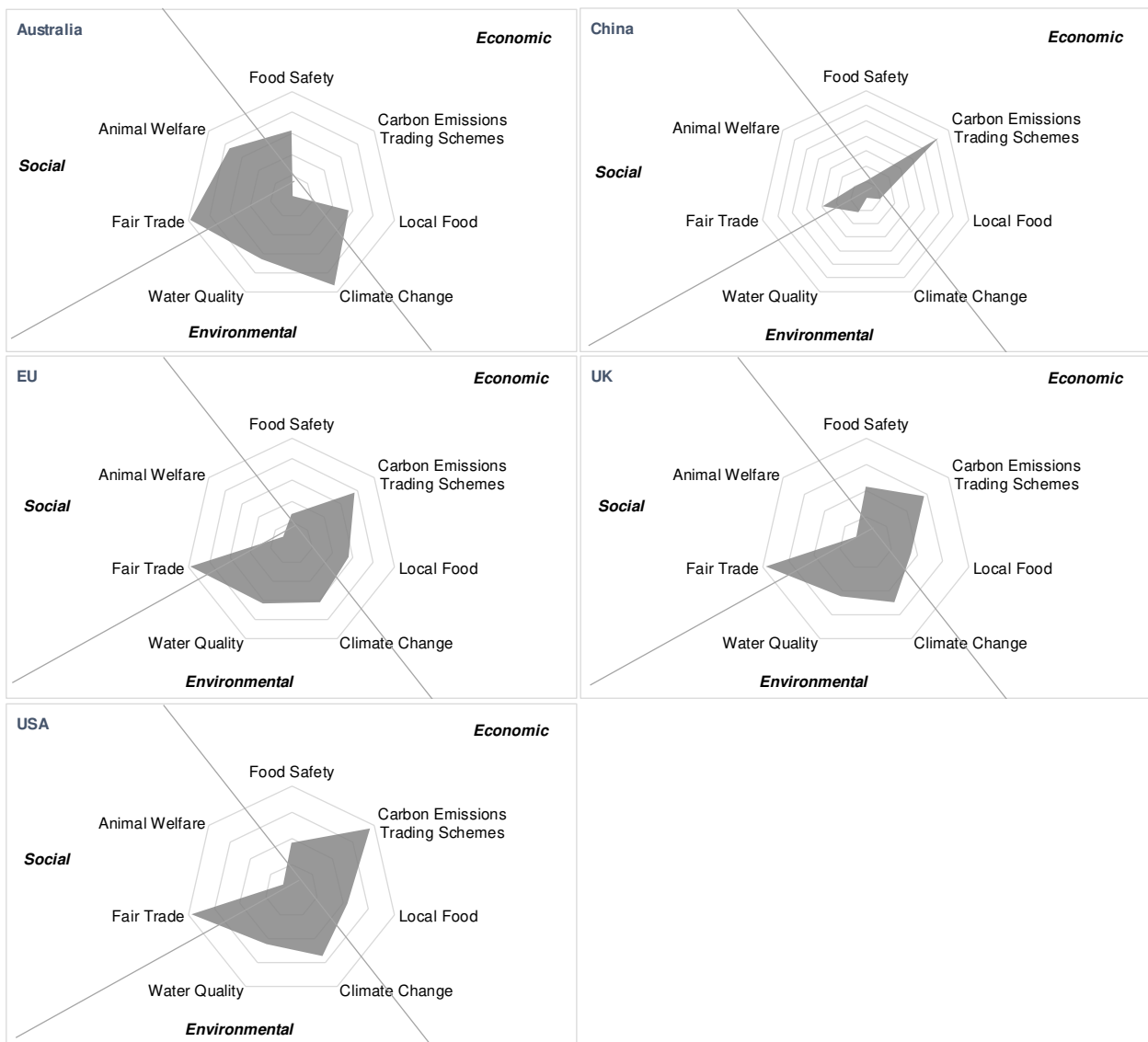
Figure 2. Indicator results

Figure 3. Relative change in indicator for each market

Australia — radar chart with axes: Economic, Food Safety, Carbon Emissions Trading Schemes, Local Food, Climate Change, Environmental, Water Quality, Fair Trade, Social, Animal Welfare

China — radar chart with axes: Economic, Food Safety, Carbon Emissions Trading Schemes, Local Food, Climate Change, Environmental, Water Quality, Fair Trade, Social, Animal Welfare

EU — radar chart with axes: Economic, Food Safety, Carbon Emissions Trading Schemes, Local Food, Climate Change, Environmental, Water Quality, Fair Trade, Social, Animal Welfare

UK — radar chart with axes: Economic, Food Safety, Carbon Emissions Trading Schemes, Local Food, Climate Change, Environmental, Water Quality, Fair Trade, Social, Animal Welfare

USA — radar chart with axes: Economic, Food Safety, Carbon Emissions Trading Schemes, Local Food, Climate Change, Environmental, Water Quality, Fair Trade, Social, Animal Welfare

5.1 Indicator perspective

The indicator graphs provide a summary assessment of the importance of each driver across the countries in the study. Each graph presents the level of the indicator on the x-axis and the compound annual growth rate (CAGR) on the y-axis. Countries closer to the origin are markets in which the indicator indicated that the particular issue was less important and consumer concern was fairly constant. Countries in the upper right-hand quadrant were markets where concern about the issue is strong and growing.

Overall, there was no strong trend among the economic drivers. The price of carbon under each trading scheme had experienced a series of fluctuations. In general, however, the price of carbon under each market's scheme had increased in the past five years, except in Australia. Carbon prices in Australia have decreased significantly since their trading scheme was replaced with an auctioning mechanism in 2015. Both China and the US had more than one emissions trading scheme. China's scheme was established most recently and covered only the six top emitting provinces and seven cities. The Chinese scheme was introduced in 2017 and the price has increased in 2018 in all provinces and cities it covers. The US had two schemes: the California Cap and Trade Programme and the Regional Greenhouse Gas Initiative (RGGI), covering nine north-eastern states. The UK did not have a specific emissions trading scheme as it fell under the EU scheme. The figure suggests that emissions trading schemes were important in several countries, and becoming even more important. For the second driver, foodborne illness outbreaks in Australia and the UK have increased in recent years, but they have decreased in other markets, with a significant decrease in the EU. There were also very few outbreaks each year, so even in those markets that have seen an increase, foodborne illness outbreaks are uncommon. The graphs for these two indicators suggest that these drivers behave differently across the markets, and there is no consistent economic theme for market access.

The indicator graphs showed mixed results. The level of trade protectionism had decreased, with a higher proportion of agricultural products now being imported duty free compared with 2010. For most of New Zealand's top export markets, around half of agricultural products are able to be imported duty-free. China, however, has duties on around 99 per cent of all agricultural imports. There has been only a small amount of change in this proportion in these countries, with most increasing the amount of duty-free products. Only the US has increased the proportion of products that are subject to import duties. However, the indicator graphs do suggest some concern about the environment in the markets investigated. For climate change, most countries were in the upper right-hand quadrant of the graph. The data showed that a high proportion of people were concerned about climate change in each of the markets, and the proportion has been increasing in every market except China. Similarly, the data showed a high level of concern about the environment in each market, with growth in that concern. The graphs suggest that environmental concerns are possibly important as potential trade issues across the countries investigated.

Two social drivers were investigated, although the data for creating indicators were relatively poor. One social driver was ethical consumption, proxied by purchases of FairTrade products. Because FairTrade International does not report country-specific consumption figures, it was not possible to assess the scale of the issue or the change over time at a country level. It was possible, however, to observe that trade in FairTrade products has been growing at nearly ten per cent per year. The increase suggests an increase in global awareness of the brand and concern about ethically produced and traded goods, although not specific to food products. The other social driver was animal welfare, and the indicator was the proportion of vegetarians in each market. The level of vegetarianism has decreased in most of the markets we investigated; they decreased in the EU, UK and US, although they increased in Australia. Vegetarianism is only one way that people can demonstrate their concern for the welfare of animals through dietary choices, however, so the link between the driver and the indicator could be weak. The two indicators do not provide a strong result about directionality of social concerns with regard to food consumption or imports in the target markets.

5.2 Country perspective

The second approach to summarising the indicators involved creating a country-specific perspective, to examine the drivers that were potentially affecting consumer demand. The approach used was to present the indicators on spiderweb diagrams for each country, as shown in Figure 3. Taken together, the graphs suggest that there was no consistency across the countries: no driver was consistently important across all markets. They further suggest that no particular theme was important: across the economic, social, and environmental themes, no one of them was consistent prominent.

The graphs do suggests which drivers were of concern in each country. In Australia, the issues that seemed to be the greatest concern were climate change, food safety and animal welfare. Concern about the environment and climate change, as well as the proportion of vegetarians, have shown the biggest increases in recent years. The graph does suggest that the social theme has some prominence, although, again, the FreeTrade data were global rather than national. Data for some of the indicators were not available for China, however economic issues appear to be the most important. The driver that could be the biggest issue for access to the market in China was the price of carbon under their emissions trading scheme. The price of carbon has increased by over 25 per cent since the scheme was launched in 2017. On the issue of local food, it is important to note that, while the proportion has decreased, China imposes duties on almost 99 per cent of relevant products. The impact of the China-New Zealand Free Trade Agreement has not been factored into the analysis, because the aim is to understand general attitudes towards local foods rather than specific trade policies. Overall, the economic drivers were mixed for China. In the EU, carbon prices and environmental issues appeared to be important drivers. Under the EU emissions trading scheme, the price of carbon has increased by over 20 per cent in the past five years. Concern about the environment generally and climate change specifically have both increased in recent years. These results suggested that environmental concerns were the drivers most likely to cause market issues. In the UK, economic and environmental issues tended to be of greater concern than social issues, but even they showed mixed results. The biggest issues for the UK market were concern about the environment and climate change, as well as the price of carbon; foodborne illness outbreaks also had some significance. As with the EU and UK, economic and environmental issues tended to be important themes for the US. The proportion of people concerned about climate change, and the environment more generally, increased over the past few years. The price of carbon also increased under US emissions trading schemes. The US was the only market in which the proportion of agricultural products subject to import duties increased. Local food, carbon prices and environmental impact thus seemed to be salient issues for the US market.

The overall impression is mixed. There were no specific themes around which New Zealand could organise its primary exports and hope to appeal consistently to its largest export markets. Within the themes, specific drivers were important for each country, but the importance of each driver varied by country. The general pattern (shape) for the EU, UK, and US was somewhat consistent, emphasising climate change and carbon price (and possibly ethical/fair trade), and de-emphasising food safety and local foods as consumer drivers. However, the patterns of drivers were different for Australia and China. For Australia, animal welfare and climate change could be useful to address, while the carbon price seemed to be a key driver for China.

6   Discussion

New Zealand's position as an exporter focused on primary production means that it relies on access to international food markets. Potential issues that could threaten this access need to be addressed to ensure that exports are not compromised. A wide range of drivers of international demand have the potential to create market access issues for New Zealand (Saunders C. , et al., 2017). To get a sense of the issues that could become important and to prioritise efforts to address them, an assessment that integrates across many drivers and markets is needed. Furthermore, to ground the analysis in evidence and data, the drivers should be quantified by indicators.

The research demonstrated a possible approach to getting this high-level view. It demonstrated that it is possible to assemble data from different sources and analyse and present it in a way that demonstrates the importance of specific indicators, both overall and by export market. The graphs presented provide a digestible summary view of some key drivers and suggest which consumer issue could become important in the near future.

From an indicator perspective, there are a few drivers to monitor. Examining both the scale and the recent change of each driver provided an indication of the issues that could be important for New Zealand. When looking at a combination of scale and change, the data suggests that climate change and the environment in general are both a large and growing concerns. Over half of people in all markets are concerned about climate

change, with over 90 per cent of those in the EU concerned. That level of concern had generally grown over the previous five years. Looking at both scale and change also indicates that emissions trading schemes could prove an issue for New Zealand. The price of carbon under each market's scheme has increased over the past five years, except in Australia.

The indicator data suggests certain drivers are less important than others, and may become less of an issue over time. Animal welfare, for example, does not appear to be a pressing issue. The rate of vegetarianism in each market, chosen as the indicator for animal welfare, is low and decreasing in most markets. This finding suggests that the risk of consumers choosing a meat-free diet is low. As meat products are a significant export commodity for New Zealand, the decline in vegetarianism is likely to be good for exports. Whether the rate of vegetarianism is a good indicator for more generalised animal welfare concern is an open research question, and would have bearing on potential market access issues.

For some of the drivers selected, it is difficult to infer trends based on the indicator data. Food safety is one such issue. The level of foodborne illness is inconsistently reported, although it is possible to track changes over time for most export markets. A further issue is whether the actual rate of incidents is a good measure of concern or perceptions. The indicator for ethics and fair trade shows that the value of products traded under the FairTrade brand is growing. The available data is not specific to markets, so it is difficult to know whether the generalised growth in concern is replicated across all countries. Local food is another issue in which there is no clear pattern in the indicator data. China was the extreme example in this case, with nearly 99 per cent of all agricultural imports subject to duties. In each of the other markets, the proportion of agricultural products subject to import duties was around 50 per cent, and had decreased in all markets except the US. There is some evidence from the literature of growing consumer preferences for locally produced food (Coley, Howard, & Winter, 2009), but there is no widely available source of data to assess this trend across markets and relative to other drivers.

Examining the indicators in each market highlighted some of differences among New Zealand's trade partners. In Australia, for example, food safety, climate change and animal welfare are the issues that have shown the biggest increase in importance. Australia is one of just two markets in which foodborne illness outbreaks increased, and the only one in which vegetarianism increased. In China, the price of carbon is the issue that has increased the most. In the EU, UK and USA, carbon prices are also an important issue, although concern about climate change and the environment in general are just as important. The results suggest that similar drivers are important for the EU, UK, and USA, but that Australia and China could be focusing on different drivers.

The analysis also show that, while drivers can be linked to certain themes (economic, environmental and social), consumer demand seems more likely to be driven by specific issues than broad themes. In general, the social drivers were less important than the economic and environmental ones. Not all economic and environmental drivers were equally important, however. Carbon emissions trading schemes were the only economic driver that appeared to be an important issue in most markets. The level of concern about climate change was the most important environmental issue in every market, and is also growing. The results suggest that it is important that New Zealand address drivers of international consumer demand on an issue-by-issue and country-by-country basis. The two drivers that look most likely to present issues across key export markets are climate change and emissions trading. These two issues are interlinked. The implementation of emissions trading schemes is a reaction to growing global concern over climate change, and is a measure intended to mitigate climate change.

The goal of the exercise was to create a summary of consumer drivers across major export markets for New Zealand, using quantitative indicators. While it was possible to locate indicators for many drivers and markets, the process has identified limitations in doing so. Fit-for-purpose indicators for some drivers were located; however, for other drivers the link between the indicator and the driver was less direct. For example, while vegetarianism and animal welfare are linked, the one is not necessarily a good indicator of the other. Pragmatism was allowed to prevail, in the sense that the exercise focused on finding the best available information in a cost-effective way. The biggest limitation to using indicators for the research was the lack of consistent data, particularly for comparisons across countries. For example, data on the number of foodborne illness outbreaks were inconsistently defined across the countries, data on FairTrade were insufficiently disaggregated, and some data were unavailable for China. Focusing on rates of change rather than raw data helps overcome international inconsistencies, but the level of concern in each country is also likely to be useful to understand. The central difficulty is that anticipating consumer, gatekeeper, and regulatory risks is

important for maintaining market access, but the type of data required to do so across multiple drivers and countries – panel datasets of consumer and market concerns – simply do not exist. The best that can be hoped for is a cobbled-together analysis of multiple data sources.

7   Conclusion

Multiple drivers of trade and market access are likely to affect New Zealand's primary sector exports, which are an important part of its economy. Important drivers have been identified in prior research (Saunders, Duff, & Driver, 2017), and they are likely to lead to consumer, gatekeeper, and regulatory risks in the future. To anticipate those risks, an analysis of indicators for some key drivers was undertaken. The main result of the assessment of seven indicators for five countries was the variability across them. There was little consistency regarding which drivers were important across the countries. To some extent, climate change and carbon prices concerns are important, but only for some markets. In each country, indicators pointed to a different set of drivers as being key for that market.

To support New Zealand's positioning in these markets, there are a few blanket observations about the drivers. The first is that climate change and related concerns do appear to be more important than other issues for most countries, so creating a marketing narrative that meets those concerns could be useful. Water quality or a general focus on the environment appeared to be less compelling. Food safety, proxied by outbreaks of foodborne illness, also appeared to be much less of an issue. Finally, a focus on local food might cause a market access problem given the distance of New Zealand from most markets, but the indicator for trade protectionism suggested that it is not likely to be a concern.

These blanket statements should be read in the context of the research, which was trying to predict the future using indicators that may be poorly linked to the consumer drivers of interest. The research was, admittedly, searching under the lamppost for the keys dropped in the alley nearby. There are three comments to make about that approach, however. First, it is important to attempt this type of summary research to get a view across issues and markets. Policy-makers and exporters need to make decisions now about where to focus their efforts, and cannot wait for the perfect dataset to be available. Even though the data may be inadequate, experimenting with ways to analyse and present the information helps prepare the way for future, better, work. Secondly, the lamppost analogy is not exact, because the data and indicators are linked to drivers; it is the strength of the linkage that is uncertain. Thirdly, identifying the gaps in data and inconsistencies in definitions provides an indication of potentially useful future avenues of primary research. By identifying what could be usefully measured, it is hoped that someone may go measure it.

8   References

AERU. (2017). Maximising Export Returns for New Zealand's Biological Industries. Retrieved July 11, 2018, from Lincoln University: http://www.lincoln.ac.nz/aeru/mer

Anderson, C. (2007). The long tail: how endless choice is creating unlimited demand. Random House.

Astridge, K. H., McPherson, M., Kirk, M., Knope, K., Gregory, J., Kardamanidis, K., & Bell, R. (2011). Foodborne Disease Outbreaks in Australia 2001 - 2009. Food Australia, 63(12), 44-50.

Australian Bureau of Statistics. (2013). Australian Bureau of Statistics. Retrieved from Australian Bureau of Statistics: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4807.0.30.001main+features301995

Besedeš, T., & Prusa, T. J. (2006). Product differentiation and duration of US import trade. Journal of international Economics, 70(2), 339-358.

Bremer, P. J., Mirosa, M. J., Kaye-Blake, W. H., Cong, L., & Harker, F. R. (2018). Chinese consumer insights regarding immune health: draft white paper. Auckland: Plant and Food Research for High-Value Nutrition National Science Challenge.

Castaldo, S., Perrini, F., Misani, N., & Tencati, A. (2009). The missing link between corporate social responsibility and consumer trust: the case of Fair Trade products. Journal of Business Ethics, 84, 1-15.

Centers for Disease Control and Prevention. (2018). List of Selected Multistate Foodborne Outbreak Investigations. Retrieved from Centres for Disease Control and Prevention: https://www.cdc.gov/foodsafety/outbreaks/multistate-outbreaks/outbreaks-list.html

Chen, I. J., & Paulraj, A. (2004). Towards a theory of supply chain management: the constructs and measurements. Journal of Operations Management, 22, 119-150.

Coley, D., Howard, M., & Winter, M. (2009). Local Food, food miles and carbon emissions: A comparison of farm shop and mass distribution approaches. Food Policy, 34(2), 150-155.

de Boer, J., de Witt, A., & Aiking, H. (2016). Help the climate, change your diet: a cross-sectional study on how to involve consumers in a transition to a low-carbon society. Appetite, 98, 19-27.

Driver, T., Saunders, C., Guenther, M., Dalziel, P., & Rutherford, P. (2015). Maximising Export Returns: The use of digitial media and smart technology in shopping and information gathering for food and beverages i nmarkets relevant to New Zealand. Christchurch: Lincoln University.

Earl, P. (1986). Lifestyle economics: consumer behaviour in a turbulent world. Wheatsheaf Books.

European Comission. (2017). Special Eurobarometer 459 - Climate Change. Brussels: European Commission. Retrieved from European Comission: https://ec.europa.eu/clima/sites/clima/files/support/docs/report_2017_en.pdf

European Commission. (2014). Food Indormation to Consumers - Legislation. Retrieved from Labelling and Nutrition: https://ec.europa.eu/food/safety/labelling_nutrition/labelling_legislation_en

FairTrade International. (2015). Monitoring the scope and benefits of FairTrade. Retrieved from http://fairtrade.org.nz/~/media/Fairtrade%20Australasia/Files/Resources%20for%20pages%20-%20Reports%20Standards%20and%20Policies/2015-Fairtrade-Monitoring-Scope-Benefits_web.pdf

FAOSTAT. (n.d.). Country indicators: World. Rome. Retrieved July 03, 2018, from http://fenixservices.fao.org/faostat/static/documents/CountryProfile/pdf/syb_5000.pdf

Food and Agriculture Organization. (2015). The state of agricultural commodity markets. Rome. Retrieved from http://www.fao.org/3/a-i5090e.pdf

Grunert, K. G. (2005). Food quality and safety: consumer perception and demand. Eurpoean Review of Agricultural Economics, 32(3), 369-391.

Guenther, M., Saunders, C., Dalziel, P., Rutherford, P., & Driver, T. (2015). Maximising Export Returns: Consumer attitudes towards attributes of food and beverages in export markets relevant to New Zealand. Lincoln university, Agribusiness and Economics Research Unit. Christchurch: Lincoln Univeristy. Retrieved from http://www.lincoln.ac.nz/aeru/mer

Hainmueller, J., Hiscox, M. J., & Sequeira, S. (2015). Consumer demand for the Fair Trade label: Evidence from a multi-state field experiment. Review of Economics and Statistics, 242-256.

Harper, G., & Henson, S. (2001). Consumer Concerns about Animal Welfare and the Impact on Food Choice. University of Reading, Centre for Food Economics Research. United Kingdom: University of Reading.

Helpman, E. (1981). International trade in the presence of product differentiation, economies of scale and monopolistic competition. Journal of International Economics, 11, 305-340.

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. The American Economic Review, 70(5), 950-959.

Krugman, P. (1995). Increasing returns, imperfect competition and the positive theory of international trade. In Handbook of international economics 3 (pp. 1243-1277).

Krugman, P. (1998). Introduction: new thinking about trade policy. In P. Krugman, Strategic Trade Policy and the New International Economics (pp. 1-22). Cambridge, MA: The MIT Press.

Lees, N., & Saunders, C. (2015). Maximising Export Returns: Communicating New Zealand's credence attributes to international consumers. Christchurch: Lincoln University.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., Rosenthal, S., Cutler, M., & Kotcher, J. (2018). Politics and Global Warming March 2018. Yale University, Centre for Climate Change Communication. New Haven: Yale University. Retrieved from http://climatecommunication.yale.edu/publications/politics-global-warming-march-2018/

Lenzen, M., Moran, D., Kanemoto, K., Foran, B., Lobefaro, L., & Geschke, A. (2012). International trade drives biodiversity threats in developing nations. Nature, 486(7401), 109-112.

Lowy Institute for International Policy. (2017). The Lowy Institute Poll 2017. Sydney: The Lowy Institute for International Policy.

Miller, S., Driver, T., Velasquez, N., & Saunders, C. (2014). Maximising Export Returns: Consumer behaviour and trends for credence attributes in key markets and a review of how these may be communicated. Christchurch: Lincoln University.

Ministry for Primary Industries. (2018). Situation and outlook for primary industries: March 2018. Wellington.

Moore, G. (2004). The fair trade movement: parameters, issues and future research. Journal of Business Ethics, 53(1-2), 73-86.

National Geographic. (2008). Greendex 2008: Consumer Choice and Environment - A Worldwide Tracking Survey. Retrieved from National Geographic: https://www.nationalgeographic.com/greendex/assets/GS_NGS_Full_Report_May08.pdf

National Geographic. (2010). Greendex 2010. Retrieved from Globescan: https://globescan.com/wp-content/uploads/2017/07/Greendex_2010_Full_Report_NationalGeographic_GlobeScan.pdf

National Geographic. (2012). Greendex 2012. Retrieved from Globescan: https://globescan.com/wp-content/uploads/2017/07/Greendex_2012_Full_Report_NationalGeographic_GlobeScan.pdf

National Geographic. (2014). Greendex 2014. Retrieved from Globescan: https://globescan.com/wp-content/uploads/2017/07/Greendex_2014_Full_Report_NationalGeographic_GlobeScan.pdf

Ozcaglar-Toulouse, N., Shui, E., & Shaw, D. (2006). In search of fair trade: ethical consumer decision making in France. International Journal of Consumer Studies, 30(5), 502-514.

Peters, G. P., & Hertwich, E. G. (2008). CO2 embodied in international trade with implications for global climate policy. Environmental Science and Technology, 42(5), 1401-1407.

Public Health England. (2017, March 10). Foodborne illness in humans: General outbreaks in England and Wales in 2017. Retrieved from Gov.uk Research and Analysis: https://www.gov.uk/government/publications/foodborne-illness-in-humans-general-outbreaks-in-england-and-wales-in-2017

PwC. (2017). Signs to look for: Criteria for developing and selecting fit for purpose indicators. Christchurch: Our Land and Water.

Reinaud, J. (2009). Trade, Competitiveness and Carbon Leakage: Challenges and Opportunities. Chatham House. London: Chatham House. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.452.9167&rep=rep1&type=pdf

Ricardo, D. (1817). On the principles of political economy and taxation. London: John Murray. Retrieved from http://www.gutenberg.org/files/33310/33310-h/33310-h.htm

Sanderson, K., Saunders, C., Nana, G., Stroombergen, A., Campbell, H., Fairweather, J., & Heinemann, A. (2003). Economic risks and opportunities from the release of genetically modified organisms in New Zealand. Wellington: Ministry for the Environment and The Treasury. doi:ISBN 0-478-24086-4

Saunders, C. M., Barber, A., & Taylor, G. J. (2006). Food miles - comparative energy / emissions performance of New Zealand's agriculture industry. Agribusiness and Economics Research Unit. Christchurch: Lincoln University. Retrieved from http://researcharchive.lincoln.ac.nz/handle/10182/125

Saunders, C., & Barber, A. (2008). Carbon Footprints, Life Cycle Analysis, Food Miles: Global Trade Trends and Market Issues. Political Science, 60(1), 73-88.

Saunders, C., Dalziel, P., Tait, P., Miller, S., Guenther, M., Saunders, J., . . . Driver, T. (2016). Maximising Export Returns. Australian Agricultural & Resource Economics Society 60th Annual Conference. Canberra. Retrieved from Maximising Export Returns: https://ageconsearch.umn.edu/bitstream/235604/2/Saunders%20ppt%20upload.pdf

Saunders, C., Dalziel, P., Wilson, M., McIntyre, T., Collier, H., Kaye-Blake, W., . . . Reid, J. (2016). How value chains can share value and inventivise land use practices: a white paper. Lincoln: Our Land and Water. Retrieved from https://www.otago.ac.nz/research/forms/Our%20Land%20&%20Water%20-%20NSC/AERU%20Value%20Chain%20White%20Paper_FINAL.pdf

Saunders, C., Driver, T., Mowat, A., Kaye-Blake, B., Payn, T., Bayne, K., . . . Tait, P. (2017). Driving Better Programme Investment and Accelerating Challenge Impact Through a Prioritisation Matrix of International and National Perspectives. Christchurch: Our Land and Water.

Saunders, C., Duff, S., & Driver, T. (2017). The Matrix - Driving Better Programme Investment and accelerating Challenge impact through a prioritisation matrix of international and national perspectives. Agribusiness and Economics Research Unit, Lincoln Univeristy. Christchurch: Our Land and Water National Science Challenge. Retrieved from http://www.ourlandandwater.nz/assets/Uploads/FINAL-OLW-matrix-report-B-2016-09-30-002.docx

Saunders, C., Guenther, M., Driver, T., Tait, P., Dalziel, P., & Rutherford, P. (2015). Consumer attitudes to New Zealand food product attributes and technology use in key international markets. Christchurch: Lincoln University.

Saunders, J. T., & Driver, T. (2016). International trade implications for consumer attitudes to New Zealand food attributes. Christchurch: Lincoln University.

Shankarmahesh, M. N. (2006). Consumer ethnocentrism: an integrative review of its antecedents and consequences. International Marketing Review, 23(2), 146-172.

Statista. (2018). Revenue of Fairtrade International products worldwide from 2004 to 2016 (in million euros). Retrieved from Statista - The Statistics Portal: https://www.statista.com/statistics/271354/revenue-of-fair-trade-products-worldwide-since-2004/

Statistics NZ. (2017). Infoshare. Retrieved from Statistics NZ: http://archive.stats.govt.nz/infoshare/ViewTable.aspx?pxID=593649dd-84de-4c4e-a667-aefab7be7290

Statistics NZ. (2018). Overseas merchandise trade: April 2018. Wellington. Retrieved from https://www.stats.govt.nz/information-releases/overseas-merchandise-trade-april-2018

Statistics NZ. (2018). Series, GDP(P), Chain volume, Actual, ANZSIC06 high-level industry groups (Annual-Mar). Wellington. Retrieved July 11, 2018, from http://archive.stats.govt.nz/infoshare/?url=/infoshare/

Stokes, B., Wike, R., & Carle, J. (2015). U.S., China Less Worried; Partisan Divides in Key Countries. Retrieved from Pew Research Centre: http://www.pewglobal.org/2015/11/05/global-concern-about-climate-change-broad-support-for-limiting-emissions/

The Vegetarian Resource Group. (2017). The Vegetarian Resource Group. Retrieved from The Vegetarian Resource Group: https://www.vrg.org/nutshell/Polls/2016_adults_veg.htm

UK Department of Business, Energy and Industrial Strategy. (2012 - 2018). Reporting series: Energy and Climate Change Public Attitudes Tracker. London: UK Department of Business, Energy and Industrial Strategy. Retrieved from https://www.gov.uk/government/collections/public-attitudes-tracking-survey

Vegetarian Society. (2013). Number of UK vegetarians. Retrieved from Vegetarian Society: https://www.vegsoc.org/page.aspx?pid=753

Wang, Z., Mao, Y., & Gale, F. (2008). Chinese consumer demand for food safety attributes in milk products. Food Policy, 33(1), 27-36.

Weber, C. L., & Matthews, H. S. (2008). Food-Miles and the Relative Climate Impacts of Food Choices in the United States. Environmental Science and Technology, 42(10), 3508−3513.

Whitworth, E., Druckman, A., & Woodward, A. (2017). Food Scares: a comprehensive categorisation. British Food Journal, 119(1), 131-142.

World Health Organisation. (2015, June 06). Estimates of burden on foodborne disease - European Perspective. Retrieved from World Health Organisation Regional Office for Europe: http://www.euro.who.int/__data/assets/pdf_file/0003/295248/Presentation-DrKruse-FERG-event-Cph-031215.pdf?ua=1

World Trade Organisation. (2016). Trade Profiles. Retrieved from World Trade Organisation: http://stat.wto.org/TariffProfile/WSDBTariffPFView.aspx?Language=E&Country=E28%2cAU%2cCN%2cNZ%2cUS

Yu, H., Wang, B., Zhang, Y.-J., Wang, S., & Wei, Y.-M. (2013). Public perception of climate change in China: results. Natural Hazards, 459-472.

9 Appendix: Data for analysis

Table 2. Food Safety - number of foodborne illness outbreaks (per 100,000 population)

Market	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Australia	0.64	0.56	0.67	0.47	0.66						
EU	1.01	1.53	1.59	1.44	1.29	1.20	1.13	1.08	1.13	1.14	0.79
UK				0.05	0.1	0.06	0.14	0.07	0.05	0.02	0.06

Table 3: Food Safety - number of multistate foodborne illness outbreaks in USA (per 100,000 population)

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0.0013	0.0020	0.0032	0.0045	0.0032	0.0035	0.0041	0.0034	0.0043	0.0013	0.0020

Table 4. Emissions Trading Schemes - price of carbon by Emissions Trading Scheme (US dollars per tonne CO_2-e)

Market (scheme)	2012	2013	2014	2015	2016	2017	2018
Australia	22.20	22.34	22.35	9.33	7.75	9.66	10.22
China – Beijing						7.6	9.4
China – Tianjin						1.3	1.4
China – Shanghai						4.7	6.2
China - Chongqing						0.2	3.8
China – Shenzhen						5.5	6.7
China – Guangdong						1.9	2.3
China – Hubei						1.8	2.3
EU (including UK)	7.41	7.37	4.80	8.42	7.96	7.96	9.10
USA - California	14.0	15.1	12.3	13.1	13.8	13.6	15.6
USA - RGGI	2.8	2.8	4.8	5.4	2.5	3.9	4.3

Table 5: Local Food - proportion of agricultural products that are subject to import duties

Market	2010	2015
Australia	50.6%	48.2%
China	99.1%	98.5%
EU	58.9%	55.5%
UK	58.9%	55.5%
USA	58.4%	61.1%

Table 6. Climate Change - proportion of people concerned about climate change (%)

Market	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Australia	60	48	46	41	36	40	45	50	53	54	
China			93			78		75			
EU	90	88		89		90		91		92	
UK					65	66	68	66	70	71	74
USA	62		52	53	58	53	56	55	61	64	63

Table 7. Water Quality - proportion of people concerned about the environment (%)

Market	2008	2009	2010	2011	2012	2013	2014
Australia	53		51		42		45
China	69		75		72		77
EU				72			70
UK	45		43		43		45
USA	53		47		47		49

Table 8: Ethics and Fair Trade – global FairTrade revenue (million Euro)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1,132	1,623	2,381	2,895	3,443	4,319	4,984	4,787	5,500	5,900	7,300	7,880

Table 9. Animal Welfare - proportion of vegetarians (% of population)

Market	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Australia	3.5					9.7				11.2
EU			3.0	2.0	2.0	2.0				
UK	3.0		3.0	2.0	2.0	2.0				
USA		3.2	7.0		5.0	4.0			3.4	3.3

10 Disclaimer

This report has been prepared solely for the purposes stated herein and should not be relied upon for any other purpose. We accept no liability to any party should it be used for any purpose other than that for which it was prepared.

To the fullest extent permitted by law, PwC accepts no duty of care to any third party in connection with the provision of this report and/or any related information or explanation (together, the "Information"). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, PwC accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

We have not independently verified the accuracy of information provided to us, and have not conducted any form of audit in respect of the organisation for which work is completed. Accordingly, we express no opinion on the reliability, accuracy, or completeness of the information provided to us and upon which we have relied.

The statements and opinions expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements and opinions expressed in this report are based on information available as at the date of the report.

We reserve the right, but will be under no obligation, to review or amend our report, if any additional information, which was in existence on the date of this report was not brought to our attention, or subsequently comes to light.

This report is issued pursuant to the terms and conditions set out in our contract with the Our Land and Water National Science Challenge (via AgResearch) received 4 July 2017.