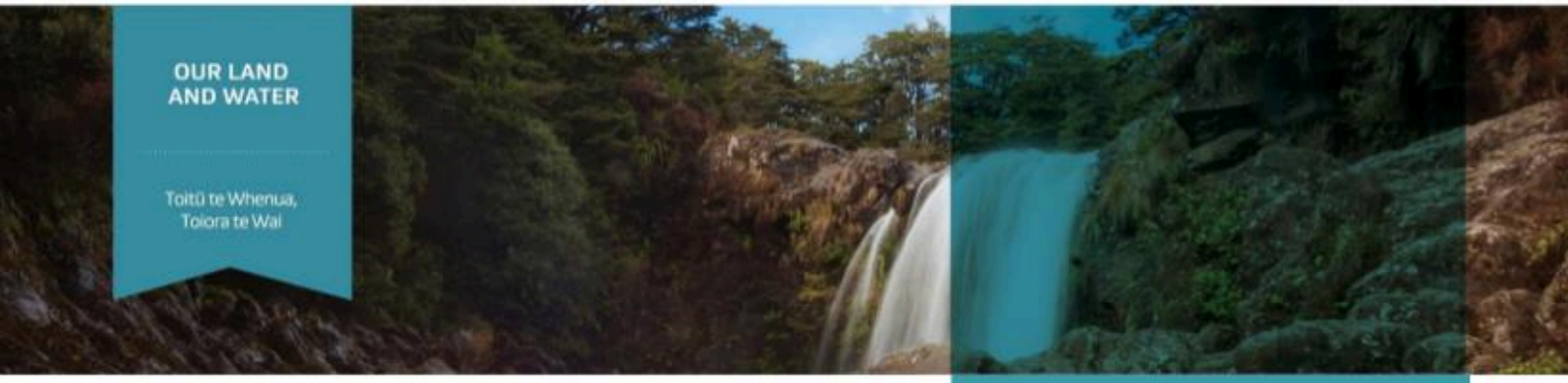
National SCIENCE Challenges



The Matrix of Drivers: 2023 Update

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Report for Our Land and Water National Science Challenge
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The Matrix of Drivers: 2023 Update

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Enhancing primary sector production and productivity while maintaining and improving our land and water quality for future generations is a key outcome of the National Science Challenge for Our Land and Water. It is therefore important to identify the hierarchy of international and national issues in order to provide an evidence base to guide investment and inform the Challenge Research Strategy. To this end, it was proposed that a small project be conducted, and regularly updated.

This project aims to deliver an overview of international and domestic drivers, as well as issues that are of particular relevance to the New Zealand primary sector and land use. This overview is based on a literature search of the most important issues, followed by a survey of key stakeholders as to their opinion of the most important issues affecting New Zealand land use and land use practice from overseas and domestically. In addition, a review of the level of interest and concern of international consumers on various issues is produced relevant to the primary sector.

This is the fifth report in this series and provides an updated understanding of the international and national drivers and issues of land use change/practice, and their importance to the primary sector. These drivers will help prioritise where investments in primary sector research based on their relationship to economic growth, social, cultural and environmental interactions. Updates of this research will allow us to understand how drivers and issues change, which will help to assess the impact the Challenge has had as well as future research investment needs. This work also provides a contribution to the Challenge Strategy.

This report is structured as follows: Chapter 1 provides an introduction to this report and its wider context; Chapter 2 presents the results of a survey of primary sector stakeholders regarding their views of the importance of key international and domestic drivers of land use change/practice; Chapter 3 examines future trends and challenges related to land use change/practice (particularly within a New Zealand context); and Chapter 4 concludes the report and provides a summary of its findings.

1. Introduction

1.1 Project background

This report is the fifth in a series providing updated overviews of international and domestic drivers that have the potential to affect land use change and/or practice. This work has been undertaken to allow us to understand how drivers and issues change, which will help to assess the impact the Challenge has had as well as future research investment needs. This work also informs the strategic direction of the Our Land and Water (OLW) component of the National Science Challenge. The OLW challenge mission is to "enhance primary sector production and productivity while maintaining and improving our land and water quality for future generations." As different international and domestic drivers are likely to impact on New Zealand land use change and/or practice in a variety of ways, it is important to quantify to what extent this is likely to occur in order to prioritise key areas of focus for the Challenge.

To meet this requirement, this report presents an academic literature review of the latest research relevant to the international and domestic drivers of land use change and/or practice. The initial literature review undertaken in the first Drivers Project identified a preliminary list of 30 drivers (Saunders et al., 2016). This was updated in the years 2018, 2019 and 2022 to include new arising issues or drivers relevant to land use change/practice (Saunders et al., 2018; Driver et al., 2019; 2022). The current list of international and domestic drivers is presented in Table 1-1 below. This report has expanded upon previous literature reviews, with an examination of the latest reports produced by key organisations such as the United Nations (including the FAO and IPCC), as well as key academic literature. A summary of each driver and its impact on land use change and/or practice (where possible) has been compiled, and can be accessed digitally by clicking on the links in Table 1-1 below. The updated evidence base used to inform these summaries is also available here.

Table 1-1: Current list of international and domestic drivers likely to impact on land use practice and/or change (as of September 2023)

Agricultural and Trade Policy	Air Quality	Animal Health and Welfare	Authenticity and Traceability
Biodiversity	Biosecurity	Brand	Chemical Residues
Climate Change	Country-of-Origin	Cultural Values	Demographics
Digital Communication Systems	Emissions Trading Schemes	Environmental Condition	Extreme Weather Events
Family and Community	Food Safety	Functional Food	Gene Technology
Greenhouse Gas (GHG) Emissions	Innovative Products	Local Food/Food Miles	Organic Production
Pasture-Based Production	Precision Agriculture	Product Quality	Public Health
Religion	Social Responsibility and Fair Trade	Soil Quality	Sustainable Supply
Waste and Recycling	Water Footprinting and Use	Water Quality	

The literature review identified the key domestic and international drivers that have the potential to affect land use change and/or practice in New Zealand. The review also identified literature that demonstrated how these drivers may change over time drawing on trade modelling, consumer attitudes and behaviour research.

The domestic drivers were originally informed by key strategic documents from government agencies such as The Ministry for Primary Industries (MPI), The Ministry for the Environment (MfE) and The Ministry of Foreign Affairs and Trade (MFAT). The strategic documents of regional and local agencies were also reviewed. Where publicly available, key information from sector groups and farmer associations such as Beef+Lamb New Zealand and Fonterra were also considered. Relevant academic literature was assessed. Important legislative and regulatory documents were also considered. This review included voluntary standards such as AsureQuality Organic standards and Sustainable Winegrowing New Zealand standards. International trade agreements, government legislation and reports, retailer requirements, strategic documents, and academic literature helped identify the international drivers. The literature review also looked at future trends that could influence these drivers.

The initial Drivers Project (Saunders et al., 2016) included a broad literature review of studies involving the use of methods such as choice experiments (CE) – an economic valuation method

used to assess willingness-to-pay (WTP) for different attributes of goods and/or services. Purchasing behaviour in markets is often influenced by product attributes such as price, quality and appearance, but also the credence attributes of a product. These are qualities that are not immediately seen or experienced during purchase or consumption, such as food safety, animal welfare, environmental protection, country-of-origin, and sustainability credentials. The CE method requires participants to make trade-offs between attributes by selecting one option from a series of products with multiple attributes, typically with an associated price attribute. This literature review has been updated to include recent CE and other WTP studies relevant to the drivers, covering academic literature published up to 2023. These can be found in Appendix A of this report.

2. New Zealand Primary Industry Stakeholder Survey

The overall aim of this project is to review and cross-reference domestic and international drivers in order to identify and prioritise areas of importance to the National Science Challenge, to assess the relative importance of the drivers by international regions and in New Zealand, and a survey addressing issues relating to the drivers administered to stakeholders involved in New Zealand's primary industries. In this report, the survey has been updated, as presented below.

2.1 Survey methodology

As stated above, the four earlier Drivers reports included a survey of stakeholders (Driver et al., 2019; 2022; Saunders et al., 2016; 2018). This was repeated for this report with an updated survey, administered in August 2023. The overall aim of this survey was to assess the relative importance of the drivers from New Zealand and international regions, with a particular focus on drivers' impact on land use practice/change in New Zealand. The survey was initially distributed on August 15th 2023 using Qualtrics™, a web-based survey system. Four rounds of survey participation invitations were distributed – the first were specific invitations to a list of participants selected in consultation with the Science Challenge Directorate based on their experience and expertise in relation to New Zealand's primary industries. The second, third and fourth were distributed to lists of participants from a database held by the Our Land and Water National Science Challenge. Additional reminder emails were sent following the initial distribution. The survey was distributed to 3,815 people in total, receiving 532 responses, including 283 completed surveys, thereby achieving an approximate 7.42 per cent completion rate.

The survey first asked participants to indicate (unprompted) the three most critical international and domestic issues that they believed could influence New Zealand land use practice/change in a ranked order (e.g. 1 = most critical, in descending order of importance). These responses were then weighted (e.g. 1 (Most Critical) was given a weighting of 3; 3 (Least Critical) was given a weighting of 1) to provide scores of the overall importance of these international and domestic issues.

Participants were then asked to identify from a predetermined list of issues/drivers which of these were likely to have a *'high'*, *'medium'* or *'low'* impact on New Zealand land use change/practice. These predetermined drivers were chosen from previous Drivers reports, the literature, and in consultation with the Challenge Directorate.

Participants were also asked to identify their field of expertise and geographical region that they were most familiar with in relation to their work in New Zealand's primary industries. A copy of the survey instrument is in Appendix B of this report. Completed responses were then analysed and are given below.

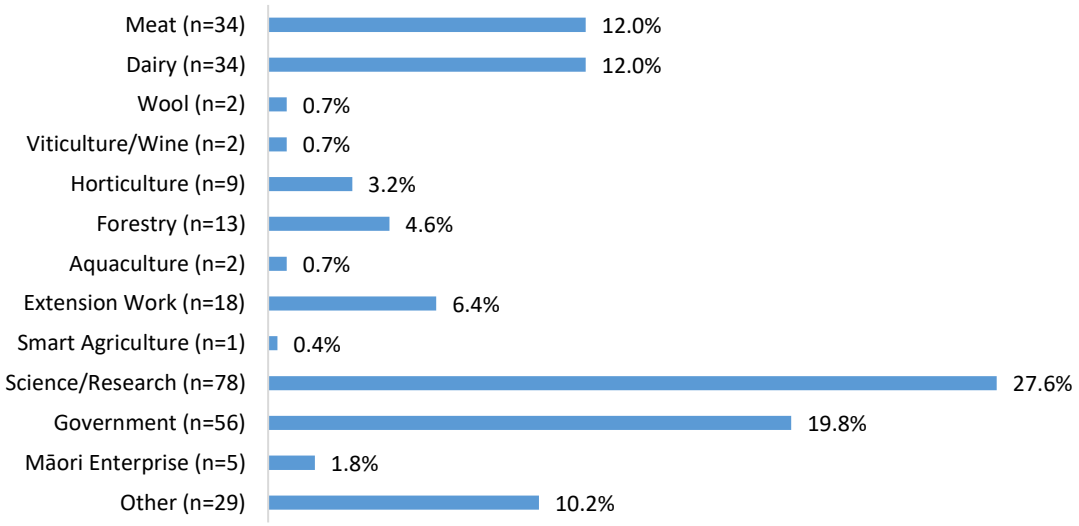
The survey was expanded to include questions regarding participants' engagement with agribusiness schemes, including the number of schemes and criteria therein, across four sets of considerations – environmental, social, economic and cultural. This also included questions relating to the extent to which participants believed that these schemes improved returns for their products. In addition, a question regarding participant's view on the importance of a

range of product attributes in achieving higher product value from lower volume was also included in this survey.

2.2 Survey results

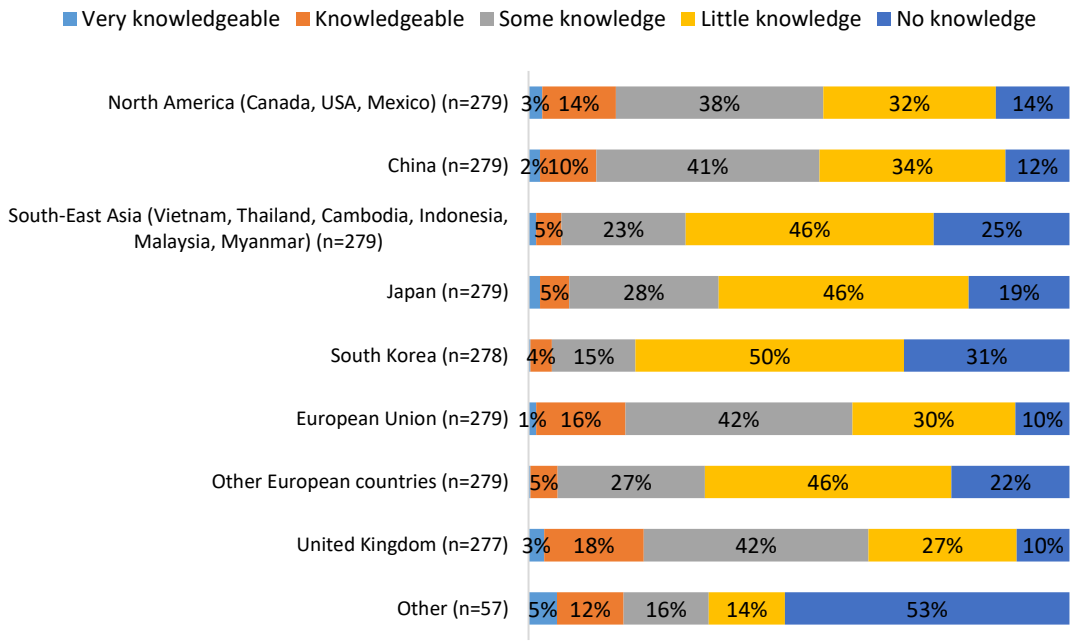
Survey participants were asked to identify the sector that they were most closely aligned with. As shown in Figure 2-1, 27.6 per cent of participants identified with the *Science/Research* sector, followed by *Government* and *Other* sectors (19.8 per cent and 10.2 per cent respectively). The most represented primary sector were *dairy* and *meat* (both 12 per cent), followed by *extension work* (6.4 per cent), *forestry* (4.6 per cent) and *horticulture* (3.2 per cent). Sectors stated within the *'other'* category included multiple sectors, arable, environmental management and monitoring, certification, manufacturing, professional development, consultancy services, and community services.

Figure 2-1: Survey participants' alignment with sectors (%) (n=283)



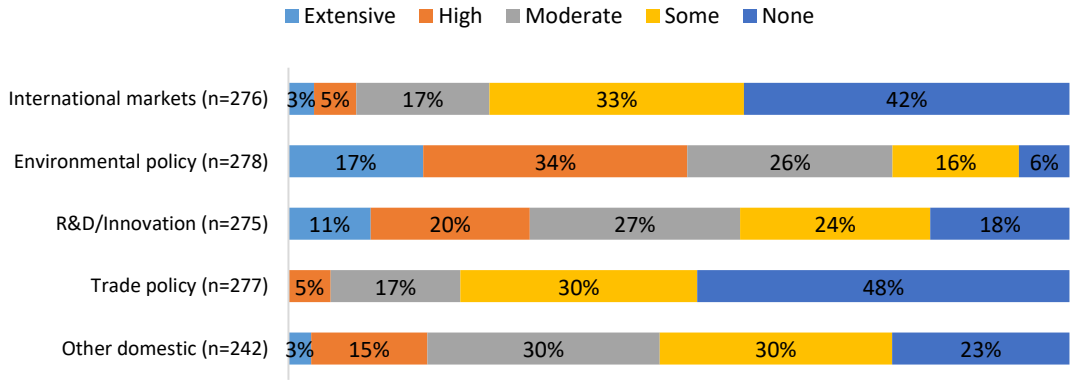
Participants were also asked to indicate their levels of knowledge regarding particular markets and regions. As shown in Figure 2-2 below, 21.3 per cent of participants indicated they were *'very knowledgeable'* or *'knowledgeable'* regarding the United Kingdom, followed by the European Union (17.9 per cent *'very knowledgeable'* or *'knowledgeable'*) and North America (16.1 per cent *'very knowledgeable'* or *'knowledgeable'*). Other markets/regions that participants identified as being familiar with included Australia, India, New Zealand, Middle East, North Africa, Pacific, Ireland, South America and United Arab Emirates.

Figure 2-2: Participant's level of knowledge regarding markets/regions



As shown in Figure 2-3 below, participants were also asked to indicate their level of experience in Environmental Policy, International Markets, R&D and Innovation, Trade Policy and Other Domestic. Approximately 51 per cent of participants had either *'extensive'* or *'high'* experience in *environmental policy*, followed by R&D/Innovation (30.9 per cent *'extensive'* or *'high' experience'*) and other domestic (17.8 per cent *'extensive'* or *'high'* experience).

Figure 2-3: Participants' level of experience in industry fields



Further analysis revealed participants' level of knowledge regarding particular markets and regions by sectoral alignment. As shown in Tables 2-1 to 2-8 below, results show that participants across all sectors did not often report that they were either *very knowledgeable* or *knowledgeable* about a range of areas/markets, and instead tended to indicate between *some knowledge* and *no knowledge* of many areas/markets. In addition, participants aligned with the primary sector generally reported a higher relative level of knowledge of all areas/markets relative to participants in other sectors.

Table 2-1: Level of knowledge (China) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		1%	14%	48%	29%	7%
	Meat	0%	16%	50%	25%	9%
	Dairy	0%	15%	50%	26%	9%
	Horticulture	0%	0%	44%	44%	11%
	Forestry	8%	15%	38%	38%	0%
	Other Primary Sector	0%	14%	57%	29%	0%
Science/ Research		4%	7%	37%	41%	12%
Government		2%	4%	41%	30%	23%
Māori Enterprise		0%	20%	40%	40%	0%
Extension Work		0%	22%	17%	44%	17%
Other Sector		3%	14%	45%	34%	3%

Table 2-2: Level of knowledge (European Union) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		0%	18%	46%	26%	9%
	Meat	0%	22%	50%	25%	3%
	Dairy	0%	15%	44%	35%	6%
	Horticulture	0%	11%	67%	11%	11%
	Forestry	0%	8%	31%	23%	38%
	Other Primary Sector	0%	43%	43%	14%	0%
Science/ Research		3%	13%	43%	34%	8%
Government		0%	18%	29%	36%	18%
Māori Enterprise		0%	0%	60%	20%	20%
Extension Work		0%	0%	56%	39%	6%
Other Sector		7%	32%	39%	18%	4%

Table 2-3: Level of knowledge (Japan) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		4%	5%	35%	38%	18%
	Meat	9%	3%	31%	34%	22%
	Dairy	0%	6%	35%	44%	15%
	Horticulture	0%	0%	56%	33%	11%
	Forestry	8%	0%	38%	23%	31%
	Other Primary Sector	0%	29%	14%	57%	0%
Science/ Research		1%	4%	21%	59%	14%
Government		2%	5%	25%	38%	30%
Māori Enterprise		0%	0%	40%	40%	20%
Extension Work		0%	6%	11%	61%	22%
Other Sector		0%	10%	34%	48%	7%

Table 2-4: Level of knowledge (North America) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		4%	16%	40%	27%	13%
	Meat	9%	16%	41%	28%	6%
	Dairy	3%	18%	38%	29%	12%
	Horticulture	0%	0%	44%	44%	11%
	Forestry	0%	15%	31%	15%	38%
	Other Primary Sector	0%	29%	57%	14%	0%
Science/ Research		3%	16%	33%	37%	12%
Government		2%	9%	32%	32%	25%
Māori Enterprise		0%	20%	40%	20%	20%
Extension Work		0%	20%	40%	20%	20%
Other Sector		0%	17%	48%	31%	3%

Table 2-5: Level of knowledge (Other European countries) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		0%	4%	35%	40%	21%
	Meat	0%	3%	41%	47%	9%
	Dairy	0%	6%	29%	41%	24%
	Horticulture	0%	0%	44%	22%	33%
	Forestry	0%	8%	15%	31%	46%
	Other Primary Sector	0%	0%	57%	43%	0%
Science/ Research		1%	4%	22%	57%	16%
Government		0%	4%	21%	46%	29%
Māori Enterprise		0%	0%	20%	60%	20%
Extension Work		0%	6%	22%	39%	33%
Other Sector		0%	14%	31%	34%	21%

Table 2-6: Level of knowledge (Southeast Asia) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		1%	8%	25%	40%	25%
	Meat	0%	9%	22%	44%	25%
	Dairy	0%	6%	32%	35%	26%
	Horticulture	11%	11%	22%	44%	11%
	Forestry	0%	8%	23%	23%	46%
	Other Primary Sector	0%	14%	14%	71%	0%
Science/ Research		1%	4%	18%	58%	18%
Government		4%	0%	21%	39%	36%
Māori Enterprise		0%	0%	40%	20%	40%
Extension Work		0%	0%	11%	56%	33%
Other Sector		0%	7%	34%	45%	14%

Table 2-7: Level of knowledge (South Korea) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		0%	6%	16%	48%	30%
	Meat	0%	13%	16%	48%	23%
	Dairy	0%	3%	18%	47%	32%
	Horticulture	0%	0%	22%	56%	22%
	Forestry	0%	0%	0%	46%	54%
	Other Primary Sector	0%	14%	29%	43%	14%
Science/ Research		1%	3%	12%	63%	21%
Government		0%	4%	13%	38%	46%
Māori Enterprise		0%	0%	40%	20%	40%
Extension Work		0%	0%	11%	44%	44%
Other Sector		0%	3%	28%	52%	17%

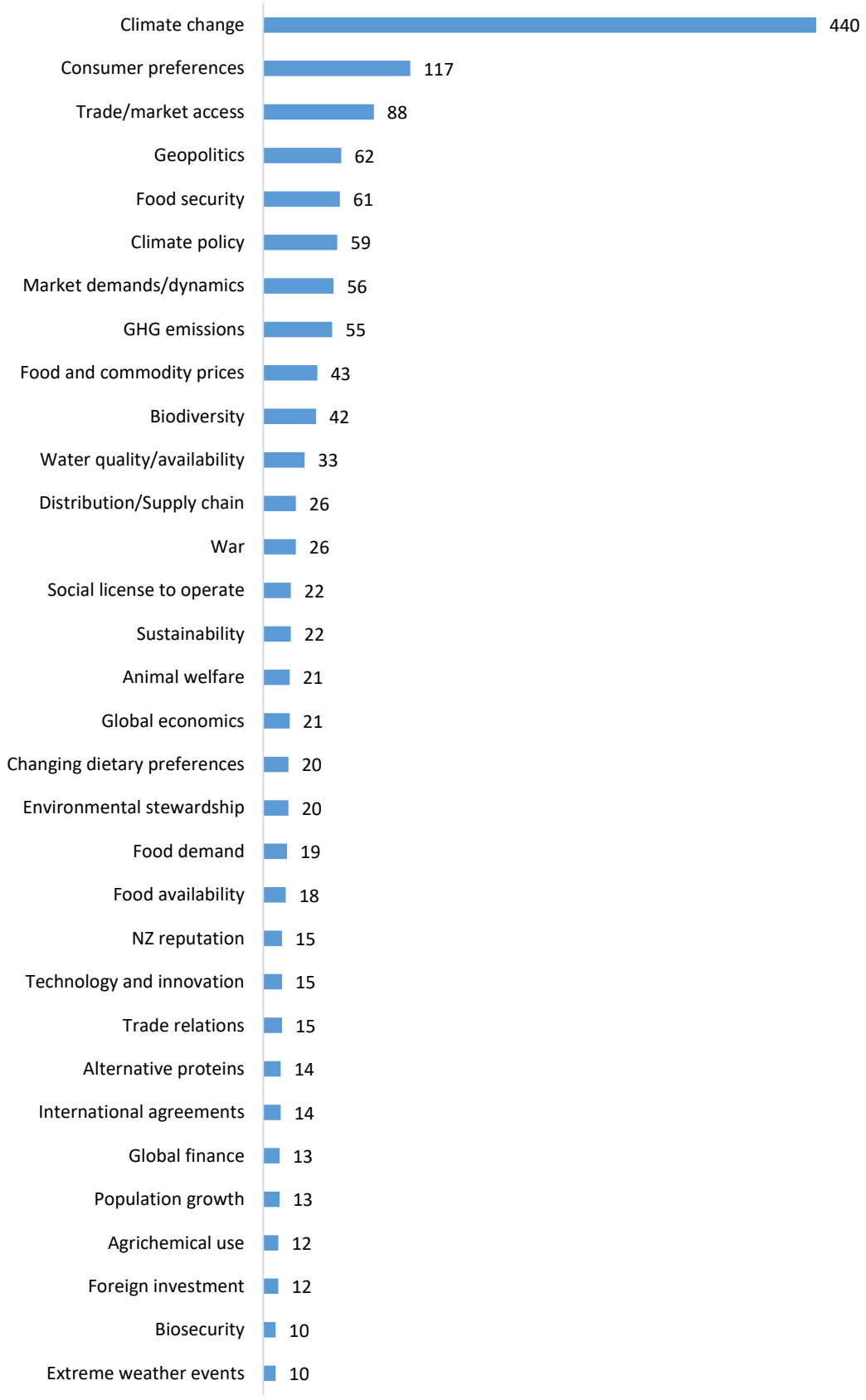
Table 2-8: Level of knowledge (United Kingdom) by sectoral alignment, % of sector participants

		LEVEL OF KNOWLEDGE				
SECTOR	Industry	*Very knowledgeable*	*Knowledgeable*	*Some knowledge*	*Little knowledge*	*No knowledge*
Primary Sector		3%	21%	47%	19%	9%
	Meat	3%	22%	53%	16%	6%
	Dairy	3%	21%	50%	21%	6%
	Horticulture	0%	22%	56%	11%	11%
	Forestry	0%	8%	31%	31%	31%
	Other Primary Sector	14%	43%	29%	14%	0%
Science/ Research		3%	13%	40%	39%	5%
Government		2%	13%	38%	29%	20%
Māori Enterprise		0%	20%	60%	0%	20%
Extension Work		0%	11%	33%	50%	6%
Other Sector		7%	39%	36%	14%	4%

2.2.1 Critical International Issues

Participants were then presented with an open-ended question that asked them to identify the three most critical domestic issues that would have the potential to influence land use change/practice in New Zealand. This was done to allow participants to identify important domestic issues without being prompted. As shown in Figure 2-4 below, *climate change* was indicated to be significantly more important to participants than any other international issue. These results are consistent with previous surveys in which participants identified climate change as the most highly critical international issue, with the relative importance of climate change as an international issue increasing between the previous and current surveys (Driver et al., 2019, 2022; Saunders et al., 2016; 2018). Other critical issues identified included *consumer preferences* and *trade/market acces*s. The results were consistent with previous survey results (Driver et al., 2019, 2022; Saunders et al., 2016; 2018). However, in the current iteration of this study, issues relating to geopolitical conflict and food security have notable increased in their perceived importance, including the issues of *geopolitics*, *war*, *food security*, and similar.

Figure 2-4: Critical international issues (ranked scores) (unprompted)

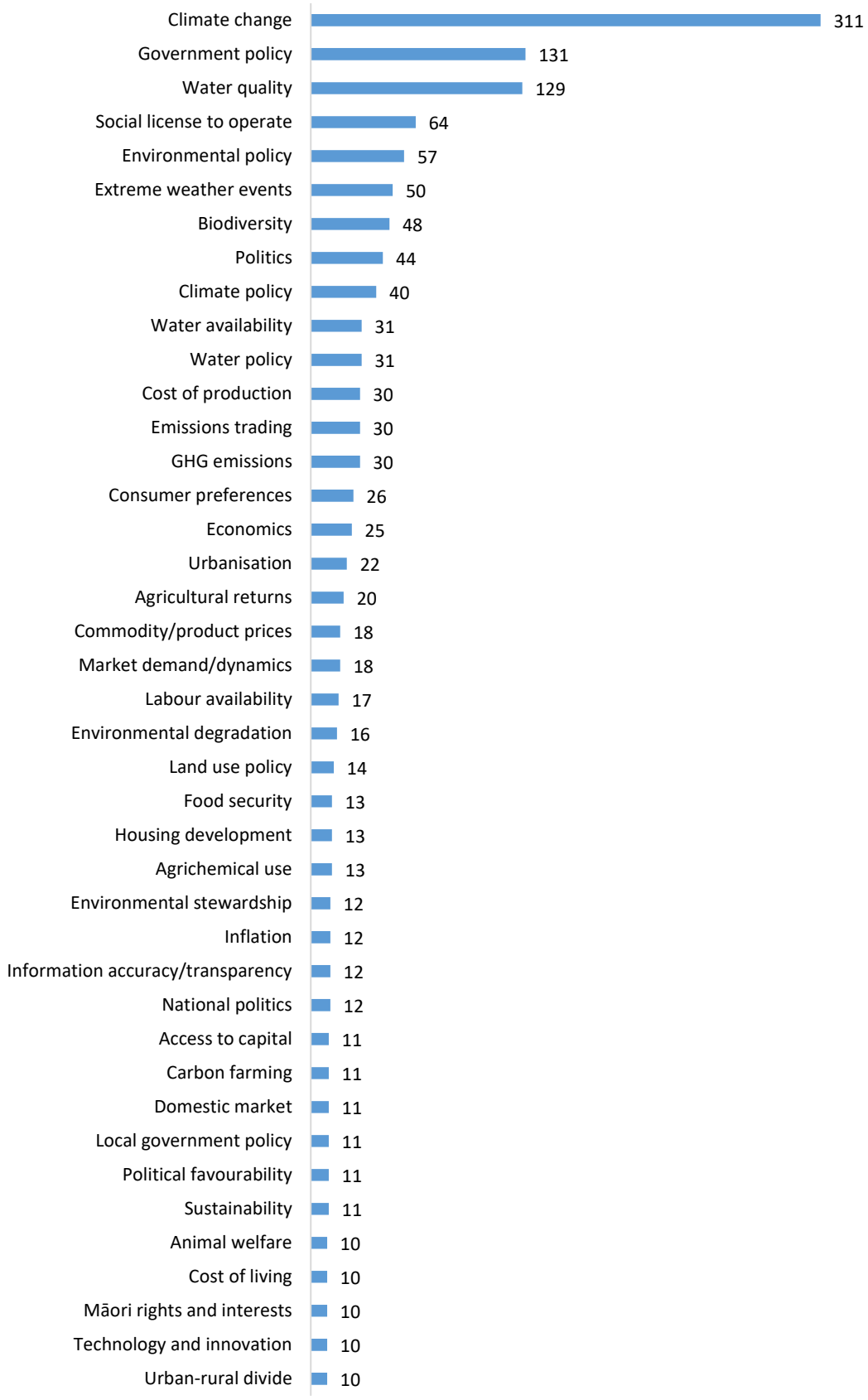


Note: Issues with scores of less than 10 are omitted from this figure.

2.2.2 Critical Domestic Issues

The survey also asked participants to identify the three most critical international issues that could influence New Zealand land use change/practice. Like the previous question, this was done to allow participants to identify important international issues without being prompted. As shown in Figure 2-5 below, *climate change* was indicated to be important to more participants than any other domestic issues. Other critical issues identified included *government policy* and *water quality.* These results are consistent with previous surveys in which participants identified water-related issues as highly critical domestic issues, with the exception of the increase in the importance of climate change at a domestic level (Driver et al., 2019, 2022; Saunders et al., 2016; 2018). In addition, issues regarding government policy, particularly environmental and agricultural policy, were shown to be of high importance as domestic drivers of New Zealand land-use change. This could be attributed to the increasing prevalence of public discussion and policy development regarding primary production's impact on the natural environment in recent years.

Figure 2-5: Critical domestic issues (ranked scores) (unprompted)

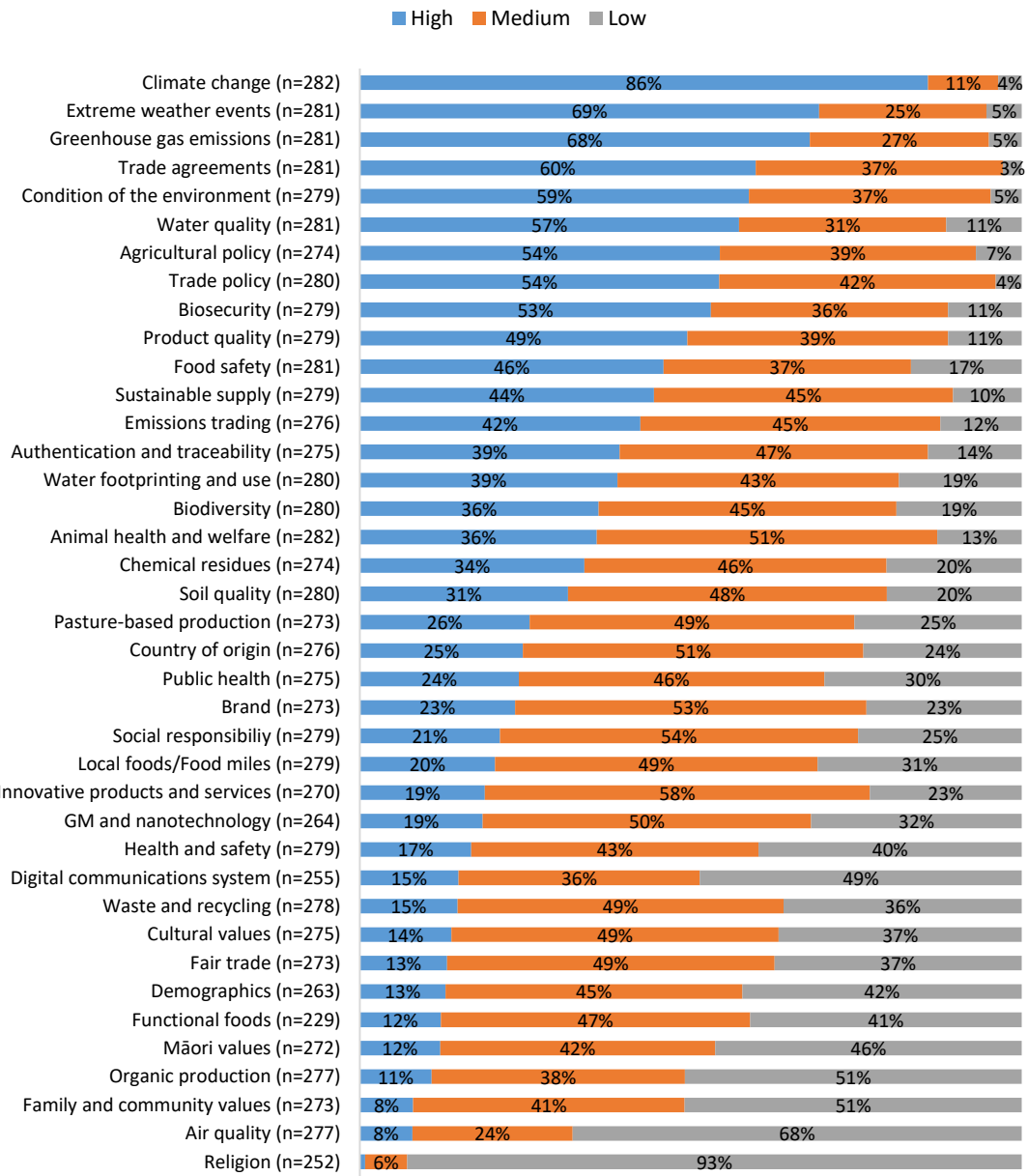


Note: Issues with scores of less than 10 are omitted from this figure.

2.2.3 Impact of international drivers/issues on New Zealand land use change/practice

Participants were then presented with a list of 39 international drivers (as identified by previous surveys and extensive literature review) and asked to indicate whether these would have a low, medium, or high impact on New Zealand land use change/practise over the coming decade. Echoing prior unprompted statements, Figure 2-6 below shows that 86 per cent of respondents identified *climate change* as having a potentially high impact on New Zealand land use change/practice. This was followed by *extreme weather events* (69 per cent *high*, 25 per cent *medium*), *greenhouse gas emissions* (68 per cent *high*, 27 per cent *medium*) and *trade agreements* (60 per cent *high*, 37 per cent *medium*).

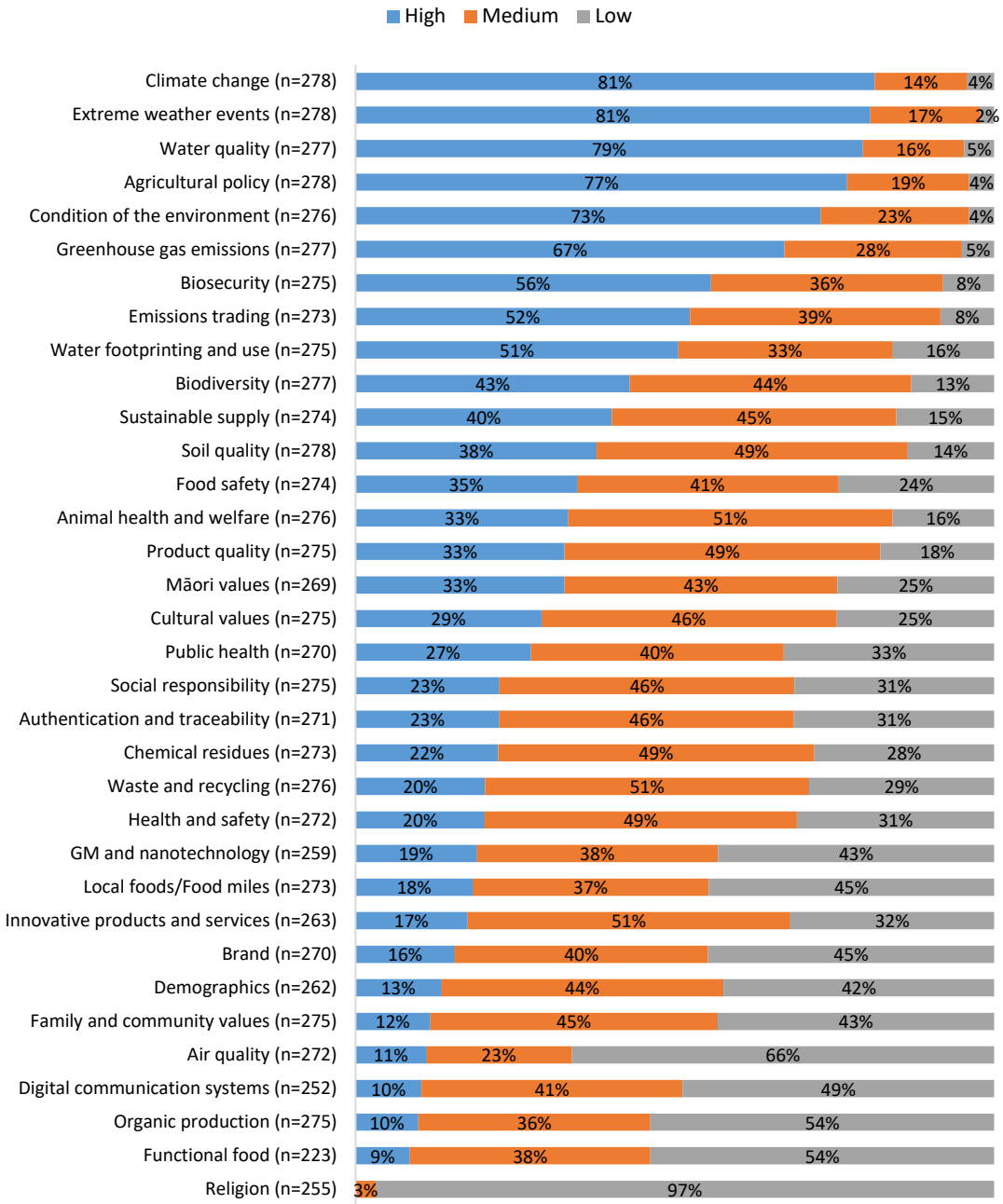
Figure 2-6: Impact of international drivers/issues on New Zealand land use change/practice



2.2.4 Impact of domestic drivers/issues on New Zealand land use change/practice

Participants were then presented with a list of 39 domestic drivers (as identified by previous surveys and extensive literature review) and asked to identify whether these would have a high, medium or low impact on New Zealand land use change/practice. As shown in Figure 2-7 below, per cent of respondents indicated that *climate change* was of high importance in relation to New Zealand land use change/practice, followed by *extreme weather events* (81 per cent *high*, 17 per cent *medium*) and *water quality* (79 per cent *high*, 16 per cent *medium*).

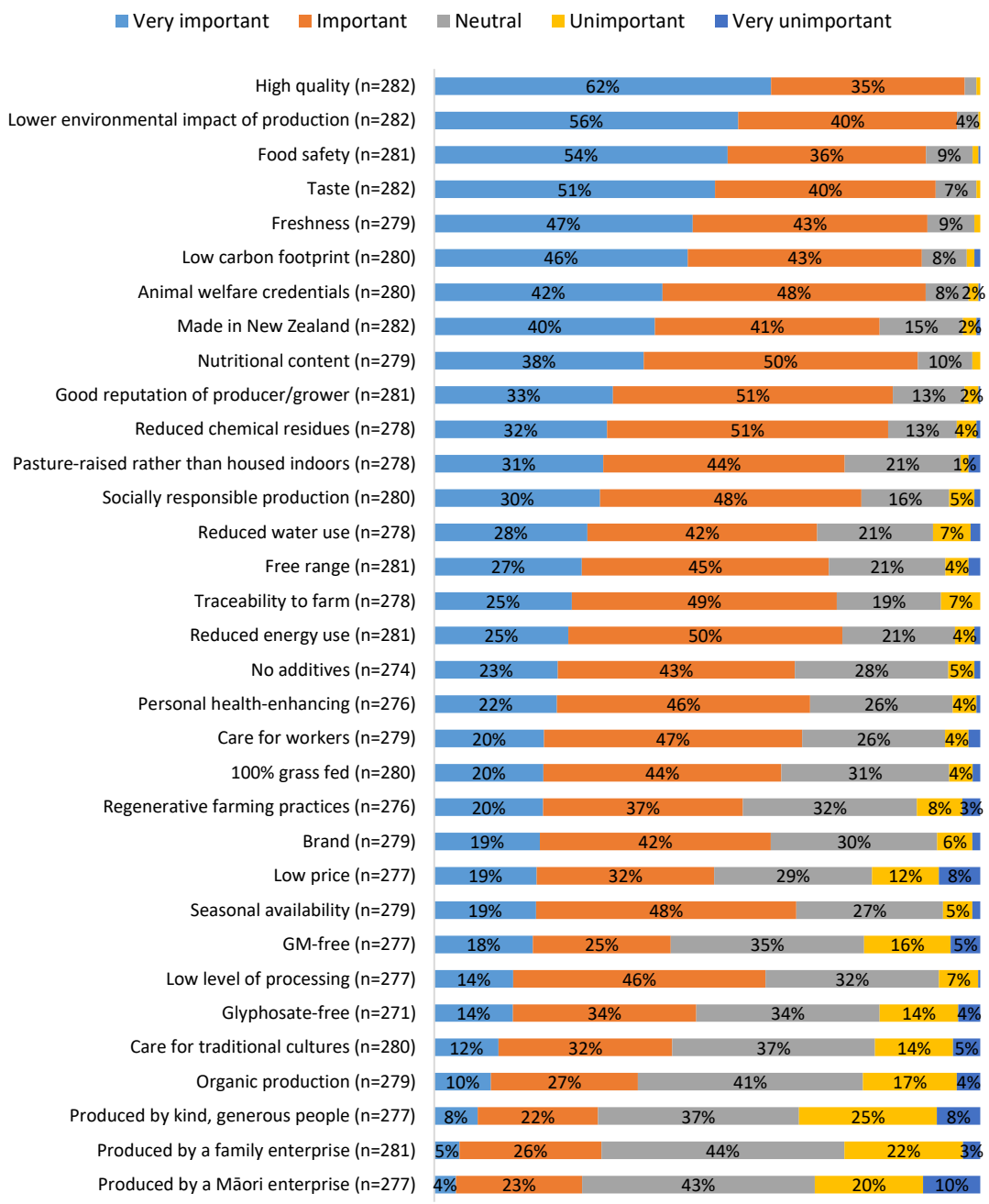
Figure 2-7: Impact of domestic drivers/issues on New Zealand land use change/practice



2.2.5 Moving from volume to value

Participants were then asked to indicate the relative importance of a range of primary product attributes in achieving higher product value from lower volume – these results are presented in Figure 2-8 below. This shows that participants rated *high quality* (62 per cent *very important*, 35 per cent *important*) as the most important product attribute in achieving higher product value from lower volume, followed closely by *lower environmental impact of production* (56 per cent *very important*, 40 per cent *important*).

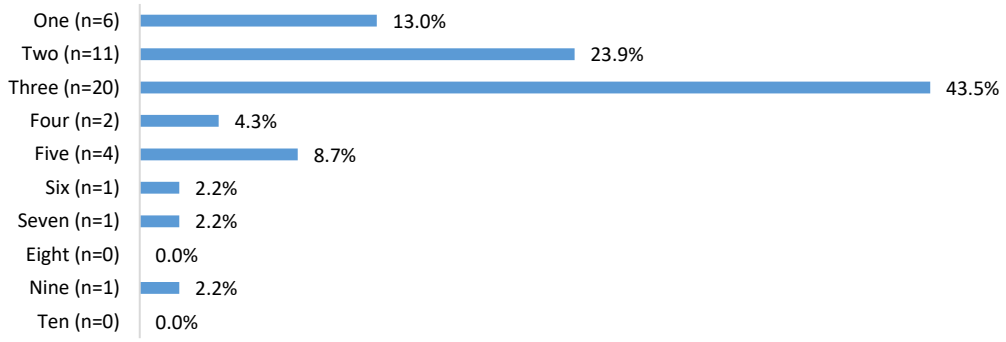
Figure 2-8: Importance of product attributes in achieving higher product value from lower volume



2.2.6 Agribusiness scheme participation

Participants were then asked to indicate their level of participation in *agribusiness schemes*. In this survey, agribusiness schemes were defined as schemes through which agribusinesses could improve quality assurance, marketing, certification, and other purposes. Examples used in the survey instrument (see Appendix) included the New Zealand Farm Assurance Programme (NZFAP) and GlobalGAP. In total, 60 participants (21.4 per cent) indicated that they participated in agribusiness schemes, while 221 participants (78.6 per cent) indicated that they do not currently participate in agribusiness schemes. Participants were also asked to indicate how many agribusinesses schemes they participated in – as shown in Figure 2-9 below, the largest proportion of participants participated in two agribusiness schemes. The responses indicate that people tend to participate in multiple schemes: only 13 per cent participated in only one scheme, while 87 per cent participated in more than one.

Figure 2-9: Number of agribusinesses schemes participated in (n=46)

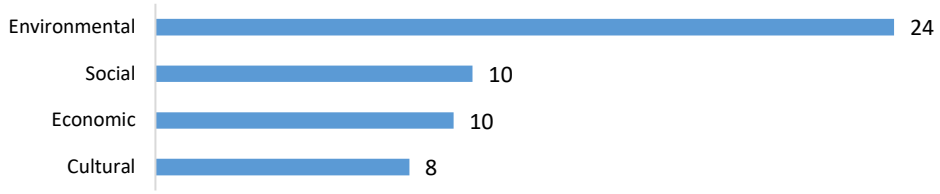


Participants were then asked to indicate whether, and the extent to which, the agribusiness scheme(s) that they participated in accounted for *environmental*, *social*, *economic* and *cultural* dimensions. As shown in Figure 2-10 below, of those who participated in agribusiness schemes, approximately 92 per cent indicated that their scheme(s) included an *environmental* dimension, followed by social, economic and cultural dimensions.

Figure 2-10: Number of dimensions accounted for in agribusinesses scheme(s)

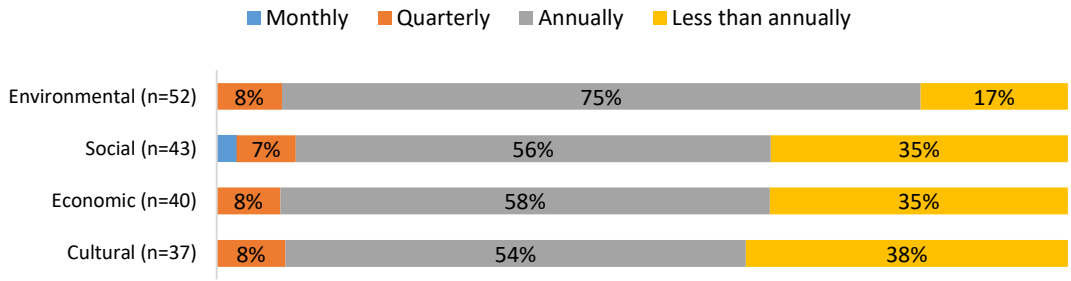
Following this, participants were asked to indicate the number of criteria considered for each dimension included within their agribusiness scheme(s) - Figure 2-11 below presents the average number of criteria indicated for each dimension. This shows that participants indicated the highest number of considered criteria within the environmental dimension (24 criteria on average), followed by social (10 criteria on average), economic (10 criteria on average) and cultural dimensions (8 criteria on average). The total range of criteria ranged for each dimension – environmental, between 1 and 289 criteria; social, economic, and cultural, between 1 and 57 criteria.

Figure 2-11: Number of criteria for each dimension accounted for in agribusinesses scheme(s) (average)



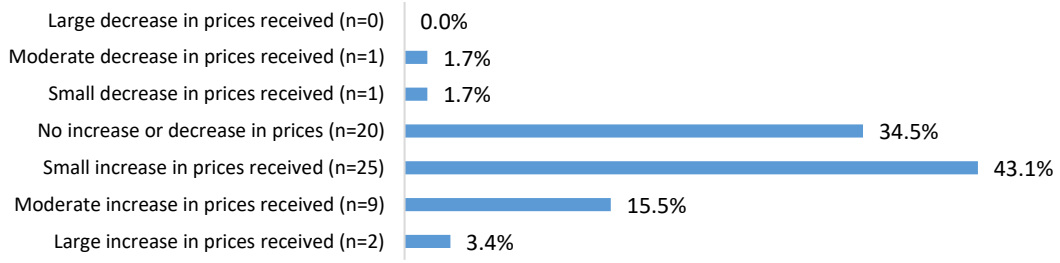
Following this, participants were asked to indicate the frequency at which they are audited for their compliance with the agribusiness scheme(s) they participate in across the above dimensions – these results are presented in Figure 2-12 below. This shows the most common audit frequency across all dimensions considered to be *annually*, followed by *less than annually*.

Figure 2-12: Audit frequency by dimension for agribusiness scheme(s)



Finally, participants were asked to indicate how their participation in agribusiness schemes affects the prices that they receive for what they sell – results are shown in Figure 2-13 below. This shows that only 2 participants (approximately 3.4 per cent) indicated a decrease in prices received for their goods as a result of participation in agribusiness schemes, with just over a third of participants (34.5 per cent) indicating neither an increase or decrease in prices received.

Figure 2-13: Impact of agribusiness scheme participation on prices received (n=58)

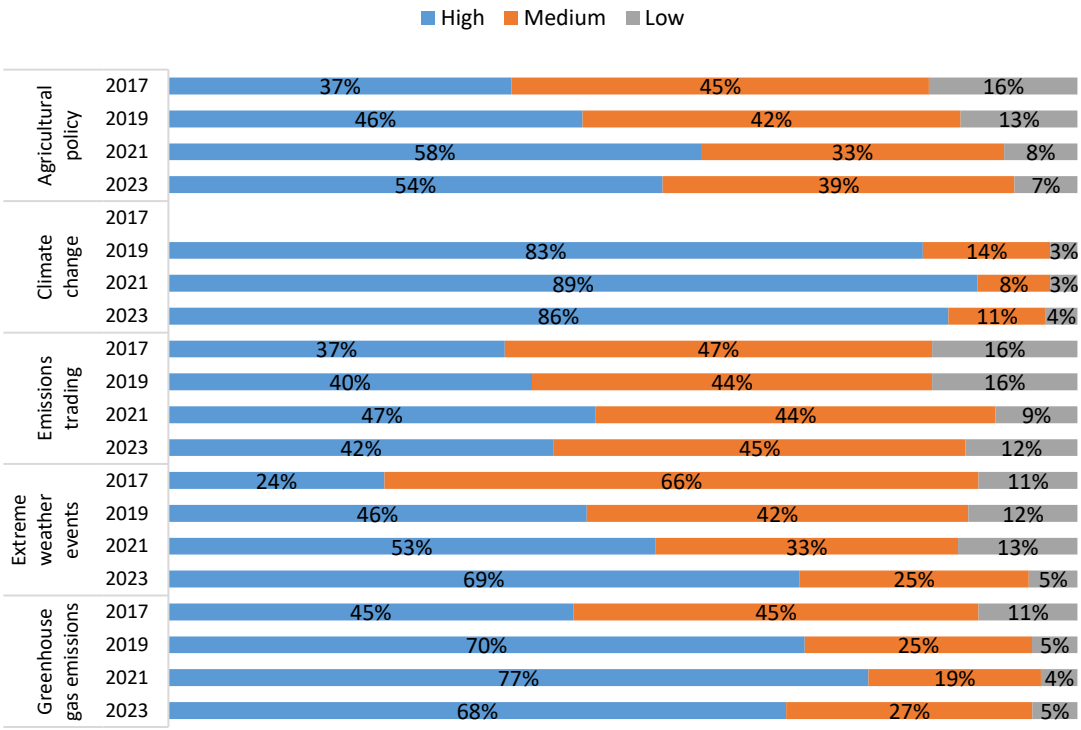


2.2.7 Discussion

A side-by-side analysis of results from previous expert surveys provides an indication of changes in the importance of international and domestic drivers of land-use change over time. In both the current and previous surveys (2017, 2019, 2021, 2023) participants were asked to indicate the relative importance (High, Medium, Low) of a range of pre-defined international drivers of New Zealand land-use change (see Figure 2-6 above). The following analysis shows key results of changes over time across the four surveys, suggesting changing trends in the perceived importance of particular international drivers of New Zealand land-use change.

Observed across the four survey years was a shift in the importance of a range of international drivers related to climate change and associated issues – results are shown in Figure 2-14 below. This shows a relatively high importance attributed to climate change at an international level, with consistently high importance placed on related drivers, such as agricultural policy, emissions trading, extreme weather events, and greenhouse gas emissions. The continuous importance of these drivers may be related to high awareness of the impacts of greenhouse gas emissions from New Zealand agriculture, including the potential international reputational risk associated with greenhouse gas emissions, and New Zealand domestic policy intended to slow and sequester emissions, such as the New Zealand Emissions Trading Scheme.

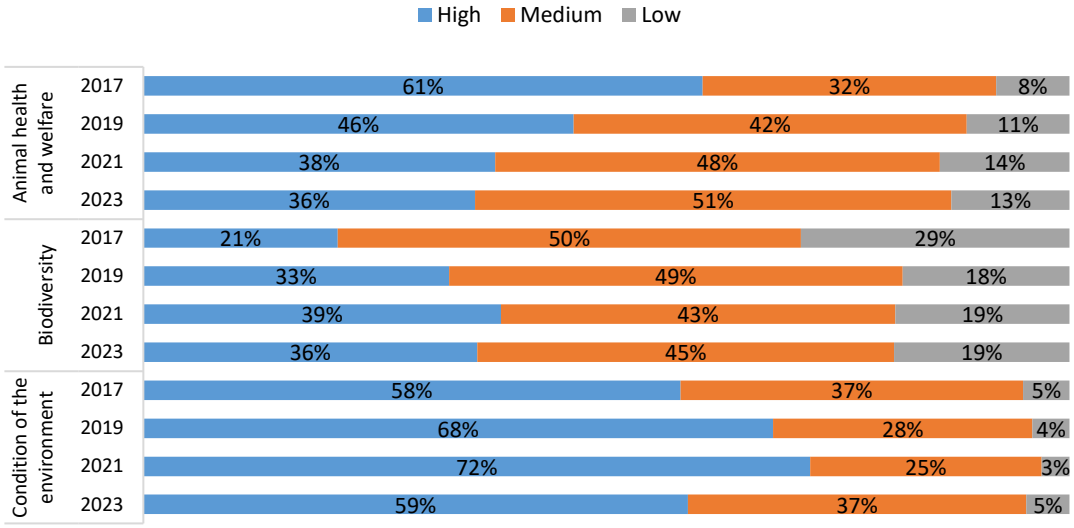
Figure 2-14: Relative importance of pre-defined international drivers of New Zealand land-use change – Climate Change (Agricultural Policy, Climate Change, Emissions Trading, Extreme Weather Events, and Greenhouse Gas Emissions)



Similarly, change in the relative importance international drivers of land-use change in relation to potential consumer reputational risk over time are shown in Figure 2-15 below – specifically, animal health and welfare, biodiversity, and condition of the environment. This shows a step-wise decrease in the perceived importance of animal health and welfare as an

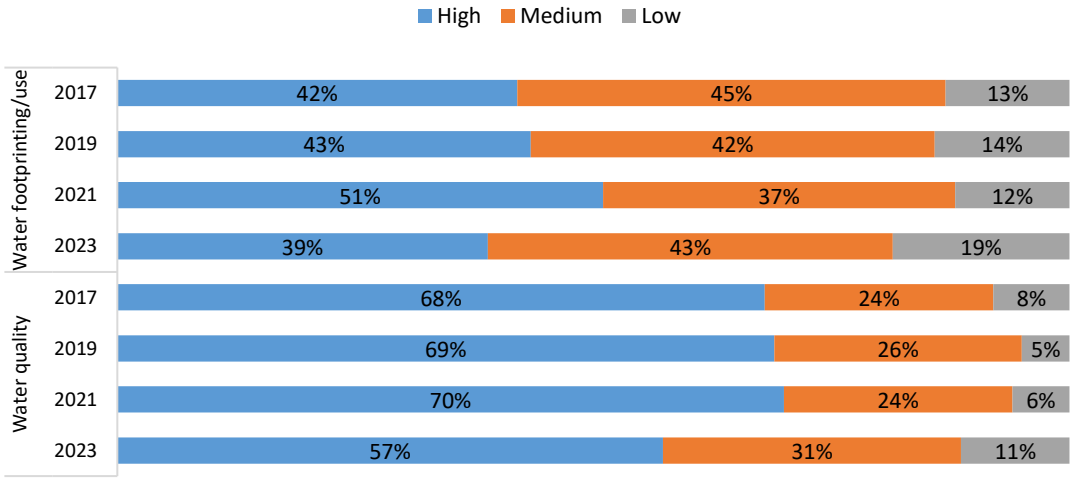
international driver of New Zealand land-use change, and a relative increase in the importance of biodiversity and condition of the environment as international drivers of New Zealand land-use change.

Figure 2-15: Relative importance of pre-defined international drivers of New Zealand land-use change – Consumer Preferences (Animal Health and Welfare, Biodiversity, and Condition of the Environment)



The relative importance of international drivers of New Zealand land-use change relating to water over the four survey years is shown in Figure 2-16 below. This shows that participants rated water issues consistently highly over the four survey years, with a slight decrease in the current iteration.

Figure 2-16: Relative importance of pre-defined international drivers of New Zealand land-use change – Water (Water Footprinting/Use and Water Quality)

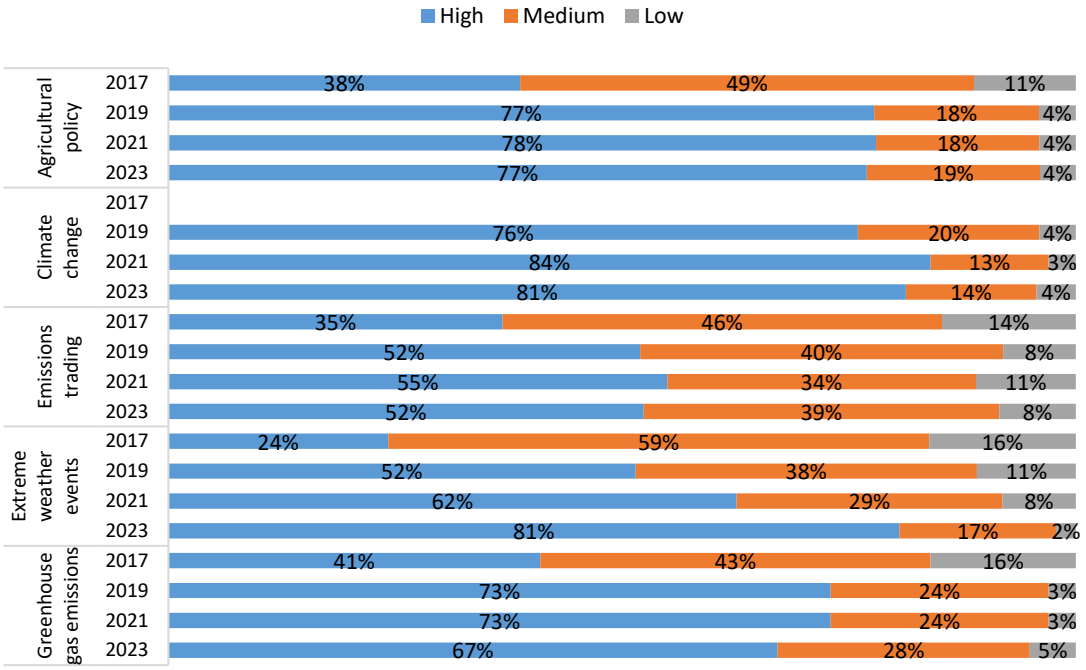


In both the current and previous surveys (2017, 2019, 2021, 2022) participants were also asked to indicate the relative importance (High, Medium Low) of a range of pre-defined *domestic* -drivers of New Zealand land-use change (see Figure 2-7 above). The following analysis shows key results of changes over time across the four surveys, suggesting changing

trends in the perceived importance of particular domestic drivers of New Zealand land-use change.

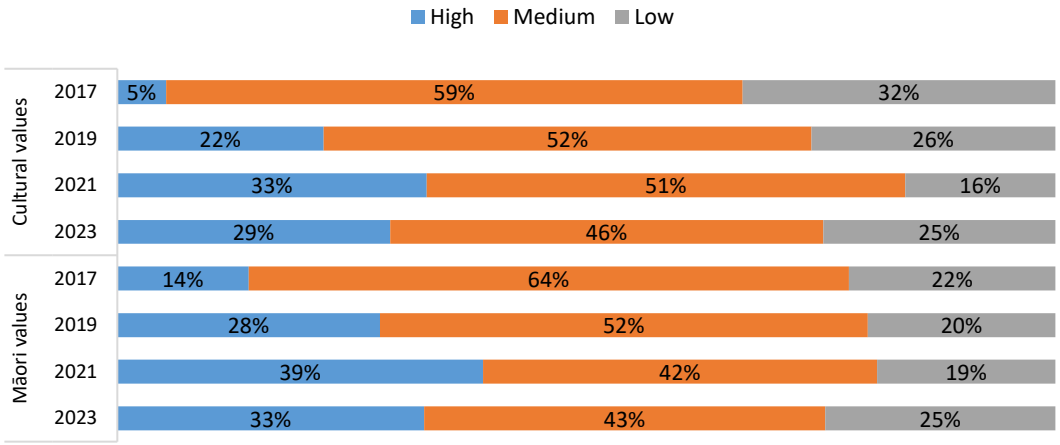
Observed across the four survey years was a shift in the importance of a range of domestic drivers related to climate change and associated issues – results are shown in Figure 2-17 below. This shows consistent importance placed on *greenhouse gas emissions* and *agricultural policy* as domestic drivers of New Zealand land-use change across the survey years. This could be attributed to the prevalence of public discussion regarding policy approaches to curbing greenhouse gas emissions from the primary section. However, while the importance of *emissions trading* has remained consistent over the same period, this has not kept pace with the increasing importance of *agricultural policy* and *greenhouse gas emissions*. Similarly, the overall importance of *climate change* has remained consistently high (see also Figures 2-4 and 2-5), as have *extreme weather events*, as domestic drivers of New Zealand land-use change.

Figure 2-17: Relative importance of pre-defined domestic drivers of New Zealand land-use change – Climate Change (Agricultural Policy, Climate Change, Emissions Trading, Extreme Weather Events, and Greenhouse Gas Emissions)



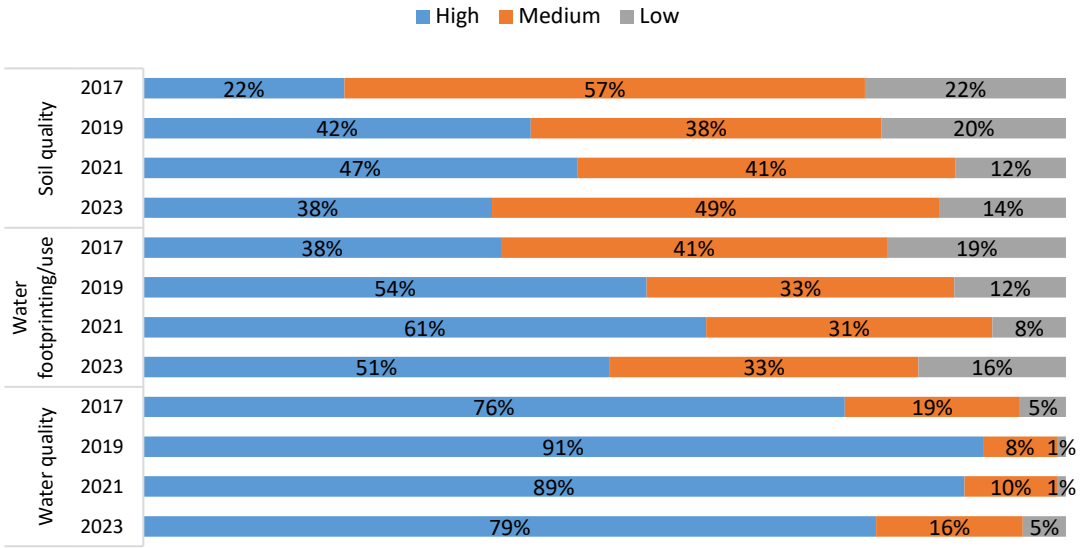
Also observed across the four survey years was a shift in the importance of cultural, and specifically Māori, values as domestic drivers of New Zealand land-use change – results are shown in Figure 2-18 below. This shows a consistency in the importance of both general *cultural values* and *Māori values* over time.

Figure 2-18: Relative importance of pre-defined domestic drivers of New Zealand land-use change – Cultural and Māori values (Cultural Values, Māori Values)



The relative importance of domestic drivers of New Zealand land-use change relating to soil and water quality/use were also examined. As shown in Figure 2-19 below, the importance of water quality as a domestic driver of New Zealand land-use change remained consistently high over the four survey years, with the relative importance of both soil quality and water footprinting/use generally increasing over time.

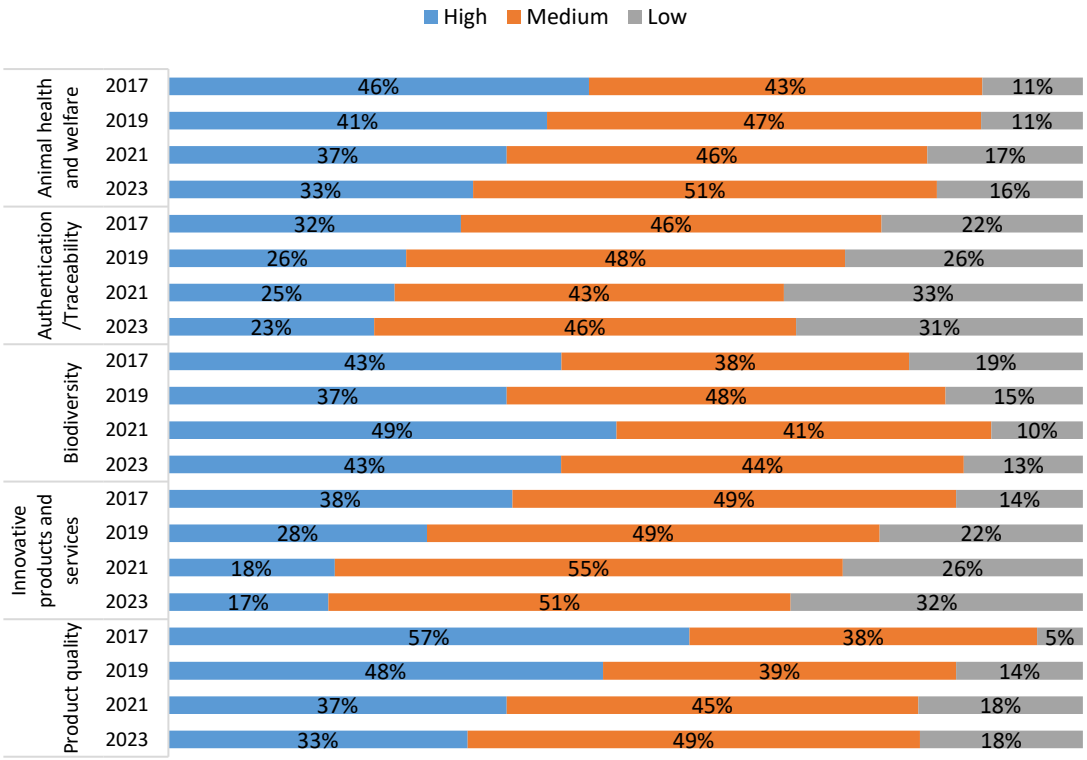
Figure 2-19: Relative importance of pre-defined domestic drivers of New Zealand land-use change – Soil and Water (Soil Quality, Water Footprinting/Use and Water Quality)



Finally, domestic drivers of New Zealand land-use change relating to consumer preferences and product quality were examined – results are shown in Figure 2-20 below. This shows a relative decrease in the importance of a range of drivers, including *animal health and welfare, authentication/traceability*, *innovative goods and services*, and *product quality* over time. This could be caused by a perceived shift in consumer preferences away from traditional ethical and product quality-related attributes to more environmentally-focussed concerns, such as climate change. In addition, the relative importance of biodiversity

remained high over the four survey years, with a relative uptick in importance shown between 2019 and 2021.

Figure 2-20: Relative importance of pre-defined domestic drivers of New Zealand land-use change – Consumer Preferences and Product Quality (Animal Health and Welfare, Authentication/Traceability, Biodiversity, Innovative Products and Services, Product Quality)



3. Future trends and challenges and their impact on New Zealand land use change/practice

The primary sector represents a large proportion of domestic land use and contributes heavily to the New Zealand economy. It contributes around 11 per cent of gross domestic product (GDP), which rises to nearly 20 per cent if downstream and processing industries are included. Agricultural exports represent more than 80 per cent of total merchandise exports in New Zealand, with a value of NZ$53 billion in 2022, projected to increase by 6 per cent in 2023 to NZ$56.2 billion (MPI, 2023b). New Zealand's primary sector aims to continue achieving strong export returns while simultaneously addressing local and global trends and challenges.

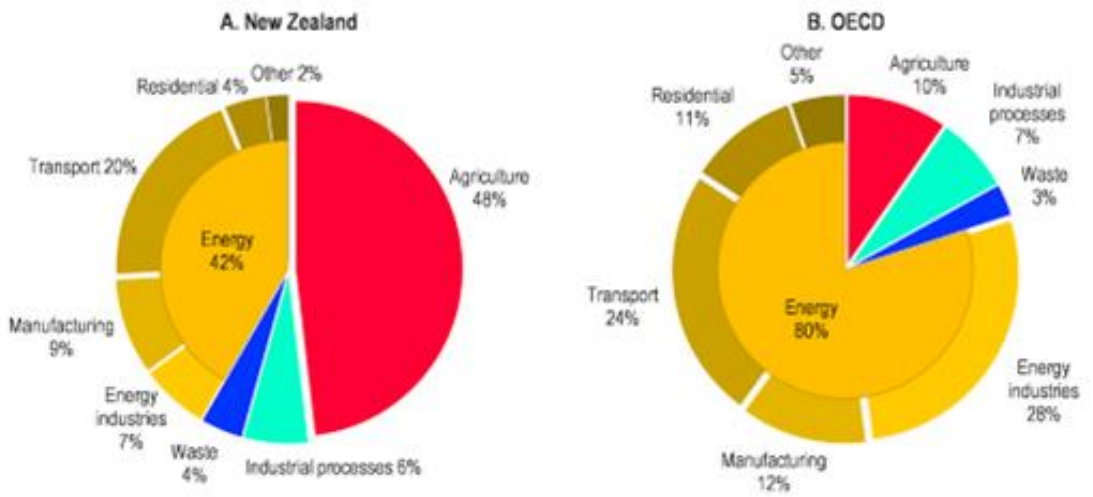
The total area of land used for agriculture and horticulture has been decreasing since 2002 with an overall reduction of 1,878,409 hectares (14 per cent) between 2002 and 2019. Also, the number and size of farms has decreased during the same period, with a reduction of 19,980 farms (29 per cent) and 2,028,710 hectares (13 per cent) between 2002 and 2019. However, the export income from farming products has increased, from $23 billion in 2010 to $44 billion in 2019 (primary industries export revenue excluding seafood). Furthermore, dairy cattle numbers have more than doubled since the 1980s, rising from 3 million to almost 7 million in 2015, with more than 6 million in 2019. Also, the use of irrigation, especially on land used for dairy farming, has nearly doubled since 2002. In 2019, five per cent (735,073 hectares) of agricultural land in New Zealand was irrigated, with dairy farming making up 58 per cent of irrigated agricultural land 2019 (StatsNZ, 2021a).

3.1 Climate Change

Climate change is already affecting New Zealand with observed impacts on the natural environment, its economy and communities. The primary sector in New Zealand is dependent on the climate for its productivity – however, the sector also contributes approximately half of New Zealand's total greenhouse gas (GHG) emissions. Climate change is therefore an increasingly important concern with pressures and changes on land-use in New Zealand (NZG, 2022a).

New Zealand has amongst the highest GHG emissions (excluding land use, land-use change and forestry) per capita among OECD countries, which have only declined by 10 per cent since 1990, less than the OECD average. A major contributor to this is biological emissions from agriculture (see Figure 3-01 below) – mainly methane – that make up almost half of total emissions, representing a much higher share than the OECD average. Agricultural emissions have grown by 17 per cent since 1990, driven by increased use of synthetic nitrogen fertiliser and higher dairy cattle numbers (OECD, 2022a).

Figure 3-01. Agricultural sector emissions profile, New Zealand versus OECD average, GHG emissions share (%), 2019



Source: OECD, 2022a.

New Zealand's first National Climate Change Risk Assessment (NCCRA) (MfE, 2020) identified risks to land-based primary sector productivity and output (due to changing precipitation and water availability, temperature, seasonality, climate extremes and the distribution of invasive species) as a priority risk. Changes to the timing of growing seasons are already being observed, and likely to change further under a changing climate. This has implications across all agricultural sectors, particularly horticulture, for which modelling suggests that climate change will modify the seasonality of pasture growth rates more than annual yields in New Zealand. In many regions, warming is increasing winter pasture growth (Lieffering, 2016) and some regions are also experiencing increased spring growth (Newton et al. 2014). However, climate change is also likely to boost New Zealand's potential as a wine-growing region. This is expected to increase with the onset of rises in global temperatures, with increases in potential growing area of up to 168 per cent. While plant growth in agriculture and forestry may be boosted, with new crops able to be planted, this will likely be offset by increased frequency and intensity of extreme weather events (such as floods and droughts), pests and diseases, as well as limitations in water use. Higher temperatures will also cause particular regions (such as areas of the North Island) to become unsuitable for crops that have traditionally grown well, with pasture composition changing to favour more subtropical species (which in turn could influence animal health and productivity). This will likely incur unequal costs across New Zealand's growing regions, as well as inhibit New Zealand's ability to supply export markets (Wreford et al., 2022b). However, a study by the Agribusiness and Economics Research Unit (AERU) indicated that while there may be shocks to different parts of the food sector and different regions, overall, more frequent climate events are unlikely to cause major overall impact on New Zealand food export revenues by 2050. Looking at New Zealand climate scenarios alone, climate events may result in a 7-9 per cent reduction in cereal revenue, 5 per cent in wine, and 2 per cent in sheep and beef meat. Dairy revenues are not likely to be significantly impacted (Wreford et al., 2022b).

3.1.1 Extreme Weather Events

Current evidence is clear that a changing climate will be associated with an increasing magnitude and frequency of extreme weather events. These events could include longer and more severe droughts, flooding, heatwaves and wildfires, all of which have the potential to significantly negatively impact agriculture, both nationally and internationally (IPCC, 2021).

Agricultural systems are sensitive to changes due to their dependence on stable, long-term climatic conditions in which current land-use practises were developed, and through impacts on production, yield, and quality (Cradock-Henry et al., 2020). Anthropogenic climate change will increase the frequency and intensity of extreme weather events, which will likely have a negative impact on agricultural systems and cause disruptions to existing supply chains (IPCC, 2021). For example, Beillouin et al. (2020) expressed concern that extreme weather would increase the risk of large-scale crop failures. Lesk et al. (2016) estimated that extreme weather events were responsible for approximately 9-10 per cent reductions in cereal production internationally between 1964 and 2007, and that the intensity of these events would likely increase under climate change. Lesk & Anderson (2021) outlined that extreme heat and drought often reduce important food crop yields around the world, placing additional stress on regional and global food security. The study suggests that the global climate is transitioning from one in which concurrent heat and drought occur rarely to one in which they occur over an important area of croplands every year (Lesk & Anderson, 2021).

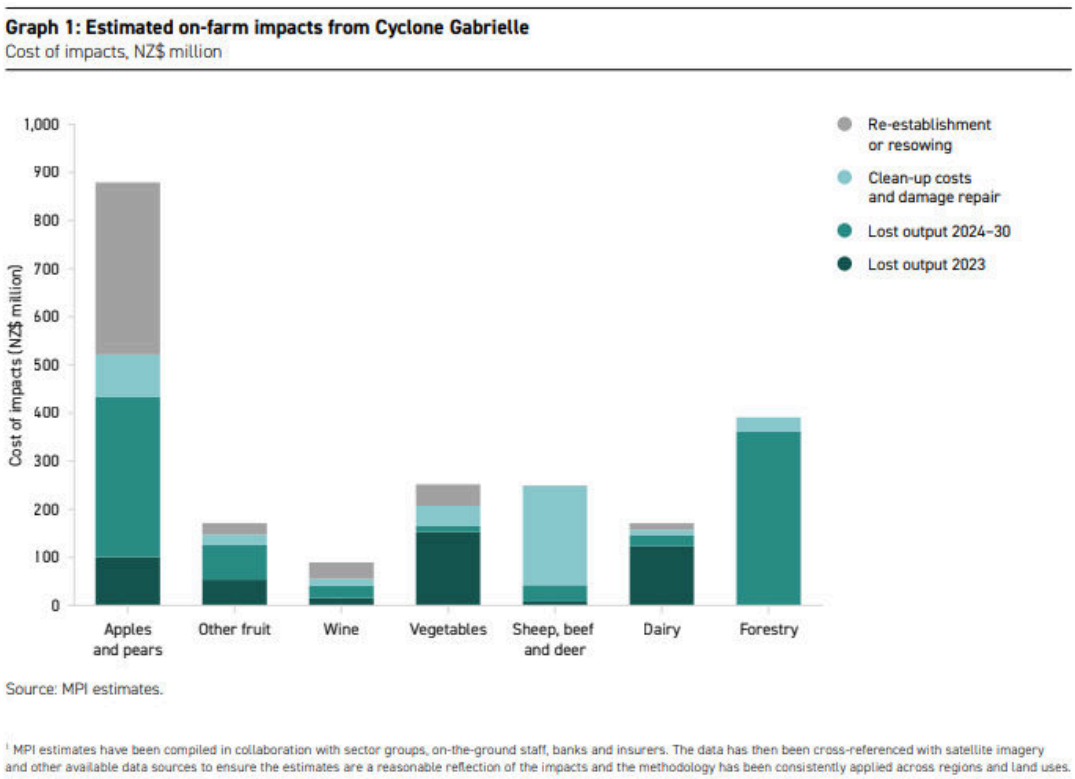
The Intergovernmental Panel on Climate Change (IPCC) also note in their latest synthesis report (IPCC, 2023a) that many weather and climate extremes in every region internationally have continued to increase over 2010-2019 due to global GHG emissions, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land use change, lifestyles and patterns of consumption and production across regions, between and within countries, and between individuals. This has led to widespread adverse impacts on food and water security, human health and on economies and society and related losses and damages to nature and people (IPCC, 2023a, p6).

Globally, across every continent, the changing climate leads to more frequent and severe storms, heatwaves, droughts, and other extreme weather events. The costliest extreme weather events in 2022 were Hurricane Ian in the USA and Cuba (with estimated damages of more than US$100 billion), the European drought (with estimated damages of more than US$20 billion), and flooding in China (with estimated damages of more than US$12.3 billion) (C2ES, 2023).

There are relatively few studies on the economic impact of extreme weather events on New Zealand. However, this information is important for New Zealand as a country that relies heavily on its agricultural exports. The effects of global climate change can have important impacts on market prices for New Zealand products through their effects on global supply. The most recent extreme weather event in New Zealand was Cyclone Gabrielle, which hit northern and eastern regions of the North Island between 12th and 16 February 2023. To date, the cyclone is New Zealand's costliest non-earthquake natural disaster, with the total value of impacts on the food and fibre sector have been provisionally estimated at NZ$2.0–$2.4 billion. This includes estimates for physical asset damage to businesses, plus additional impacts for lost production in 2023 and future years (MPI, 2023b). Rebuild costs for heavily affected orchards and vineyards are estimated to range from NZ$100,000 and NZ$250,000 per hectare, and it will likely take several years to source trees and vines and return to full production (MPI,

2023b, p11). Following Cyclone Gabrielle, the New Zealand Government moved quickly to help farmers, growers and mana whenua clean up and protect vital production such as trees and vines. The New Zealand Government provided NZ$74 million in grants and NZ$4 million to help rural communities with immediate recovery needs such as aerial surveys, mental wellbeing, recovery advice, fencing support, logistics and transport, and NZ$172 million committed to help silt clean-up in affected regions (MPI, 2023b). Figure 3-02 below shows the estimated costs by sector attributed to Cyclone Gabrielle. This shows the most significant total estimated costs attributed to apples and pears, followed by forestry, with the types of costs varying by industry. For example, the sheep, beef and deer industry largely incurred costs relating to clean-up and damage repair, while forestry largely incurred costs related to lost output in future seasons (MPI, 2023b).

Figure 3-02. Estimated on-farm impacts from Cyclone Gabrielle by cost type, NZ$ millions



Source: MPI, 2023b.

Droughts have historically been the most economically costly extreme weather event in New Zealand due to their impacts on the primary sector (Treasury and MfE, 2023) - therefore, drought is the most studied climate extreme in New Zealand. Drought affects pasture growth, as well as the nutritional value of pasture. The extent of this effect depends on the severity and duration of water deficit(s), as well as the species under consideration (Lee et al. 2013). Increased variability in growth rates can lead to uncertainty in feed planning, resulting in either deficits or surpluses. The profitability of extensive sheep and beef systems that rely less on purchased inputs are generally more affected by drought (Clark et al. 2012). In 2021, NZ Treasury projections estimated a loss of 0.5 per cent of GDP from droughts over the next 40 year. Nixon et al. (2021) calculated the economic effects of the 2019/20 drought, describing the effects for New Zealand's economy based on the pace of recovery (see Table 3-01 below).

This analysis shows that the negative impact on GDP was estimated to range from NZ$596 million to NZ$760 million, depending on a 1 to 3 year recovery. Similarly, household consumption was estimated to decrease between NZ$548 million to NZ$689 million. In addition, research published in 2020 estimated that approximately 15 per cent of the economic costs of the 2007-2008 drought (NZ$485 million in 2017 dollars) and 20 per cent of the costs of the 2012-2013 drought (NZ$315 million in 2017 dollars) could be attributed to climate change (Frame et al., 2020).

Table 3-01. Economy-wide effects of the 2019/20 drought, changes in NZ$ millions from 2019 baseline, in real terms (2019 prices)

	Scenario 1: Fast recovery, 1-year impacts	Scenario 2: Medium recovery, 2-year impacts	Scenario 3: Slower recovery, 3-year impacts
GDP	-596	-703 to -636	-760 to -659
Household consumption	-548	-640 to -582	-689 to -602
Exports	-142	-189 to -156	-261 to -164
National output	-885	-1,170 to -985	-1,320 to -1,043
Employment	-79	-108 to -93	-123 to -101

Note: For both Scenarios 2 and 3, lower estimate includes dairy ('dairy affected' scenarios), while higher excludes it ('dairy not affected'). Dairy is included in Scenario 1 along with sheep and beef.
Source: Nixon et al., 2021.

Studies examining the economic implications of drought generally show negative impacts on economic factors, such as output or the wider effect on GDP. The exception is Pourzand et al. (2020), which indicates a positive effect on dairy profits, which they attribute to the moderating effect of milk price on the international market.

To date there have been relatively few studies on the impact of flooding on the agricultural sector in New Zealand, as most existing studies have tended to focus on urban environments. In 2021, New Zealand Treasury projections estimated a loss of 0.7 per cent from storms and floods over the next 40 years. One recent study explored the consequences of flooding on dairy farms in the Bay of Plenty region (Paulik et al., 2021), and identified a range of direct and indirect damages to production and assets. Direct damage was attributed to flood duration and silt deposition, while indirect damage was influenced by the season in which the flooding occurred and the response actions implemented at the farm level. The authors concluded that resilience to a changing climate will rely on planning and farm-level responses (Paulik et al., 2021).

Heavy rainfall and storms are projected to lead to increased erosion, particularly in extensively grazed systems on steeper land, reducing productivity for decades, reducing soil carbon (Orwin et al., 2015), and increasing sedimentation. There is little published research examining the potential effects of climate change on erosion and sedimentation in a New Zealand

context. One study shows that sediment load is expected to increase in a changing climate, for example, by up to 24% by 2040 in the Manawatu-Wanganui region if no remedial action takes place, with much higher rates by the end of the century (Basher et al., 2020). While climate, especially rainfall intensity, but also vegetation cover and soil properties, and geology have an important impact on erosion and sedimentation, human activity is still regarded as having the largest impact. This has impacts on the quality of soil, the area of land available for production, and other impacts such as sedimentation of waterways (which can impact flooding and water quality). Slips may also impact transport infrastructure (e.g. roads, farm tracks) which may in turn affect connectivity of farms and orchards to markets (Wreford et al., 2022a).

In a recent study, Wreford et al. (2022a) examined the combined effect of global climate changes and their impacts on global production and trade, as well as domestic production, and the implications for New Zealand market prices, providing a different and complementary perspective for estimating the economic impacts of extreme weather events. The impacts of extreme weather events were simulated in this project using the Lincoln Trade and Environment Model (LTEM), a primary-sector focused partial-equilibrium net trade model with global coverage and additional detail on products of importance for New Zealand agricultural trade. The results indicated that in a world experiencing frequent and widespread extreme events, New Zealand producers may benefit from the global reductions in supply and resulting higher prices, and experience higher producer revenue than in a world with less frequent extreme events. Consumers, however, are likely to be worse off due to higher commodity prices. This would exacerbate existing inequalities, potentially in conjunction with increased climate events putting stress on households and other sectors in New Zealand (Wreford et al., 2022a).

A recent article showed that climate extremes can make New Zealand supply chains highly vulnerable, especially considering New Zealand's dependency on the road network, as just under 93 per cent of New Zealand freight travels by road. In response, New Zealand may need to focus on building more resilient food systems, including local food networks with increased diversification of products grown in each region (Renwick, 2023). It is highly likely that extreme weather events will continue to impact future land use change/practise across New Zealand's primary industries including meat, dairy, horticulture, viticulture, wool, and forestry.

3.1.2 Response to Climate Change

In March 2023, the Intergovernmental Panel on Climate Change (IPCC) released their synthesis report of their Sixth Assessment (AR6) - Climate Change 2023. The report outlined that many of the climatic changes observed are unprecedented, and some of the changes are irreversible over centuries or even longer (IPCC, 2023b). The report noted that strong and sustained reduction in carbon dioxide (CO_2) emissions could help to limit climate change. However, the pace and scale of what has been done so far, and current plans, are insufficient to tackle climate change and keep global warming to 1.5°C. The IPCC (2023b) pointed out that there are multiple, feasible and effective options to reduce GHG emissions and adapt to anthropogenic climate change that are currently available. In particular, the authors highlighted that *"In this decade, accelerated action to adapt to climate change is essential to close the gap between existing adaptation and what is needed. Meanwhile, keeping warming to 1.5°C above pre-industrial levels requires deep, rapid and sustained greenhouse gas*

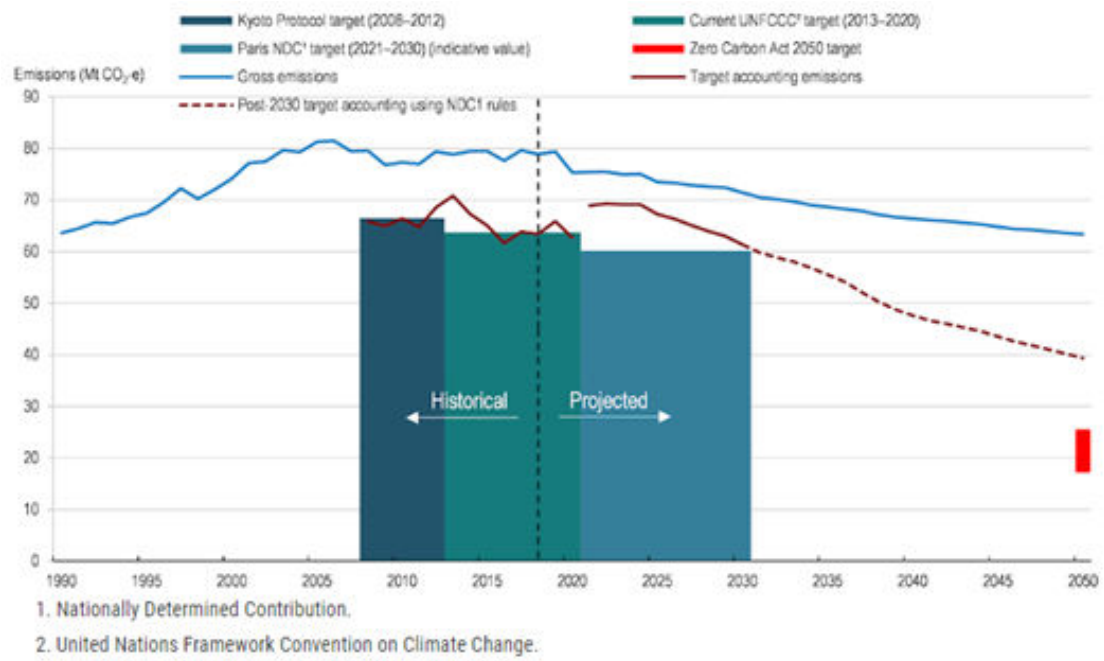
emissions reductions in all sectors. Emissions should be decreasing by now and will need to be cut by almost half by 2030, if warming is to be limited to 1.5°C.". The report further highlighted that changes in the food sector and land-use can reduce GHG emissions (IPCC, 2023b).

In November 2022, Egypt hosted the 27th United Nations Climate Change Conference of the Parties (COP27). The main output of this was multilateral agreement that losses and damages from severe climate-related disasters incurred by vulnerable communities should be subsidised (UNFCCC, 2023). In addition, COP27 pushed for further international efforts to mitigate climate change and a clear intention to keep the limitation of global warming within 1.5^{o}C. In December 2023, COP28 will be hosted in Dubai, United Arab Emirates, wherein governments will assess progress towards meeting the goals of the Paris Agreement.

In 2015, the Paris Agreement was adopted by 195 countries, a legally binding international climate agreement, which entered into force on November 4th 2016. It was signed with the intention that participating countries would achieve net zero emissions by 2050. A raft of measures were agreed upon, including attempting to limit global temperature increase to 1.5^{o}C (EC, 2023c). However, a recent report (June 2023) from Climate Action Tracker (CAT) showed that every participating state is currently falling short of their commitments under the Paris Agreement to achieving 2030 emissions reduction targets (Boehm et al., 2023). New Zealand has committed to a range of targets, including reducing total GHG emissions (excluding biogenic methane) to 30 per cent below 2005 levels by 2030 (MfE, 2021). As of March 2023, the Climate Action Tracker (CAT) has viewed New Zealand's efforts towards reducing GHG emissions as being "*highly insufficient*", noting that New Zealand's climate policies and current rate of emissions (if adopted by all countries) are likely to track towards 3^{o}C of global warming. However, CAT notes that New Zealand is the only nation-state to engage in actions such as ending subsidies for oil and gas production and ending international public finance for fossil fuels to-date. In addition, CAT (2023) has found that none of the world's largest fossil fuel producers have committed to ending new investments in oil and gas production, which are instead increasing. Furthermore, major oil and gas producers are currently promoting technologies that could prolong oil and gas production, thereby creating distance from the demonstrated need to half GHG emissions by 2030 and reduce global production of fossil fuels (CAT, 2023).

These observations are in line with those of the OECD (2022). In their economic survey of New Zealand, the OECD showed that New Zealand is not on track to meet its GHG abatement objectives, as shown in Figure 3-03 below. The OECD (2022) have recommended that new policies are needed to achieve abatement targets at least cost, with emissions pricing working in conjunction with companion policies that help to provide a wider range of low-emissions options. In addition, the OECD (2022a) has recommended that emissions pricing needs to increase substantially, combined with efficient complementary measures. The OECD (2022a) concluded that New Zealand currently has a solid institutional framework to reduce GHG emissions, but may need to implement additional abatement measures to meet its objectives, as the country is currently not on track to reach net zero emissions by 2050 (OECD, 2022a).

Figure 3-03. New Zealand's progress towards meeting GHG abatement objectives, emissions Mt CO_2e



Source: OECD, 2022a.

Updates to New Zealand's environmental policy suite, including those relating to climate change, are discussed in further detail in Section 3.2 below.

3.1.3 International Climate Change Policy/Legislation

Climate policies are being steadily implemented internationally. For example, The European Union currently has extensive legislation regarding the strategic action in relation to climate change, including the 2020 Climate and Energy Package (2009), the 2030 Climate and Energy Framework (2014), the EU Adaptation Strategy (2013) and the 2050 LowCarbon Economy Roadmap (2011). In 2021, negotiations focused on reforms that would support agriculture making stronger contributions to the climate goals of the European Green Deal. The European Green Deal is the EU's most comprehensive set of climate policy initiatives with the overall aim for Europe to be the first climate-neutral continent by 2050. At the heart of the Green Deal sits the Farm to Fork strategy (F2FS) which aims to establish a sustainable food system that has a neutral or positive environmental impact and to reduce the climate footprint of the food system (among other goals). The strategy sets specific agricultural emission reduction targets for 2030. These are as follows: 50 per cent cut in agricultural GHG emissions, 50 per cent cut in pesticide use and 20 per cent reduction in fertiliser use. Also, the policy demands for an increasing percentage of EU farmland under organic management from 8 per cent to 25 per cent by 2030 to achieve these targets. The strategy includes specific actions for farming, such as working with EU member states to support better implementation of Common Agricultural Policy (CAP) objectives, enact a carbon farming initiative, and improve pesticide regulations. The EU has allocated 37 per cent of its recovery fund for green transition, including EUR7.5 billion to deliver on the F2FS and improve sustainability of European farm

policy. The EU approach also requests putting sustainability considerations central to the revised CAP and applying 40 per cent of its overall budget to climate action (EPRS, 2020).

In 2020, the EU revised their contribution under the Paris Agreement, agreeing to reduce its GHG emissions by 55 per cent of 1990 levels by the year 2030. The EU operates an Emissions Trading Scheme (established in 2005) that is currently the largest carbon market internationally, with the programme in its fourth phase (2021-2030). To achieve the EU's overall GHGs reduction target for 2030, sectors included in the EU's Emissions Trading Scheme (ETS) (i.e. electricity and heat generation, energy-intensive industry sectors, and commercial aviation) are obliged to reduce emissions by 43 per cent while the non-ETS sectors (i.e. transport, buildings, agriculture and waste) have to reduce emissions by 30 per cent (compared to 2005 levels) by 2030. The non-ETS sectors emission reduction targets for each member state were set in the Effort Sharing Regulation (ESR) in 2018. These national targets initially ranged from 0 per cent to 40 per cent reductions in emissions compared to 2005 levels. Within the national targets set by the legislation, member states have flexibility regarding the contribution from each non-ETS sector. In 2021, these national emission targets for non-ETS sectors were adjusted in order to meet the EU's overall emission reductions target by 2030 and to achieve climate neutrality by 2050. The European Commission (EC) proposed to reduce emissions under the ESR by at least 40 per cent (compared to 2005 levels). This is an increase of 11 percentage points compared to the existing target of a 30 per cent emission reduction, adopted in 2018 (EC, 2021a).

3.1.4 Climate-Focused Finance

There has been a strong movement within the banking and investment sector towards sustainable finance and investing using ethical, social and governance (ESG) criteria. Investors are currently seeking to make investments that generate returns while also having positive social, economic, and/or environmental impacts. Bank of New Zealand (BNZ) chief executive Angela Mentis outlined that their bank *"will increasingly seek to use environmental, social, and governance (ESG) linked lending with New Zealand farmers, agribusinesses, and other sectors to help meet New Zealand's climate change obligations"* (BNZ, 2021). In December 2021, New Zealand became the first country in the world to make climate-related disclosures mandatory for all banks, credit unions and building societies with total assets of more than $1 billion – about 200 organisations (MPI, 2022).

New Zealand is also world-leading in the development of the Sustainable Agriculture Finance Initiative (SAFI) - a definition of good sustainable agriculture practices in New Zealand for use by the finance sector. This provides the finance sector with open-source information on sustainable farming and growing practices that are suitable for the New Zealand environment, but also meet the growing environmental, social and governance (ESG) requirements of international capital providers. SAFI will also align with emerging international frameworks and sustainability standards used by New Zealand farmers and growers. New Zealand's primary sector and land users may have to adapt existing, or adopt new, land use practises to gain investment or access to lending/credit from banks in the future (MPI, 2022).

International institutions are also seeking to enable and direct finance/capital towards initiatives and investments that will likely influence land use change and/or practise. For example, the European Union (EU) has issued a sustainable finance strategy and framework. This will help guide the flow of private finance towards sustainable economic activities and

will enable the transition towards a carbon neutral economy by 2050. The EU Platform on Sustainable Finance is an expert group established to advise the European Commission on the development of a sustainable finance market. In 2021, the group released a report on transition finance that detailed how the Commission can enable financing from companies and other economic actors working to improve their environmental footprint (EC, 2021b). The United Nations has also launched the Land Use Finance Programme (UNLUFP) to proactively unlock and upscale private finance from banks, investors, and agribusinesses directed towards sustainable land use. It has established partnerships with banks, including BNP Paribas and Rabobank, which have contributed significant funds to preventing deforestation and promoting inclusive commodity production (UNEP, 2021).

3.1.5 Climate Change and International Trade

There is an increasing global focus on the role that international trade rules can play in addressing climate change, especially through climate clauses in new trade deals, but more importantly through the implementation of carbon border adjustment mechanisms (CBAM). Carbon border adjustment mechanisms (CBAM) apply emission levies on imported goods from other countries. Hence, countries that fail to decarbonise domestic production might face punitive costs for their exports into other countries. The European Union (EU) has a mandate to implement such a CBAM by 2023; hence the EU CBAM will come into force in October 2023. The United States (US), the United Kingdom (UK) and Canada have all committed to exploring or implementing similar schemes in the future (Cosbey et al., 2021). This could have implications for New Zealand, as these countries are important trading partners for New Zealand. In 2020, the US and EU were New Zealand's third- and fourth-largest export markets respectively (StatsNZ, 2021b). Th UK is also an important trading partner (New Zealand's seventh-largest export market in 2020) and is likely to grow in its importance following the signing of the NZ-UK FTA (MFAT, 2023a).

3.1.5.1 The EU carbon border adjustment mechanism

As part of a plan to decarbonise its economy by 2050, the EU released its proposal for the creation of a CBAM in July 2021. The CBAM regulation officially entered into force one day following its publication in the Official Journal of the EU on 16th May 2023. The CBAM itself has entered into force in its transitional phase from 1 October 2023, with the first reporting period for importers ending 31st January 2024 (EC, 2023a). The EU CBAM applies a tax on the embodied carbon of emissions-intensive imports with the aim of limiting carbon leakage and ensuring domestic industries that produce goods with a smaller carbon footprint can compete with cheaper imports from countries with lower environmental ambitions and regulations than the EU. The mechanism reflects the costs that the EU imposes on domestic producers under its Emissions Trading Scheme (ETS). The CBAM initially applies industrial emissions with the implementation of a carbon tax for imports cement, iron and steel, aluminium, fertilisers, electricity and hydrogen to the EU (UNCTAD, 2021). When fully phased in, the EU CBAM is intended to capture more than 50 per cent of the emissions in the EU's ETS-covered sectors (EC, 2023b). The European Commission (EC) also anticipates using the scheme as an economic incentive for other countries to decarbonise domestic production and exports and adopt environmental policy frameworks. The EC has presented the scheme as an environmental policy tool aiming to equalise the price of carbon between domestic products and imported goods for some sectors (MFAT, 2021a).

UNCTAD (2021) analysed the potential effects of the EU CBAM on international trade, carbon emissions, income and employment using a computable general equilibrium model – the Global Trade Analysis Project (GTAP). The analysis applied an ad valorem equivalent for a carbon price of US$44 per tonne of CO_2 (Scenario 1), and an ad valorem equivalent for a carbon price of US$88 per tonne of CO_2 (Scenario 2). Commodities included were paper products, aluminium, steel, ferrous metals, petroleum, coal, cement, glass, chemicals, fertilisers and electricity. Projection results showed that the impact of carbon border adjustments (CBAs) varied significantly by country and commodity, indicating large differences in the GHG emissions embedded in production. For Australia/New Zealand, projections showed a decrease in CO_2 emissions by 1.33 million MT CO_2 in Scenario 1 and 2.26 million MT CO_2 in Scenario 2. Real income in Australia/New Zealand was projected to fall by approximately US$788 million when a carbon price of US$44 per tonne of CO_2 was applied (Scenario 1) and by approximately US$1.3 billion when a carbon price of US$88 per tonne of CO_2 was applied (Scenario 2). Finally, exports of energy-intensive products from Australia/New Zealand were projected to fall by approximately 2.6 per cent in Scenario 1 and by approximately 4.5 per cent in Scenario 2. It is important to note that the majority of the commodities taxed were exported from Australia rather than New Zealand – therefore, the economic impacts in this study are more applicable to Australia (UNCTAD, 2021). Chepeliev (2021) also assessed the economic impacts of the EU CBAM with the EU carbon tax imposed on all countries. The author applied an ad valorem equivalent on imports of US$26 per tonne CO_2 to commodities currently covered by EU ETS (i.e. gas, chemical, iron and other metals, petroleum products, and electricity). Results showed that, for Australia and New Zealand, a welfare decrease of approximately US$126.7 million was projected, equating to an approximate 0.01 per cent drop in per-capita income (Chepeliv, 2021).

3.1.5.2 Carbon border adjustment mechanisms in other countries

Similar to the EU, the US has announced proposals to introduce levies on imports that are not subject to carbon pricing in their own countries. This is to ensure that US producers are not undermined by cheaper high-emissions imports. Democrat lawmakers have proposed a carbon border tax as part of the current budget discussions, with likely included commodities being iron and steel. However, the US concept is at a much earlier stage than the EU (Hansen-Kuhn, 2021). Similarly, the UK Environmental Audit Committee (EAC) launched an inquiry into a potential future CBAM in October 2021. The EAC will make recommendations to the UK Government on the possibility of introducing a unilateral CBAM in the UK (Hedley et al., 2021). The Canadian government has also announced its intention to explore the potential implementation of a CBAM, and how this approach could support the country to meet its climate targets while ensuring a fair environment for domestic industries. Consultation processes with the provinces and territories, and industry associations and the broader Canadian public commenced (Government of Canada, 2021).

3.2 New Zealand's Environmental Policy

A range of new environmental policy with the potential to influence land use change or practise in Aotearoa New Zealand was introduced by the Sixth Labour Government, particularly in their latest term. However, with the election of a new National Government in the 2023 New Zealand General Election, the national direction for environmental policy is, as the time of writing, uncertain.

3.2.1 Climate Policy and the New Zealand Emissions Trading Scheme (NZETS)

The legislation guiding New Zealand's efforts to combat climate change is the Climate Change Response Act (2002), which was developed to meet obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. In 2019, this was amended to the Climate Change Response (Zero Carbon) Amendment Act. These amendments set targets for reducing all GHG emissions (excluding biogenic methane emissions) to net zero by 2050, with targets for reducing biogenic methane emissions to 10 per cent below 2017 levels by the year 2030 (MfE, 2019). In 2020, the Climate Change Response (Emissions Trading Reform) Amendment Act was passed to support New Zealand's efforts to move to a low-emissions, climate-resilient economy (NZP, 2020). This introduced a new penalty regime and set out new provisions for forestry. It also included decisions to address New Zealand's agricultural emissions, committing the primary sector to have a system for farm-level accounting and reporting of agricultural GHG emissions for all farms by 2025. This framework is being developed by He Waka Eke Noa, a primary sector climate action partnership between the New Zealand Government, the primary sector, and iwi. The partnership seeks to equip and empower farmers and growers to measure, manage and reduce agricultural GHG emissions, including biogenic methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2) (MPI, 2023f).

In May 2022, He Waka Eke Noa (Primary Sector Climate Action Partnership) released their recommendations for pricing agricultural emissions for review by the New Zealand Government. Instead of agriculture entering into the NZETS in 2025, He Waka Eke Noa recommended the introduction of a farm-level split-gas levy on agricultural emissions, with built-in incentives for reduction emissions and sequestering carbon on-farm. Specifically, the report recommends that farmers calculate their short- and long-lived GHG emissions separately through a single centralised calculator, which would assist in determining the levy cost. In addition, it was recommended that on-farm sequestration activities could be incentivised through offsetting levy charges, with levy revenue invested into research, development and extension activities, including a dedicated fund for Māori landowners. Their recommendations also included setting minimum thresholds for entry, including GST-registered farms with over a certain number of livestock, including: 550 stock units (sheep, cattle, deer and goats), 50 dairy cattle, 700 swine, 50,000 poultry, and 40 tonnes of synthetic nitrogen fertiliser use (He Waka Eke Noa, 2022a).

The New Zealand Government responded in December 2022 with a report produced under reporting requirements within Section 215 of the Climate Change Response Act 2002 (requiring Ministers to report on alternative pricing system for farm-level agricultural emissions). The so-called "Section 215 Report" outlined a possible pricing system for agricultural emissions based on He Waka Eke Noa recommendations, including a farm-level split-gas levy, unique prices for nitrous oxide and biogenic methane (to be reviewed on a regular basis), with levy revenue put back into the pricing system to further mitigate emissions, and similar stipulations (NZG, 2022c).

Greenhalgh and Djanibekov (2022) have estimated that pricing agricultural emissions could reduce net revenue for agriculture between 4.3 and 5.9 per cent, with the sheep and beef sector estimated to experience the largest reductions in net revenue (between approximately 12 and 36 per cent reductions), followed by the dairy sector (between approximately 7 and 12 per cent reductions). However, the authors estimated that arable and horticultural net

revenue could increase (between approximately 2 and 10 per cent) (Greenhalgh and Djanibekov, 2022).

The New Zealand Emissions Trading Scheme (NZETS) continues to be New Zealand's main policy tool for reducing GHG emissions. The NZETS currently requires agri-food companies (e.g. meat processors, dairy processors, nitrogen fertiliser manufacturers and importers) to report on their agricultural emissions – however, these companies are not required to pay for their emissions. The NZETS was first introduced in 2008 to encourage people and businesses to minimise and reduce their emissions, and to plant forests in order to offset emissions. Carbon credits are the trading units or currency used in the NZETS, with one New Zealand Unit (NZU) representing one tonne of GHG emissions (measuring in carbon dioxide equivalent (CO_2e)). Sequestration actions like planting forests can earn NZU credits, which can then be sold on to emitters at a market price. Businesses also have the ability to buy and sell these units depending on their ability to reduce emissions (MfE, 2022c). While previously admissible, in 2015 the New Zealand government disallowed businesses from purchasing overseas carbon credits in response to concerns regarding the integrity of purchasing cheap and potentially fraudulent international credits from nation-states such as Russia and the Ukraine (Frykberg, 2019).

The NZETS has undergone several major changes in recent years. Under the Climate Change Response (Emissions Trading Reform) Amendment Act 2020 and additional provisions in 2021, a new penalty regime was introduced to the NZETS for those participants who had failed to meet emissions returns or repayment deadlines, or filed incorrect emissions returns. In line with this, the cost of fixed-price option New Zealand Units (NZUs) increased from NZ$25 to NZ$35 per tonne CO_2e, with industrial allocations phased out from 2021. In addition, New Zealand Government auctions for NZUs was introduced in 2021, allowing businesses to bid for the purchase of NZUs (MfE, 2022c). Furthermore, new forestry provisions regarding the ability of forest managers to classify existing post-1989 plantations came into effect from January 2023 (Leining, 2022).

In April 2023, the Climate Change Commission warned that New Zealand's heavy reliance on planting trees to offset GHG emissions could threaten its ambitious plans to reach net zero emissions by 2050. In particular, achieving a net reduction in emissions primarily through planting trees is impossible to sustain in the long-term, as forests could be destroyed through fire or extreme weather events, and have a limited carbon sequestration lifetime (Graham-McLay, 2023).

Various studies have assessed the impact of climate change mitigation and adaptation strategies on land-use change. In particular, studies exist that measure potential changes in emissions associated with changes in farming system practice, with many different options discussed for different farming systems, all of which are likely to impact on land-use change in Aotearoa New Zealand in the future. For example, AgFirst (2019) assessed the impact of different GHG mitigation options for dairy and sheep/beef farms in New Zealand on GHG emissions and farm revenue. While most options reduced emissions, the largest reductions were associated by land-use change into forestry (whereby the carbon sequestered by trees was used to offset GHG emissions from pastoral farming operations (AgFirst, 2019). Similarly, Motu (2019) provided an overview of the expected impacts on land-use change from climate policy, including mitigation and adaptation policies. Four major types of land-use changes were identified to be likely between 2020 and 2050: a shift from 1) dairy to horticulture; 2) scrub to forestry; 3) sheep/beef to forestry; and 4) sheep/beef to scrub. Other types of

conversions were also identified (such as sheep/beef to dairy, sheep/beef to horticulture, scrub to dairy, and scrub to horticulture), but these were considered to be more minor in the likely extent of land-use change in the future (Motu, 2019).

Wreford et al. (2022b) identified a range of climate change mitigation strategies for New Zealand agricultural operators based on the currently available literature. These are shown in Table 3-02 below.

Table 3-02. Summary of on-farm emissions reduction methods

CATEGORY	IMPORTANCE
Feed Management: Adjustments to the frequency and methods of feed type and distribution to animals used within the production system.	As biogenic methane emissions from livestock production are mostly generated through feed types or practices, and there is a direct relationship between food consumed and methane emitted, methods for reducing feed intake can greatly reduce biogenic GHG emissions on-farm.
Pasture, Crop and Soil Management: Adjustments to the growth, rotation and selection of pasture and/or crops within the production system, as well as the application of fertilisers.	The application of different pasture and crop management approaches in the context of New Zealand pastoral production systems can be effective in reducing GHG emissions. However, improvements in pasture and crop production in a pastoral context will only reduce emissions if combined with reduction in total feed consumed on-farm.
Stock Management: Adjustments to stocking rates, productivity, production methods in relation to, as well as the performance and health of, animals used in production systems.	The application of different stock management approaches in the context of New Zealand pastoral production can be effective in reducing GHG emissions.
Effluent Management: Adjustments to methods for capturing, managing and applying effluents from animals used in production systems.	The application of different effluent management approaches in the context of New Zealand pastoral production can be effective in reducing GHG emissions.
Technology Investment: Management decisions relating to the purchase, use and innovation of different forms of technology within the production system.	Investment in and use of existing and novel technologies in the context of New Zealand pastoral production can be effective in reducing GHG emissions. However, many proposed technologies (such as methane vaccines and inhibitors) are not currently commercially available, and may be prohibitively expensive.
Sequestration: Actions and methods for capturing and/or utilising GHG emissions on-farm.	The establishment and use of a number of GHG emissions sequestration activities in the context of New Zealand agricultural production can be effective in capturing, utilising, and thereby reducing, GHG emissions. Increased forestry is the most effective method for sequestering farm emissions – however, this should be considered in relation to potential decreases in profitability in different farming systems.

Source: Wreford et al., 2022b.

Additional national-level climate-focused policies are discussed in Sections 3.2.3 (National Emissions Reduction Plan) and 3.2.4 (National Adaptation Plan) below. In addition, technologies for climate change mitigation are discussed in Section 3.5.1 (Climate Change Mitigation).

3.2.2 Resource Management Act (RMA) (1991) Reform

New Zealand's resource management policy suite is currently undergoing major reform, with significant implications for future land use planning. Following a 2019 review of the effectiveness of New Zealand's resource management legislation (specifically the Resource Management Act (RMA) 1991), the New Zealand Government announced that it would repeal the RMA and replace this with three new pieces of legislation (based on review recommendations). The proposed Acts included:

- The Natural and Built Environment Act (NBA) – the main replacement for the RMA, with stronger environmental protection alongside development;
- The Spatial Planning Act (SPA) – establishing long-term Regional Spatial Strategies to coordinate resource management legislation and protocols;
- The Climate Adaptation Act (CAA) – specifically aimed at addressing climate change adaptation, particularly managed retreat (MfE, 2022b).

The Natural and Built Environment Act (NBA) 2023 and Spatial Planning Act (SPA) 2023 passed their third reading in the House of Representatives on August 16th 2023, coming into effect on August 24th 2023 (MfE, 2023a; NZP, 2023). Applied together, these two new pieces of legislation will govern the development and implementation of planning processes in Aotearoa New Zealand. Specifically, the Acts require that regional authorities develop a Regional Spatial Strategy (RSS) and Natural and Built Environment plan (NBE Plan) (MfE, 2023a).

To develop these, each region will establish a Regional Planning Committee (RPC), which will be responsible for the development of an RSS and NBE Plan. The RPC requires the appointment of at least six members – each local council can appoint at least one member, while each RPC must have at least two members from iwi/hapū, with a central government representative appointed to each RPC (MfE, 2023a).

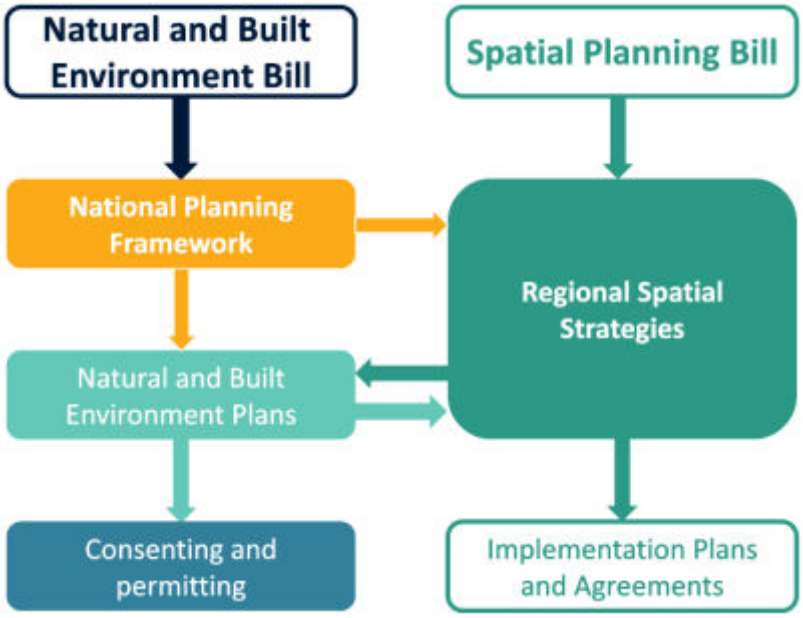
Each RSS is required to be high-level and long-term (30 to 100 years) that outline each region's development and environmental goals, including transport, construction, infrastructure, and environmental protection/restoration, thereby introducing a requirement for long-term strategic planning into resource management practice (MfE, 2023a). Similarly, NBE Plans will replace regional policy statements (RPS) and district and regional plans (DRP), setting out rules regarding land use and environmental protection, permitted activities, and the consenting process. Specifically, over 100 RPS and RDP will be consolidated into 16 NBE Plans with a view to achieving greater consistency across regions in plan deployment (MfE, 2023a).

The National Planning Framework (NPF) is expected to be developed following the passing of the NBA and SPA, and is intended to replace the various aspects related to "national direction" currently under the RMA. In effect, the NPF would integrate all aspects of national direction for resource management into a single framework, including National Policy Statements (NPS), National Environmental Standards (NES), National Planning Standards, and some

Section 360 regulations of the RMA. In this way, the NPF is expected to provide central guidance for Regional Spatial Strategies (RSS) and NBE Plans, as well as matters of national significance or consistency, and all outcomes from the NBA (including mandatory environmental limits) (MfE, 2022a). The NPF is intended to come into force in 2025 following the passing of the NBA, SPA and Climate Change Adaptation Bill (MfE, 2023c).

Figure 3-04 belows shows the proposed framework under the NBA and SPA. In short, the intended framework would operate as follows: The NBA establishes the NBF, while the SPA establishes the need for Regional Spatial Strategies (RSS). RSS are intended to guide the development of NBE Plans, with the NPF providing direction for both RSS and NBE Plans. RSS determine the direction of Implementation Plans and Agreements, while NBA Plans inform local authorities' consenting and permitting processes.

Figure 3-04. Key components of the future resource management system under RMA reform



Source: MfE, 2023c.

A third piece of legislation, the Climate Change Adaptation Bill (CCAB), is in development, and set to be integrated with the NBA and SPA to complete New Zealand's resource management reform. This was included as an action within the National Adaptation Plan (see Section 3.2.5 below), and is expected to be introduced to Parliament in 2023. This is expected to be largely focused on local government- and community-led initiatives and approaches for climate change adaptation, particularly managed retreat. At the time of writing (September 2023), the Environment Select Committee is currently accepting public submissions to inform their inquiry into climate change adaptation, which is expected to inform possible policy options and feed into the development of the CCAB (MfE, 2023b; Shaw, 2023). It is also likely that the Climate Change Adaptation Bill will be enacted in 2024 (MfE, 2023b).

Unlike the RMA's focus on the *effects* of approved activities, the RMA reform is focused on the *outcomes* of activities, from and in relation to natural and built environments. Outcomes detailed within the NBA are intended to be featured prominently in other planning mechanisms, such as the National Planning Framework (see below) and NBE Plans. This will include the provision of environmental *limits* (to prevent harms) and *targets* (to improve

outcomes). In particular, limits and targets are expected to set in six key areas: air; indigenous biodiversity; coastal water; estuaries; freshwater; and soil.

It is further expected that the RMA reform will strengthen local authorities' ability to monitor and enforce consent conditions, and improve guidance and certainty regarding consenting processes. In particular, NBE Plans are intended to include four categories of activities: permitted activities (identified and well-understood, without a need for case-by-case basis assessment, will help achieve outcomes and comply with limits); anticipated activities (effects generally known, but require case-by-case assessment, will help achieve outcomes and comply with limits); discretionary activities (need assessment in more detail, unclear. Whether they will achieve outcomes or comply with limits); and prohibited activities (effects won't achieve outcomes or comply with limits) (MfE, 2023j).

3.2.2 Freshwater Management Policy

In 2020, the New Zealand Government introduced new legislation under the banner of Essential Freshwater: Action for Healthy Waterways (NZG, 2020). This legislation initially sought to stop further degradation of freshwater resources and improve water quality within a five-year period, as well as reverse past damages and bring waterways and ecosystems back to a healthy state within one generation (MfE, 2023r). These reforms included the following:

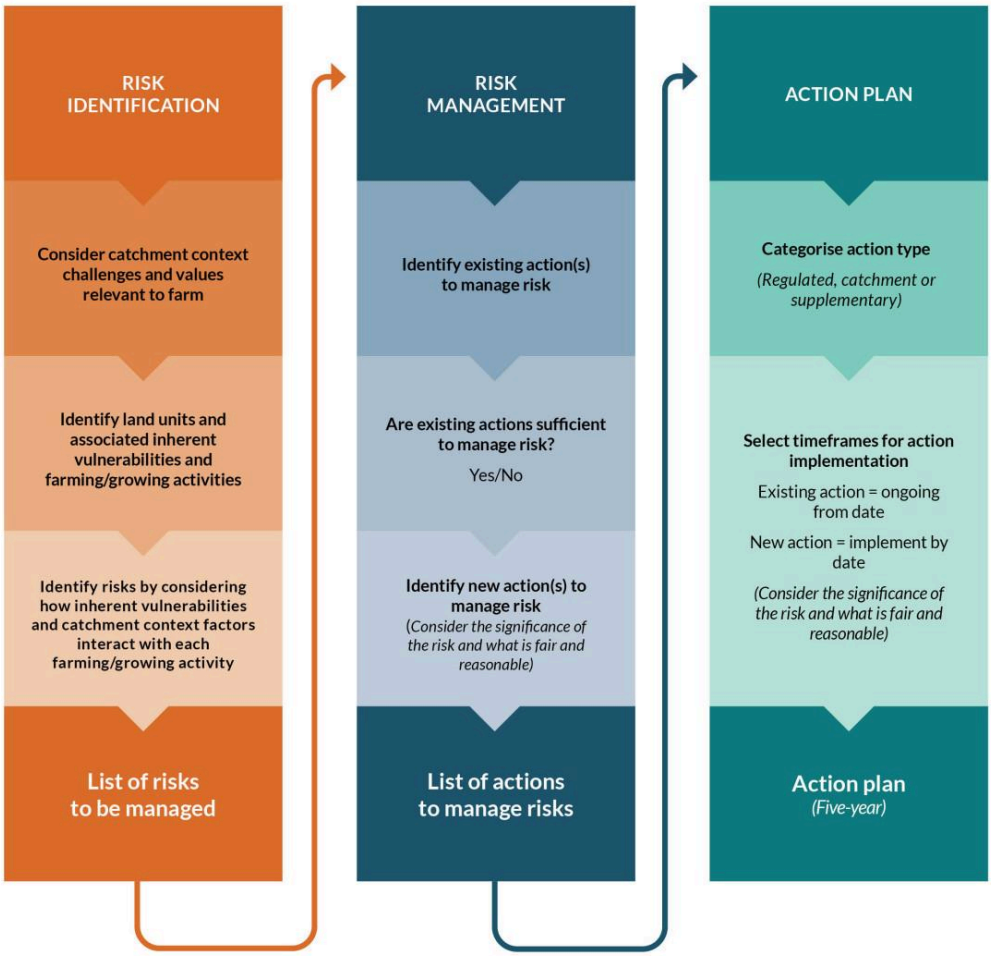
- The creation of mandatory and enforceable Freshwater Farm Plans (FFP) and a faster freshwater planning process (via amendments to the RMA);
- New National Environmental Standards for Freshwater (NES-F);
- Updating the National Policy Statement for Freshwater Management (NES-FM) – from NES-FM 2017 to NES-FM 2020;
- New stock exclusion regulations (Section 360 Regulations);
- Amendments to the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010.

Under the Water Services Reform plan, ten publicly-owned Water Services Entities (WSEs) will be established and charged with managing drinking water, wastewater and stormwater services, previously operated by local councils within their territorial jurisdictions. These WSEs will be rolled out nationally on a staggered timeline between July 2024 and July 2026. This has been enabled through the passage of four new pieces of legislation: The Water Services Entities Act 2022, The Water Services Entities Amendment Act 2023, The Water Services Legislation Bill, and The Water Services Economic Efficiency and Consumer Protection Act 2023 (DIA, 2023).

The Water Services Reforms are intended to allow for the significant financial investment required (estimated between NZ$120 billion and $185 billion) to maintain and improve water services infrastructure that would otherwise be unobtainable by individual councils, thereby placing these within the remit of central government. In effect, these reforms will shift responsibility for the management and improvement of water services from 67 individual councils to the 10 WSEs. Councils will retain ownership of water services infrastructure assets, but will be financed and operated at arms-length from councils (WSRP, 2023a). In addition, iwi will have a greater role in water services management, through statutory recognition of Te Tiriti o Waitangi and Te Mana o Te Wai, as well as mana whenua having equal representation on Regional Representative Groups (WSRP, 2023b). Furthermore, businesses requiring access to water services will be required to deal with WSEs (from their date of establishment), with water charges issues by WSEs rather than councils (WSRP, 2023c).

Regulations enabling FFP (Resource Management (Freshwater Farm Plans) Regulations 2023) entered into effect in August 2023, with initial FFPs in effect in Waikato (the Waipā Freshwater Management Unit (FMU)) and Southland (Aparima and Fiordland and Islands freshwater catchments). Following this, it is expected that the remaining FMUs and freshwater catchments in Waikato and Southland will become operational between February 2024 and July 2025, with FFPs expected to be rolled out nationally by the end of 2025. An FFP requires the inclusion of an on-farm freshwater risk assessment, identifying actions to manage or mitigate risks, with actions based on each farm's landscape, activities, and local catchment. This applies to farms that meet particular criteria, specifically: 20 hectares or more in arable or pastoral use; 5 hectares or more in horticultural use; or 20 hectares or more of combined use (MfE, 2023g). The intended FFP development process is outlined in Figure 3-05 below.

Figure 3-05. Freshwater farm plan (FFP) development process



Source: MfE, 2023g.

In line with the above, new regulations on the exclusion of livestock from waterways (Resource Management (Stock Exclusion) Regulations 2020) apply from 1st July 2023. These regulations are intended to prohibit the movement of cattle, pigs and deer into wetlands, lake and rivers, with various stipulations for permitted activities, based on the use of maps that show low slope land (MfE, 2023n). Specifically:

- Dairy cattle, intensively grazed beer cattle and deer, and pigs must be excluded from lakes and rivers more than a metre wide by 1st June 2023;
- Dairy support cattle must be excluded by 1st June 2025;
- Beef cattle and deer that aren't grazed intensively must be excluded from lakes and rivers more than a metre wide by 1st June 2025, but only on parts of a farm captured in the map of low slope land;
- All stock must be excluded from wetlands on low slope land by 1st July 2025 (MfE, 2023n).

3.2.4 National Emissions Reduction Plan

The National Emissions Reduction Plan (NERP), developed between 2020 and 2022, sets out Aotearoa New Zealand's national-level, long-term strategy for GHG emissions reduction to 2050, and includes emissions reduction targets, budgets and plans, including policy settings and sector-based planning mechanisms for achieving reductions. The NERP builds on prior policies and mechanisms for emissions reduction, including the Climate Change Response (Zero Carbon) Act 2019 and New Zealand Emissions Trading Scheme (NZG, 2022a).

The NERP focuses on six key priority areas for implementation: lowering living costs and supporting households; building a prosperous Aotearoa New Zealand through high-value exports and innovation; improving productivity and giving businesses greater control over their energy use and costs; embracing innovation and technology to lower emissions and improve living standards; enhancing nature in all aspects of our economy and landscapes, and; enabling an equitable transition for Māori, led by Māori. Each of these priority areas contain key actions to support their successful implementation (NZG, 2022a).

The first priority area (lowering living costs and supporting households) is focused on ensuring that actions to lower emissions will also reduce living costs and improve living standards, underpinned by the following three areas for action (each with underpinning action points):

- improving access to affordable, sustainable transport options;
- supporting sustainable, healthy and affordable homes, and;
- making it easier to reduce organic waste and manage it responsibly (NZG, 2022a).

The second priority area (building a prosperous Aotearoa New Zealand through high-value exports and innovation) is focused on building Aotearoa New Zealand's brand and reputation for being one of the most sustainable food and fibre producers in the world, underpinned by the following action points:

- incentivising farmers to reduce their impact on the climate by being the first in the world to introduce a price on agricultural emissions from 2025;
- establishing a Centre for Climate Action on Agricultural Emissions to accelerate getting emissions-reduction tools, practices and technologies on-farm;
- working alongside farmers with climate-focused farm advisory and extension services;
- funding tikanga-based agriculture programmes to support the aspirations of Māori, and;
- increasing the value of our forestry sector by supporting low-emissions products and accelerating the bioenergy market (NZG, 2022a).

The third priority area (improving productivity and giving businesses greater control over their energy use and costs) focuses on clean technology adoption and supply chain improvements, underpinning by the following action points:

- supporting businesses to improve energy efficiency, reduce costs and switch from fossil fuels to low-emissions alternatives through continuing the Energy Efficiency and Conservation Authority's business programmes and expanding the Government Investment in Decarbonising Industry fund;
- banning new low- and medium-temperature coal boilers and phasing out existing ones by 2037;
- developing a gas transition plan to set out a path away from fossil gases and explore opportunities for renewable gases;
- ensuring emissions from freight transport are reduced by 35 per cent by 2035 through initiatives such as the Sustainable Biofuels Obligation, supporting uptake of zero emissions trucks and enabling low- and zero-carbon shipping on key trade routes;
- working with the private sector to accelerate Aotearoa New Zealand's bioenergy market, and;
- enabling sustainable tourism and export industries through initiatives such as the Sustainable Aviation Fuels Partnership with Air New Zealand (NZB, 2022a).

The fourth priority area, embracing innovation and technology to lower emissions and improve living standards, involves government backing of innovative technology development, supported by programmes such as The Energy Efficiency and Conservation Authority's Technology Demonstration programme, or The Advanced Energy Technology platform (NZG, 2022a).

The fifth priority area (enhancing nature in all aspects of our economy and landscapes) seeks to integrate the importance of the natural environment into decision-making and use nature-based solutions to emissions reduction, underpinned by the following action points:

- encouraging greater levels of native afforestation to build a long-term carbon sink (where carbon dioxide is removed from the atmosphere) that supports biodiversity;
- reducing the costs of restoring our native forests and delivering pest control that will help our native ecosystems thrive and remove more carbon;
- protecting our native vegetation and the carbon it stores from climate change impacts, and;
- prioritising nature-based solutions, such as dunes and wetlands, to remove and store carbon and provide protection from flooding and rising sea levels.

The sixth priority area (enabling an equitable transition for Māori, led by Māori) focuses on the enhancement of Māori-Crown relationships, such as upholding Māori rights and interest under Te Tiriti O Waitangi, in relation to emissions reduction, underpinned by the following action points:

- develop a new platform for Māori climate action that will enable tangata whenua to actively participate in the climate response;
- develop a Māori climate strategy and action plan that will elevate te ao Māori and mātauranga Māori within the overall climate response, and;

- ensure the right funding and resourcing for community action, kaupapa Māori, and tangata Māori actions and solutions.

In addition to the above priority areas, the NERP identifies actions to be carried out in terms of policy settings and sector-specific goals to support a "productive, sustainable and inclusive economy". Policy settings include those relating to: emissions pricing; funding and finance; planning and infrastructure; research, science, innovation and technology; and circular economy and bioeconomy. Key actions for each of these policy settings under the NERP are detailed in Table 3-03 below.

Table 3-03. Key actions for policy settings under the National Emissions Reduction Plan by Policy Area

Policy Area	Key Actions
Emissions pricing	• implement emissions pricing for agriculture; • align the New Zealand Emissions Trading Scheme unit and price controls with climate goals; • adjust the New Zealand Emissions Trading Scheme to drive a balance of gross and net emissions reductions
Funding and finance	• establish the Climate Emergency Response Fund (with initial down payment of NZ$4.5 billion); • support climate objectives by issuing Sovereign Green Bonds; • improve transparency and management of climate risks through mandatory climate reporting
Planning and infrastructure	• reform the resource management system to promote lower emissions and climate resilience; • enable low-emissions and resilient housing and urban development; • address funding and financing challenges for infrastructure to support low-emissions urban environments
Research, science, innovation and technology	• develop a portfolio of climate innovation platforms; • support the development, assessment and deployment of low-emissions technology; • scale up and reorient existing initiatives towards accelerating our transition to a low-emissions economy
Circular economy and bioeconomy	• accelerate the supply and uptake of bioenergy; • support businesses moving to circular practices; • develop a circular economy and bioeconomy strategy

Source: NZG, 2022a.

Similarly, the NERP provides key actions for achieving a "productive, sustainable and inclusive economy" across key sectors, including: transport; energy and industry; building and construction; agriculture; forestry; waste; and fluorinated gases. Key actions for each of these sectors under the NERP are detailed in Table 3-04 below.

Table 3-04. Key actions for specific sectors under the National Emissions Reduction Plan by Sector

Sector	Key Actions
Transport	• increase support for walking and cycling, including initiatives to increase the use of e-bikes; • improve the reach, frequency and quality of public transport, and make it more affordable for low-income New Zealanders; • provide funding to support the freight sector to purchase zero- or low-emissions trucks; • support the uptake of low-carbon liquid fuels by implementing a sustainable aviation fuel mandate and a sustainable biofuels obligation; • continue to incentivise the uptake of low- and zero-emissions vehicles through the Clean Car package and consider the future of the road user charge exemption for light vehicles beyond 2024; • improve electric vehicle charging infrastructure across Aotearoa to ensure that all New Zealanders can charge when they need to; • increase access to low- and zero-emissions vehicles for low-income households by supporting social leasing schemes and trialling an equity-oriented vehicle scrap-and-replace scheme
Energy and industry	• improve business and consumer energy efficiency through targeted programmes; • investigate the need for electricity market measures to support the transition to a highly renewable electricity system; • help low-income New Zealanders have warmer, drier homes through Warmer Kiwi Homes; • reduce our reliance on fossil fuels and exposure to volatile global fuel markets; • ban new low- and medium-temperature coal boilers and phase out existing ones by 2037; • develop an energy strategy to support a sustainable, affordable and secure energy system; • support industry to improve energy efficiency, reduce costs and switch from fossil fuels to low-emissions alternatives
Building and construction	• reduce the embodied carbon of construction materials by supporting innovation and regulating to promote the use of low-emissions building design and materials; • establish foundations for future emissions reduction by improving data, building relationships with Māori, and progressing behaviour change and workforce transition programmes; • improve building energy efficiency by amending the Building Code; • shift energy use from fossil fuels by developing a gas transition plan; • accelerate the shift to low-emissions buildings by promoting good examples, providing incentives and supporting the use of low-emissions practices
Agriculture	• fund tikanga-based climate programmes to support the needs and aspirations of Māori; • support for early adoption of mitigation technology and farm practice; • develop food and fibre science and mātauranga accelerators to support lower-emissions land use and food production; • establish a new Centre for Climate Action on Agricultural Emissions to drive a step change in mitigation technology innovation and uptake on farm; • introduce climate-focused extension and advisory services; • introduce a price mechanisms for agricultural emissions by 2025
Forestry	• grow the forestry and wood processing industry to deliver more value from low-carbon products, while delivering jobs for communities; • provide advisory services to land users, councils, Māori and other stakeholders to support choices for sustainable afforestation; • support landowners and others to undertake afforestation, particularly for erodible land; • encourage native forests as long-term carbon sinks through reducing costs and improving incentives; • maintain existing forests by exploring options to reduce deforestation and encourage forest management practices that increase carbon stocks in pre-1990 forests;

	• consider amendments to the New Zealand Emissions Trading Scheme and resource management settings to achieve the right type and scale of forests, in the right place
Waste	• enable households and businesses to reduce organic waste; • increase the amount of organic waste diverted from landfill; • reduce and divert construction and demolition waste to beneficial uses; • explore bans or limits to divert more organic waste from landfill; • increase the capture of gas from municipal landfills; • improve waste data and prioritise a national waste licensing system
Fluorinated gases	• build the capability to shift to low-global-warming-potential (GWP) F-gases; • control imports of pre-charged equipment containing high-GWP F-gases; • regulated product stewardship for refrigerants; • investigate prohibiting the sale and use of F-gases where low-GWP alternatives are available

Source: NZG, 2022a.

The development and implementation of NERPs relies on the setting of National Emissions Budgets (NEB). In an Aotearoa New Zealand context, the first three NEBs were established and set in 2022 for the periods 2022-25, 2026-30 and 2031-35 respectively. Each subsequent NERP will be based on monitored progress towards emissions reduction targets, with new plans set in accordance with NEBs over time (NZG, 2022a).

3.2.5 National Adaptation Plan

Similar to the NERP, the National Adaptation Plan (NAP), developed between 2020 and 2022, sets out Aotearoa New Zealand's national-level, long-term strategy for climate change adaptation, which has clear implications for land-use policy. The NAP builds on work carried out during the National Climate Change Risk Assessment 2020 (NCCRA), prepared under the Climate Change Response Act 2002, which identified 43 priority risks based on urgency related to the domains of the natural environment, human populations, economy, the built environment, and governance structures. In particular, the NCCRA indicated that the most extreme and urgent risks relate to the built environment (particularly potable water supplies and buildings due to the onset of extreme weather events, drought, and ongoing sea-level rise, among others), and aspects of the economy (particularly economic costs associated with lost productivity, disaster relief and unfunded contingent liabilities) (NZG, 2020; NZG, 2022b).

In line with the above, the NAP is based on four main priority areas:

1) enabling better risk-informed decisions;
2) driving climate-resilient development in the right locations;
3) adaptation options including managed retreat;
4) embedding climate resilience across Government policy.

Each priority area is discussed in detail within the First NAP, with critical actions for each identified. The first priority area (enabling better risk-informed decisions) largely focuses on providing information and guidance for decision makers and stakeholders, and includes the following 8 critical actions (NZG, 2022b):

- establish a platform for Māori climate action;
- provide access to the latest climate projections data;
- design and develop risk and resilience and climate adaptation information portals;
- deliver a rolling programme of targeted adaptation guidance;
- develop guidance for assessing risk and impact on physical assets and the services they provide;

- raise awareness of climate hazards and how to prepare;
- support high-quality implementation of climate-related disclosures and explore expansion, and;
- improve natural hazard information on the Land Information Memoranda.

The second priority area (driving climate-resilient development in the right locations) focuses on strategic planning in relation to climate change adaptation, and includes the following 7 critical actions (NZG, 2022b):

- reform the resource management system;
- reform institutional arrangements for water services;
- integrate adaptation into Waka Kotahi decision-making;
- integrate adaptation into Treasury decisions on infrastructure;
- embed adaptation in funding models for housing and urban development, including Māori housing;
- set national direction on natural hazard risk management and climate adaptation through the National Planning Framework, and;
- establish an initiative for resilience public housing.

The third priority area (adaptation options including managed retreat) aims to provide decision-makers, particularly those at a local government level, with policy options and approaches for adaptation, and includes the following 9 critical actions (NZG, 2022b):

- pass legislation to support managed retreat;
- complete case study to explore co-investment for flood resilience;
- publish the programme of work on how Aotearoa meets the costs of climate change and invests in resilience;
- the Future for Local Government review;
- scope a resilience standard or code for infrastructure;
- reduce and manage the impacts of climate hazards on homes and buildings;
- prioritise nature-based solutions;
- support kaitiaki communities to adapt and conserve taonga/cultural assets, and;
- develop options for home flood insurance.

The fourth priority area (embedding climate resilience across government) involves the integration of climate change adaptation principles into existing government policies, mechanisms and entities to support adaptation, with a number of critical actions identified across five key areas (natural environment; homes, buildings and places; infrastructure; communities; economy and financial system). The critical actions for this priority area are shown in Table 3-05 below.

Table 3-05. Critical Actions for Priority 4 (Embedding Climate Resilience Across Government) within the First National Adaptation Plan by Outcome Area

Outcome Area	Critical Actions
Natural Environment	• implement the Department of Conservation Climate Adaptation Action Plan • implement Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy • implement key freshwater management programmes • engage with councils to implement the New Zealand Coastal Policy Statement • deliver climate, biodiversity, and wider environmental outcomes • deliver biosecurity actions to protect our indigenous ecosystems and economy from invasive species • implement the National Policy Statement on Freshwater Management 2020 • implement the proposed National Policy Statement on Indigenous Biodiversity
Homes, Buildings and Places	• reduce and manage the impacts of climate hazards on homes and buildings • reduce the exposure of public housing tenants to climate hazards • embed adaptation in funding models for housing and urban development, including Māori housing • support kaitiaki communities to adapt and conserve taonga/cultural assets
Infrastructure	• develop guidance to support asset owners to understand and manage the risks of climate change on physical assets • scope a resilience standard or code for infrastructure • integrate adaptation into Treasury decisions on infrastructure • develop and implement the Waka Kotahi Climate Adaptation Plan
Communities	• modernise the emergency management system • develop the Health National Adaptation Plan • raise awareness of climate hazards and how to prepare
Economy and Financial System	• deliver the New Zealand Freight and Supply Chain Strategy • help financial entities to better identify and manage their climate risks and support financial stability • strengthen the fisheries management system and support the aquaculture sector to sustainably grow • develop options for home flood insurance • support high-quality implementation of climate-related disclosures and explore expansion

Source: NZG, 2022b.

The First NAP is scheduled to be effective between 2022 and 2028, after which a new NCCRA will be developed, upon which the Second NAP will be based and developed by 2028. This is intended to continue across six rounds in total, with the Sixth NAP due in 2052, signalling a long-term commitment to the development and implementation of NAPs in Aotearoa New Zealand. In addition, a climate change interdepartmental executive board is intended to oversee both the emissions reduction and national adaptation plans, with a separate Climate Change Response Ministers Group (chaired by the Prime Minister) overseeing plans and driving progress to their fulfilment. Furthermore, a report examining the implementation and effectiveness of the NAP will be delivered to the Minister of Climate Change by He Pou a Rangi/Climate Change Commission every two years (NZG, 2022b).

3.2.6 National Policy Statements (NPS) and National Environmental Standards (NES)

One of the main policy tools with the potential to influence land use change (via the RMA) are National Policy Statements (NPS). NPS are not mandatory (excluding the New Zealand Coastal Policy Statement), but instead provide guidance and direction on matters of national significance, particularly for local authorities, including those listed within and outside of Section 6 of the RMA. In particular, regional policy statements (RPS), regional plans (RP) and

district plans (DP) are all required to "give effect to" (implement) all relevant NPS. This could entail the inclusion of specific objectives or policies within, or ensuring consistency between, regional policy instruments (RPS, RP and DP) and NPS (Environment Foundation, 2021a).

New Zealand currently has eight active NPS (MfE, 2023e):

- National Policy Statement for Freshwater Management (NPS-FM)
- National Policy Statement for Greenhouse Gas Emissions from Industrial Process Heat (NPS-GGEIPH)
- National Policy Statement for Highly Productive Land (NPS-HPL)
- National Policy Statement for Indigenous Biodiversity (NPS-IB)
- National Policy Statement for Renewable Electricity Generation (NPS-REG)
- National Policy Statement on Electricity Transmission (NPS-ET)
- National Policy Statement on Urban Development (NPS-UD)
- New Zealand Coastal Policy Statement

Several NPS have come into effect in recent years, including the National Policy Statement for Indigenous Biodiversity (NPS-IB) (August 2023) and National Policy Statement for Highly Productive Land (NPS-HPL) (October 2022). Both NPS have potential implications for land use practice, as both are likely to influence how local authorities implement policies for the management and use of land within their territorial jurisdictions.

The NPS-IB seeks to enhance indigenous biodiversity outcomes within Significant Natural Areas (SNAs) under the RMA by providing national policy guidance for local councils. Under the RMA, councils have been required to identify SNAs within their spatial jurisdiction, with each council historically applying a different approach to the implementation of this in RPS. The NPS-IB therefore provides guidance for councils to achieve greater consistency in the application of indigenous biodiversity protections across regional and local councils nationally by requiring the implementation of specific actions within RPS. In effect, the passing and enactment of the NPS-IB has produced greater or lesser requirements on the part of councils to change RPS to more consistently reflect RMA requirements. In particular, the NPS-IB outlines different approaches for different councils based on the unique natural environments within their jurisdiction, as well as clarifies processes for identifying SNAs and provisions for honouring Te Tiriti o Waitangi (MfE, 2023h). In line with this, there is ongoing consideration of the introduction of a "biodiversity credit" system that seeks to establish a tradeable permits market for biodiversity protection (MfE, 2023q).

The National Policy Statement for Highly Productive Land (NPS-HPL) sets out national direction for policy regarding highly productive land regarding planning activities for subdivision, use and development, particularly urban development or rural residential development. In particular, the NPS requires local authorities to "fully identify, map and manage" highly productive land in order to protect the ability of land to support primary production sites. However, the NPS still allows local authorities to rezone highly productive land for development (e.g. urban housing) if particular conditions are met, such as the unavailability of other less-productive land (MfE, 2023f). At the time of writing (September 2023), the Ministry for the Environment are seeking submissions on possible amendments to the NPS-HPL due to a potential lack of clarity in consenting in terms of projects that do not rely on soil – specifically, constructing new infrastructure on highly productive land, and the development and relocation of intensive indoor primary production and greenhouses on highly productive land (MfE, 2023d).

In addition to active NPS, the Proposed National Policy Statement for Natural Hazard Decision-Making (NPS-NHD) is currently under development. The NPS-NHD seeks to direct how decision-makers consider aspects of natural hazard risk within their planning decisions in relation to new development, in accordance with the RMA. As of September 2023, when considering options to respond to natural hazards, the consultation draft policy statement would require decision-makers to determine the level of natural hazard risk (high, medium, low), considering the likelihood of a natural hazard occurring and the tolerance level of the physical environment and social structures to the natural hazard event, adopt a precautionary approach, and make planning decisions based on the determined level of risk:

- For areas of **high** natural hazard risk, councils should avoid new development unless the level of risk is "tolerable";
- For areas of **medium** natural hazard risk, mitigation measures must be taken;
- For areas of **low** natural hazard risk, new development is enabled.

In addition, the proposed draft NPS-NHD would require that the "most effective natural hazard mitigation" measures are adopted. (i.e. nature-based solutions and comprehensive area-wide measures are preferred) in order to reduce risk, and that Māori (in particular, tangata whenua) values, interests and aspirations are recognised and provided for, including the provision of early engagement in relation to Māori land (MfE, 2023i).

National Environmental Standards (NES) are regulations that provide the technical specifications for various environmental aspects, including land use, coastal and inland marine areas, water use, discharges or noise, enabled by the RMA (Environment Foundation, 2021b). There are currently 10 NES in force in Aotearoa New Zealand:

- National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat 2023;
- National Environmental Standard for Storing Tyres Outdoors 2021;
- National Environmental Standards for Freshwater 2020;
- National Environmental Standards for Marine Aquaculture 2020;
- National Environmental Standards for Plantation Forestry 2017;
- National Environmental Standards for Telecommunications Facilities 2016;
- National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health 2011;
- National Environmental Standards for Electricity Transmission Activities 2009;
- National Environmental Standards for Sources of Human Drinking Water 2007;
- National Environmental Standards for Air Quality 2004

The most recent NES, in force from 27th July 2023, are the National Environmental Standards for Greenhouse Gas Emissions from Industrial Process Heat 2023 (NES-GGEIPH). These were introduced following amendments to the RMA allowing councils to consider the effects of GHG emissions on climate change, and apply specifically to industrial process heat generation. Specifically, the NES are intended to provide national consistency in relation to reducing emissions from industrial process heat by:

- immediately prohibiting discharges of GHGs from low-to-medium temperature coal boilers, and existing coal boilers after 2037;
- requiring resource consents for both new and existing boilers using fossil fuels that emit over 500 tonnes CO_2e per year;

- requiring resource consent applicants to prepare and implement emissions plans and outline actions for emissions reduction.

In order to implement the NES-GGEIPH, in November 2022, rules relating to the discharge of GHG emissions in the RMA were repealed, thereby allowing local councils to consider the effects of GHG emissions on climate change (Resource Management Act 1991, Section 70A, *Rules relating to the discharge of greenhouse gases*). This change facilitated the implementation of NES-GGEPIH, but could have wider implications for decision-making with regards to GHG emissions, and thereby potentially influence land use practice or change. The NES-GGEIPH are intended to work alongside the NPS-GGIPH (mentioned above) (MfE, 2023k).

Furthermore, there are several NES that have been amended or are undergoing review, including the NES for Freshwater 2020 (NES-FW), Sources of Human Drinking Water 2007 (NES-DW) and Plantation Forestry 2018 (NES-PF). In line with the New Zealand's Government's suite of water reforms, the NES-FW was amended to strengthen provisions for the exclusion of agricultural stock from waterways and to improve practices for intensive winter grazing (MfE, 2023l). Similarly, the NES-DW are undergoing review, with three proposed amendments: 1) mapping three categories of source water risk management areas (SWRMA); 2) introducing controls for specific high-risk activities within SWRMAs 1 and 2; and 3) not extending the NES-DW to smaller registered drinking water supplies (as had been suggested through consultation) (MfE, 2023m). Furthermore, the New Zealand Government has decided to amend the NES-PF to include the following changes: 1) expanding forest types covered by the NES-PF to include exotic continuous-cover forests (i.e. *carbon forests*); 2) enabling councils to develop and implement rules in relation to carbon forests; and 3) operational changes to allow foresters and councils to better manage environmental effects such as slash and wilding pines (MPI, 2023a).

3.2.7 Change of government

In October 2023, New Zealand's General Election took place (election day 14th October 2023). Issues with implications for land use change and practice were integral to the 2023 General Election as pressing issues for many voters. The National Party secured approximately 39 per cent of party votes (with a projected 50 seats in Parliament), thereby allowing the party to form a coalition government with the ACT Party (approximately 9 per cent of party votes, with a projected 11 seats in Parliament) (Electoral Commission, 2023).

It is likely under a National-led government, based on National Party policy documents, that aspects of New Zealand's environmental policy could be changed or removed. For example, under National's policy focused on removing agricultural emissions, New Zealand's ban on genetically engineered or modified organisms could be lifted, thereby allowing agricultural operators access to gene-edited crops, feed and livestock, alongside pushing out the date by which agricultural emissions would be priced to 2030, and limiting forestry conversion for carbon farming purposes (National, 2023a). Similarly, a National-led government would likely repeal aspects of the Essential Freshwater Reform programme, including the removal of previously implemented legislation (discussed above) and the disestablishment of "mega entities" charged with water management, including their co-governance mechanisms (National, 2023b). In addition, ACT Party policy documents suggest a harsher approach relative to National, including repealing the Zero Carbon Act and Climate Change Commission, removing existing mitigation targets, and similar policy approaches (ACT Party, 2023).

However, at the time of writing (October 16th 2023), it is uncertain as to how the newly elected government could develop and implement policy to this effect.

3.3 COVID-19

The COVID-19 pandemic has been a significant issue confronting the global community between 2019 and 2022. Economies are still recovering and feeling the aftermath of the pandemic. When COVID-19 first entered the country in 2020, New Zealand initially adopted an elimination strategy hallmarked by a *"go hard and go early"* approach (Baker et al., 2020; Gray, 2020). While the New Zealand Government's handling of the pandemic was globally recognised for keeping infection and death rates at low levels and known as having some of the toughest COVID-19 pandemic rules in the world, domestically the New Zealand Government faced criticism for the imposition of lockdowns, school closures and closed borders. New Zealand opened its borders again in February 2022, allowing managed-isolation-and-quarantine-free (MIQ) travel (with the requirement for proof of COVID-19 vaccination), with the New Zealand Government removing the last of its COVID-19 public health restrictions in August 2023 (Craymer, 2023).

The COVID-19 pandemic has presented significant challenges for New Zealand's economy due to the emergence of new virus variants, deteriorating global economic outlooks, supply chain disruptions, and extended border closures (MBIE, 2021). The Reserve Bank of New Zealand (RBNZ) estimated that the introduction of public health measures for limiting the spread of COVID-19 had a considerable impact on GDP (see Table 3-06 below). At Alert Level 4, it was estimated that GDP was approximately 37 per cent lower than it would have been without any restrictions. Over a four and half week period, this equated to NZ$10 billion of lost production, reducing New Zealand's annual GDP by 3.2 per cent (RBNZ, 2020).

Table 3-06. New Zealand GDP reduction under COVID-19 Alert Levels

Alert Level	GDP reduction (%)
1	3.8
2	8.8
3	19.0
4	37.0

Source: RBNZ, 2020

The OECD (2022) has stated that the New Zealand economy recovered quickly from the COVID-19 pandemic, due to effective virus containment, measures to protect jobs and incomes, and highly expansionary macroeconomic policies. However, inflation has increased due to supply constraints, and also resilient demand. The Reserve Bank of New Zealand has tightened monetary policies in order to reduce inflation, and together with policy measures to increase housing supply, this approach has helped to moderate housing price inflation (OECD, 2022a).

The COVID-19 pandemic also presented significant challenges for New Zealand's primary sector. However, the sector also showed considerable resilience and strength compared to other sectors of the New Zealand economy, with commodity price increases for several primary products, including dairy, meat, and fibre products. A key concern for New Zealand's primary sector during this time was the impact of border closures on labour shortages of seasonal and skilled workers, which affected industries including dairy, wine, kiwifruit, apples,

and cherries (MPI, 2021). However, migration data (March 2023) has shown that, following the reopening of New Zealand's borders in 2022, migration gains have now returned to approximately pre-COVID-19 levels (StatsNZ, 2023a).

AThe New Zealand Government provided support for New Zealand's primary sector during the COVID-19 pandemic, as evidence by programmes such as MPI's Opportunity Grows Here campaign and Fit For A Better World roadmap (MPI, 2021). In addition, exporting companies were supported by New Zealand Trade and Enterprise's (NZTE) Made With Care campaign, launched in October 2021 – a global marketing campaign released as part of the New Zealand Government's COVID-19 recovery strategy. This campaign sought to share New Zealand's "food and beverage story" with the world at a time when many exporters could not be present in-market. The campaign was underpinned by global research that showed that consumers sought safe, nutritious, healthy, premium, quality, tasty and sustainably-produced food and beverage products. Over 2,000 New Zealand businesses engaged with the campaign – either by downloading a ready-to-use marketing toolkit, by using the campaign messaging to help build their brand story, or by being involved in NZTE's in-market activations (Kea, 2022; NZTE, 2020).

Several key consumer trends were identified as being correlative with the COVID-19 pandemic, such as a growing preference for locally grown or produced food products. This was also observed in New Zealand, driven by supply chain and food security concerns during and post-pandemic. Specifically, supply chain disruptions intensified by the COVID-19 pandemic served as a reminder that local suppliers may be more reliable than international supply chains during such events (MPI, 2023b).

There has been limited research examining the impact of the COVID-19 pandemic on land-use change in New Zealand. For example, Snow et al. (2021) examined quantitative and qualitative assessments of the impacts, adaptations, and opportunities to increase the resilience of the agricultural systems in Australia and New Zealand. The authors found that all agricultural activities, except for fibre production, were permitted to continue during quarantine periods, but were exposed to the major flow-on effects of movement control. The authors further found that, by June 2020, the impacts of the COVID-19 control measures on the agri-food sectors in both Australia and New Zealand were relatively small, due to high levels of resilience in agricultural systems and those running them. The authors concluded that agri-food systems comprise multiple subsystems with varying vulnerability to external influences (Snow et al., 2021).

3.4 Global Trends and Challenges

3.4.1 Food Waste

Across global food systems, food loss and waste (FLW) is a major issue that presents a significant challenge for waste management systems, food security, and environmental sustainability (World Bank, 2021). The United Nations Food and Agriculture Organisation (FAO) estimates that approximately one third of all global food production is wasted (Barrera & Hertel, 2021). In addition, Zhu et al. (2023) estimated that cradle-to-grave FLW emissions account for approximately half of total GHG emissions from food systems. Therefore, meeting future global food demand and reducing GHG emissions associated with food production will likely require action and initiatives that reduce waste and loss, including those that support a circular economy approach (see Section 3.4.3 below). Reducing FLW will be critical for

achieving a zero-hunger world and developing sustainable production and consumption patterns (FAO, 2023). The 2030 Agenda for Sustainable Development reflects growing awareness of the issue concerning FLW. Target 12.3 of the Sustainable Development Goals (SDGs) seeks to make improvements in global FLW, and calls for reductions in waste at the retail and consumer level, and reductions in food waste and loss along production and supply chain (FAO, 2023). Food wastage can occur at all stages of global supply chains, while the scope and nature of food waste can differ considerably between regions and states (Roodhuyzen et al., 2017; Xue & Liu, 2019).

Addressing aspects of FLW in an Aotearoa New Zealand context could be a useful component in strategies for reducing the country's GHG emissions. Ministry for the Environment (2023t) have estimated that approximately 9 per cent of New Zealand's biogenic methane emissions (equating to approximately 4 per cent of total GHG emissions) are associated with food and organic waste. The New Zealand Government is currently in the process of establishing a baseline measure for the extent of FLW in Aotearoa New Zealand, following a recommendation by the Environment Select Committee in its March 2020 report. Specifically, research being undertaken by the University of Otago intends to measure FLW through Aotearoa New Zealand's food supply chain, and establish where this waste ultimately ends up (such as landfill, compost, or animal feed). In addition, in 2023 the New Zealand Government announced plans to allow businesses to separate food waste for processing by 2030, in line with the development of new waste legislation (MfE, 2023r).

3.4.2 Sustainable Development Goals (SGDs)

In 2015, the United Nations signed the 2030 Agenda for Sustainable Development and adopted a set of 17 Sustainable Development Goals (SDGs) (UNDESA, 2023). The SDG framework consists of 17 goals, 169 targets and 247 indicators designed to reconcile the dual need of environmental protection and socio-economic development (Zeng et al., 2020). Progress towards achieving against the SDGs has been varied, with events such as the COVID-19 pandemic contributing to the first rise in extreme poverty in a generation, as well as setting back gains made in education, and the impacts of climate change remaining relatively unabated (UN, 2021). In addition, Hassen and Bilali (2022) showed that global geopolitical events such as the Russia-Ukraine war (discussed in Section 3.7.3 below) have the potential to jeopardise progress towards achieving various SDGs, notably 1 (No Poverty), 2 (Zero Hunger) and 12 (Responsible Consumption and Production). In general, agricultural land systems have been identified as being critically important in relation to achieving against the SDGs, with these systems being relevant for 11 of the 17 SDGs – specifically Goals 1 (No Poverty), 3 (Good Health and Wellbeing), 4 (Quality Education), 5 (Clean Water and Sanitation), 6 (Affordable and Clean Energy), 8 (Decent Work and Economic Growth), 9 (Industry Innovation and Infrastructure), 10 (Reduced Inequalities), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), and 15 (Life on Land) (Viana et al., 2022).

Aotearoa New Zealand's efforts towards achieving against the SDGs has been tracked, with the New Zealand Government undergoing a Voluntary National Review in 2019. This assessment provides a range of scores documenting a country's progress across the 17 SDGs, including the SDG Index Rank (the relative ranking of different countries by progress against SDGs), SDG Index Score (an indication of a country's distance from optimally achieving SDG

progress, 100 = most optimal), and indications as to the direction of progress across the 17 SDGs (Sachs et al., 2023). Figure 3-06 below shows Aotearoa New Zealand's progress towards the 17 SDGs. Specifically, this shows that, for many of the SDGs, significant or major challenges remain in achieving many SDGs related to agricultural land systems, with progress either *moderately improving* or *stagnating* (Sachs et al., 2023; SDR, 2023). In addition, Aotearoa New Zealand currently has an SDG Index Rank of 27 of 166, and an SDG Index Score of 78.4 (SDR, 2023).

Figure 3-06. Aotearoa New Zealand's progress against the 17 SDGs

Source: Sachs et al., 2023; SDR, 2023; image edited by the author(s).

3.4.3 Circular and Biological Economy

The concepts of the *circular economy* and the *biological economy (bioeconomy)* have emerged as important focuses for environmental policy in recent years, both internationally and in Aotearoa New Zealand, with the potential to influence land use practice or change. The *circular economy* is a concept that aims to shift waste management practices from a linear form (i.e. production → consumption → waste) to a circular model that takes what would otherwise be waste products and reintegrates these as inputs to other production processes (Yang et al., 2023). In addition to waste reduction, this can have secondary implications for other environmental, social and economic factors, including combating climate change by reducing GHG emissions, long-term cost savings, and economic opportunities such as new jobs and greater technical innovation) (MfE, 2023p; Yang et al., 2023). Similarly, the *biological*

economy or *bioeconomy* focuses on those parts of the economy that use and rely on biological resources, usually for the production of food, energy, and other products (MfE, 2023o).

The wholesale movement from a linear economy to a circular bioeconomy could have positive implications for environmental health, and the sustainability of economic and social systems. Literature examining the hypothetical impacts of a shift to a circular bioeconomy model have shown potentially significant gains in GHG emissions reduction, ecosystem health and biodiversity protection, reduced waste and associated costs, among a variety of similar impacts (Pyka et al., 2022; Qureshi et al., 2022; Sharma and Malaviya, 2023; Wei et al., 2022; Yang et al., 2023). Reflecting the potential benefits of the bioeconomy, Scion (2020) has estimated that the bioeconomy of Aotearoa New Zealand could generate economic gains of approximately NZ$30 billion and reduce approximately 12.5 Mt CO_2e by 203 (Scion, 2020, as cited in MfE, 2020p).

Aspects of Aotearoa New Zealand's current and emerging environmental policy are focused on the establishment and enhancement of circular and biological economy principles. As previously discussed, the National Emissions Reduction Plan contains stipulations related to circular economy principles, including the development and enactment of a circular economy and bioeconomy strategy, greater investment in research, the integration of circular practices into government, commercial and public processes, supporting businesses to shift to a circular model, and the potential establishment of a "circular economy hub" (MfE, 2023o).

In addition, a move towards circular economy and bioeconomy models has been seen at a local government level, such as within Auckland Council's Climate Plan and new Waste Management and Minimisation Plan (WMMP). Specifically, Auckland Council lists the move to a circular economy as a key action area within the Economy section of its Climate Plan under Action Area E6 (Manage our resources to deliver a zero waste, circular economy). This includes steps to implement the WMMP to include household kerbside food scraps collection, and engage in research and feasibility studies into onshore processing options to plastics, paper and cardboard from kerbside collection (Auckland Council, 2023).

3.5 Emerging Technologies

3.5.1 Climate Change Mitigation Technology

Technologies for the mitigation of climate change, particularly the sequestration or mitigation of GHG emissions, have been highlighted as an important aspect of global responses to climate change. The importance of technology and technology transfer for climate change abatement has been highlighted by the United Nations Framework Convention on Climate Change (UNFCCC) (Article 4, Paragraph 1), Kyoto Protocol (Article 10), and Paris Agreement (Article 10, Paragraph 1) (UNFCCC, 2016). In an Aotearoa New Zealand context, the development and implementation of technologies that aim to reduce agricultural emissions (notably methane emissions) is an important consideration within climate change policy. Aotearoa New Zealand is a signatory to the Global Methane Pledge – an international forum backed by the United Nations, comprising 150 nation-states pledging to reduce methane emissions from the national GHG emissions inventories (GMP, 2023; MFAT, 2022b). Under this, Aotearoa New Zealand has pledged to reduce biogenic methane emissions in line with Paris Agreement targets and those enshrined in the Zero Carbon Act 2019 – specifically, reducing biogenic methane emissions to 10 per cent below 2017 levels by 2030, and to between 24 and 47 per cent below 2017 by 2050. As previously discussed, a large focus for

methane emissions reductions has been placed on the agriculture sector due to the sector's prominence in the national inventory. The development of technologies for the mitigation of biogenic methane emissions from agriculture is a key focus of environmental policy, including the establishment of a new Centre for Climate Action on Agricultural Emissions to encourage mitigation technology innovation and on-farm uptake (MFAT, 2022b). Specifically, the New Zealand Government Budget 2022 allocated over NZ$300 million towards research and development for technologies for making on-farm emissions reductions (MPI, 2023e).

There is a range of existing, novel and in-development technology that could be used on New Zealand farms for the mitigation of biogenic emissions. Wreford et al. (2022b) point out that, as a significant portion of agricultural emissions are biogenic (i.e. produced by biological processes, mostly from ruminant animals), methods that target the reduction of emissions from biological processes (i.e. livestock and feeds) are likely to be the most effective technologies for on-farm biogenic emissions mitigation. In line with this, the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGGRC) currently operates multiple research streams examining potential technologies to address biogenic methane emissions from the agriculture sector, including the following types of technologies: breeding techniques for low-emissions cattle and sheep; alternative low-emissions feeds; methane inhibitors (i.e. chemical compounds in animal feed designed to reduce biogenic emissions from ruminants); methane vaccines (i.e. vaccinations for ruminants that trigger immune system responses that suppress biological agents responsible for methane production); and manure management techniques (NZAGGRC, n.d.). Many of these technologies are either still in-development or not yet commercially available, and could be prohibitively expensive for the effective mitigation of agricultural emissions, so may need to be considered alongside a suite of other farm management approaches to emissions reductions (Wreford et al., 2022b). However, in August 23023, the Environmental Protection Authority (EPA) approved the first methane inhibitor for use in New Zealand, developed by the Dutch firm DSM Nutritional Products Ltd (DSM), signalling potential future use of methane inhibitors in New Zealand's primary sector (EPA, 2023).

3.5.2 Artificial Intelligence (AI) for land use management

The use of artificial intelligence (AI) systems in land use planning has emerged as a key tool in potentially achieving sustainable land use. A previous iteration of this report has discussed the use of AI systems for land use management (Saunders et al., 2018), but the recent proliferation and popularisation of AI technology warrants an updated review of current and future AI technology application.

Various AI tools have been developed or are under development for mapping, tracking and predicting land-use options internationally. These tools can be used to analyse current land use options to predict future land-use patterns and consider alternative land-use options that can lower GHG emissions, improve environmental quality indicators, and similar. The use of AI technology in agriculture has been shown to assist farmers in seed selection within specific weather scenarios, as well as improve yield and crop health with reduced quantities of inputs (Javaid et al., 2023). Specific examples include the Self-Learning Digital Twins for Sustainable Land Management project, which attempts to model land use across the entire United Kingdom to create a "digital twin" in order to analyse and identify opportunities for more sustainable land use with a specific view to addressing UK GHG emissions. The project commenced on 1st May 2023 and will run for 23 months, funded by an approximate £2.5 million grant from UK Research and Innovation. There will be a specific focus on reducing

emissions from ruminant farming (sheep and cattle) and degraded peatlands, with researchers working together with the farming community to produce advice on how to reduce emissions (Loughborough University, 2023). Another example of this type of technology is OpenSurface, an open-source land use modelling platform powered by AI capable of scaling up to the entire surface of Earth, aimed at monitoring and forecasting land-use change (OpenSurface, 2019). Despite a proliferation of recent advances, critics of the use of AI systems for sustainable agriculture have argued that these systems may require greater integration of ecological principles in order to be effective, including above- and below-ground ecological dynamics, agricultural impacts on ecosystems, and the integration of domain experts (Ryo et al., 2022).

In an Aotearoa New Zealand context, the use of AI-based technology could greatly enhance agricultural productivity, value-add opportunities, and improve environmental performance. A report produced by AI Forum New Zealand (2019) described a range of case studies in which AI technology was effectively used to support yield optimisation, address labour shortages, assist in research into meat alternatives, perform real-time risk management along the supply chain, provide assurance credentials for quality and traceability, improve food safety and security (locating and isolating disease outbreaks in animals and plants), reduce waste, improve biosecurity, and improve conversion efficiency on-farm (AIFNZ, 2019). The use of AI systems for the calculation of water requirements for irrigation on Canterbury farms has also been shown to be effective in reducing risks associated with water scarcity (Chiewchan et al., 2023). AI-based technologies have also been shown to be effective in improving aspects of aquaculture management in an Aotearoa New Zealand context (Babu et al., 2023; Bi et al., 2023). The use of AI technology in relation to land-use and sustainability in Aotearoa New Zealand has also been signalled as a key aspect of efforts towards biodiversity protection and pest eradication, as indicated by the 2023 Long-Term Insights Briefing for the Department of Conservation (DOC, 2023).

3.5.3 Electrochemical Plant Sensors

Electrochemical sensor technology for the monitoring and management of plant health has emerged in recent years. Primarily used in precision agriculture operations, electrochemical plant sensors (or “wearable” plant sensors) monitor plant health by producing and transmitting data on temperature, moisture, acidity levels, pesticide and herbicide residues, nutrient and fertiliser levels, and similar indicators. The use of this data can be effective in improving yields and detecting disease or abnormalities, thereby assisting growers in their plant management operations (Kim and Lee, 2022; Tataridas et al., 2022). These sensors can also be used in conjunction with other technology, such as unmanned aerial vehicles (UAVs; drones) within an Internet-of-Things (IoT) enabled production system, to visually map areas of plant health variability, such as soil moisture measurement, to greater improve accessibility and practical implementation to plant health management approaches for growers (Awais et al., 2022; Gupta et al., 2022). In an Aotearoa New Zealand context, the use of AI-enabled food sensors has been suggested as a means of detecting food spoilage and improving traceability in food supply chains (MPI, 2023c), with potential applications for forestry and horticulture sectors (Bayne et al., 2017).

3.6 International Trading Environment

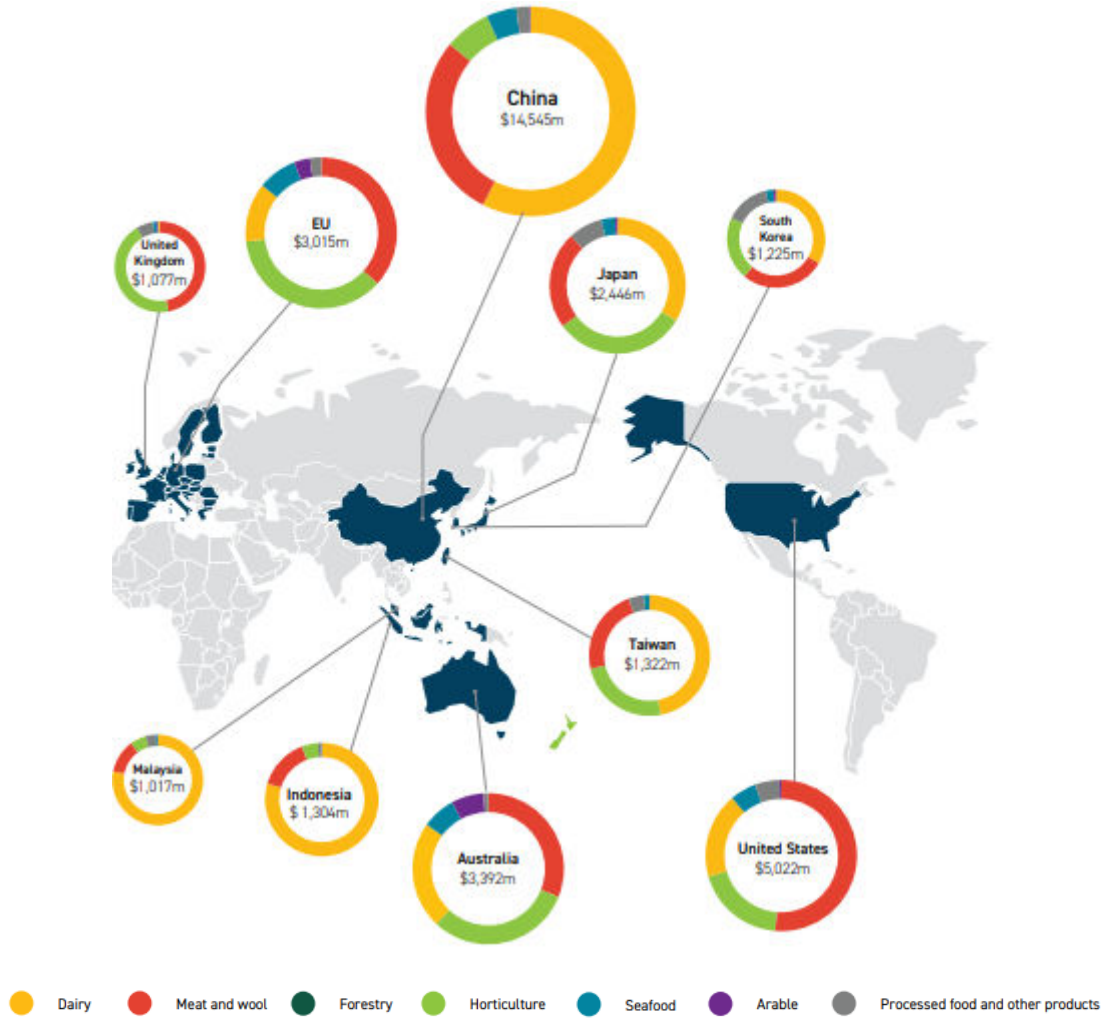
New Zealand's primary sector continues to achieve high export returns while simultaneously addressing local and global trends and challenges. Agricultural exports represent more than 80 per cent of total merchandise exports in New Zealand by value, at approximately NZ$53.1 billion in 2022- this is projected to increase by 6 per cent in 2023 to approximately NZ$56.2 billion (MPI, 2023a; see Table 3-07 below). New Zealand's main export commodities are dairy (approximately NZ$22 billion; 41 per cent of all food and fibre exports in 2022); followed by meat (approximately NZ$12.3 billion; 23 per cent of all food and fibre exports in 2022); and horticultural products (approximately NZ$6.8, 13 per cent share of all food and fibre exports in 2022). Important export countries for New Zealand are China, which has been New Zealand's key export market for agricultural commodities since 2010, as well as Australia, the USA and Japan (StatsNZ, 2023b) – see New Zealand's Top 10 food export destinations presented in Figure 3-07 below.

Table 3-07. Food and fibre sector export revenue, 2019-2027 (year ended June), actual (2019-2022) and forecasted (2023-2027), NZ$ million

	Actual				Forecasted				
SECTOR	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
Dairy	18,107	20,102	19,055	21,998	25,120	25,340	26,390	27,140	28,250
Meat and Wool	10,176	10,617	10,373	12,310	11,940	11,440	11,510	11,700	11,920
Forestry	6,883	5,452	6,499	6,578	6,530	6,590	6,770	6,990	7,330
Horticulture	6,134	6,541	6,579	6,782	6,920	7,350	7,940	8,310	8,630
Seafood	1,963	1,857	1,789	1,919	2,080	2,120	2,210	2,290	2,350
Arable	236	289	261	252	245	245	255	260	260
Processed food and other products*	2,854	2,988	3,087	3,226	3,410	3,110	3,180	3,260	3,290
Total export value	46,335	47,846	47,642	53,065	56,245	56,195	58,255	59,950	62,030
Year-on-year change (%)	9%	3%	0%	11%	6%	0%	4%	3%	3%

Source: MPI, 2023a; StatsNZ, 2023b.

Figure 3-07. New Zealand's Top 10 food export destinations by value (year ended June 2022)



Source: MPI, 2023a

3.6.1 Free Trade Agreements (FTAs) – Bilateral

New Zealand relies on market access for the trade of agricultural products and the success of its primary industries. It seeks preferential trade agreements with other nations to lower tariff and non-tariff barriers. However, trade barriers cost New Zealand's primary sector up to NZ$15 billion a year (MPI, 2022). For example, dairy export tariffs impose annual costs of approximately NZ$1.5 billion, and non-tariff measures for dairy exports cost approximately NZ$7.8 billion annually (Sense Partners, 2023). Analysis by Vervevis and Üngör (2021) estimated that, without an FTA with China, New Zealand would have 22 per cent less total commodity exports, and 185 per cent less revenue for the food and animal sectors. The most common type of free trade agreements (FTAs) are bilateral FTAs. New Zealand currently has several bilateral FTAs in force. FTAs are signed not only to reduce tariff barriers for bilateral trade, but also to create market opportunities, streamline processes, reduce overhead costs, and generate more certainty and security for businesses conducting work overseas. FTAs can also improve market access for local businesses and enable them to be more competitive in overseas markets (MFAT, 2023d).

As new agreements come into force, the primary sector may need to adapt production processes and land use practices to comply with new standards, quotas, or policies. The potential for future agreements could greatly affect the trading profile and primary production/land use in New Zealand. New Zealand is currently engaged in several FTAs with countries throughout Europe, Asia-Pacific and South America. These are as follows:

- Australia: Closer Economic Relations (1983)
- China: New Zealand-China Free Trade Agreement (2008)
- European Union: New Zealand and European Union Free Trade Agreement (2023)
- Hong Kong: New Zealand-Hong Kong, China Closer Economic Partnership (2011)
- Malaysia: Malaysia-New Zealand Free Trade Agreement (2009)
- Singapore: New Zealand and Singapore Closer Economic Partnership (2001)
- South Korea: NZ-Korea Free Trade Agreement (2015)
- Taiwan: Agreement between New Zealand and the Separate Customs Territory of Taiwan, Penghu, Kinmen, and Matsu on Economic Cooperation (2013)
- Thailand: New Zealand and Thailand Closer Economic Partnership (2005)
- United Kingdom: New Zealand and United Kingdom Free Trade Agreement (2023)

Negotiations for an FTA with the European Union commenced in 2018. In July 2023, New Zealand and the European Union signed an FTA, with the agreement to enter into force in the first half of 2024. It is expected that under this FTA New Zealand could gain up to NZ$1.8 billion in annual exports to the EU. In 2024, tariffs on 91 per cent of New Zealand's goods exports to the EU will be removed, rising to 97 per cent by 2031. This will amount to NZ$100 million of tariff savings annually on New Zealand exports to the EU. This includes tariff removal on kiwifruit, Mānuka honey, fish and seafood, onions, wine and industrial products. It also includes significant new quota access for beef, sheep meat, butter and cheese. Also, the agreement increases opportunities and reduces barriers for Māori businesses exporting into the EU (MPI, 2023d).

New Zealand spent several years negotiating an FTA with the United Kingdom (UK). Finally, in May 2023 (earlier than expected), New Zealand's FTA with the UK entered into force. The NZ-UK FTA is one of the most comprehensive FTAs that New Zealand has ever concluded. At full implementation, tariffs will be eliminated on 100 per cent of exports to the UK. From the first day of the agreement (31st May 2023), duties on 99.5 per cent of current New Zealand exports were removed, through a combination of tariff elimination and duty-free quotas. It has been estimated that New Zealand exporters will immediately save approximately NZ$37 million per year on the elimination of tariffs alone. Quotas will grow over time until they are fully removed (MFAT, 2023a). The UK-NZ free trade agreement (FTA) is also New Zealand's first bilateral trade deal to include specific commitments regarding climate change, as well as provisions eliminating environmentally harmful subsidies. This includes commitments to take steps to eliminate fossil fuel subsidies, and to prohibit fisheries subsidies that can lead to overfishing. The environment chapter of the UK-NZ FTA also prioritises the elimination of tariffs on at least 268 environmentally-beneficial products - the largest ever agreed list of environment in an FTA (DIT, 2023).

These FTA arrangements differ for different export commodities. For example, tariffs on most dairy products will be removed in gradual increments. Milk powders, for example, will have their tariffs reduced in four equal increments over a four year period until they become duty free. Butter and cheese are given tariff rate quotas that will be gradually lifted over 6 years until they are eliminated (Sense Partners, 2023). Also, tariffs will be eliminated immediately

on wine (export value of approximately NZ$463.1 million), honey (export value of approximately NZ$74.9 million) and onions (export value NZ$8 million). Tariffs on apples will be eliminated after three years, while tariff-free access has been granted for off-season exports for the first three years of the FTA. The fisheries sector will see tariffs on hoki (export value of approximately NZ$2.2 million) removed from Day 1, while after three years tariffs on mussels will be removed (export value of approximately NZ$6.4 million) (MFAT, 2021b).

Walmsley et al. (2022) have projected that New Zealand's GDP could increase by between approximately NZ$710 million and NZ$811 million by 2040 (at full implementation of the FTA), depending on tariff reductions, quota liberalisation and the level of trade facilitation. In the same scenarios, export growth to the UK is projected to range between approximately NZ$2.1 billion and NZ$2.2 billion. This export growth is largely in the processed foods sectors, particularly beef. When breaking down the various components of the FTA, tariff liberalisation contributes approximately 38 per cent of the increase in GDP, while quota liberalisation contributes approximately 47 per cent. Walmsley et al. (2022) conclude that the reductions in agricultural quota barriers to trade have the potential to contribute significantly to the gains from the NZ–UK FTA. However, this depends on the initial estimate of quota rents earned by New Zealand beef exporters to the UK (Walmsley et al., 2022).

The UK-NZ FTA includes world-leading commitments on animal welfare and the environment. Importantly, it establishes a platform for cooperation between Māori and the UK, aimed at promoting Māori interests and trade, and acknowledging the unique shared history between the two countries (MPI, 2023a). The FTA has the most far-reaching trade and environment provisions New Zealand has ever negotiated, including commitments to eliminate fisheries subsidies, to take steps toward eliminating fossil fuel subsidies (MPI, 2022). The FTA also includes commitments to prohibit subsidies that exacerbate overfishing and addresses the consumption/production of fossil fuels (MFAT, 2022c). Over 260 environmentally friendly products been selected for tariff elimination - the largest list ever complied for an FTA. Overall, the agreement represents a significant trade milestone for New Zealand's primary sector and will influence demand for agricultural products and services.

Specifically, the *environment* chapter of the UK-NZ FTA reaffirms both countries' commitments under the Paris Agreement to meet net zero GHG emissions. It also encourages trade and investment in low carbon goods, services and technology, with the most comprehensive list of "environmentally beneficial" goods with liberalised tariffs in a trade deal to-date. The deal commits New Zealand and the UK to work together on climate change, affirms both countries' commitments to implement the Paris Agreement, and preserves the right to regulate for environment and climate purposes. Both countries have made precedent-setting FTA commitments to end electricity generation from unabated coal, take steps to eliminate fossil fuel subsidies where they exist, and pursue a more ambitious phasing out of the use of hydrofluorocarbons (DIT, 2023).

Further, the UK has also signed an FTA with Australia, which also came into force in May 2023. The UK–Australia FTA is broadly similar to the UK–NZ FTA, with transitional quotas in place before complete trade liberalisation for sheep meat, beef and dairy. However, there is a key difference between the two, as text on animal welfare has been agreed between New Zealand and the UK that goes beyond standard WTO text used in trade deals, such as in the UK–Australia FTA. In fact, as mentioned above, this is the first trade deal in which New Zealand has agreed to the inclusion of a specific *animal welfare* chapter. Alongside each country's WTO commitments, the key objective within the UK-NZ FTA is to enhance cooperation between the

two countries on the welfare of farmed animals. The FTA recognises animals as sentient beings and commits to not weakening animal welfare in order to encourage trade. There is also mutual recognition in the deal that, although the countries have different farming practices, they have both placed high importance on the preservation and strengthening of animal welfare. In addition, there is also commitment to increase cooperation to enhance animal welfare standards (AHDB, 2022).

There have been changes to existing bilateral FTAs in recent years. The New Zealand-China FTA, which came into force in 2008, has played a major part in growing the Chinese market for New Zealand's exports. This FTA is highly important to New Zealand, as China is currently New Zealand's largest export market, particularly for agricultural commodities. Tariffs are eliminated for over 98 per cent of New Zealand goods exports to China. In 2021, tariffs on all exports other than dairy were eliminated (some products remain subject to tariffs and safeguards and will be phased out by 2024). In April 2022, the Upgrade to the New Zealand-China Free Trade Agreement entered into force. The Upgrade amended the 2008 FTA to align it with the latest trade policies and business practices in areas of e-commerce, government procurement, environment and trade, and competition. It also eliminated further tariffs and reduced compliance measures for exporters (MFAT, 2023b).

3.6.2 Free Trade Agreements (FTAs) - Multilateral

The failure of the World Trade Organisation (WTO) to complete the Doha Development negotiations in 2015 was a setback to the development of global/multilateral FTAs (MFAT, 2021c). New Zealand was actively involved in discussions and sought the elimination of agricultural export subsidies and other trade-distorting practises that affected agriculture. The failure of the negotiations placed New Zealand at risk of being excluded from trade negotiations, which could have resulted in lost market share in foreign markets.

New Zealand is currently a signatory on several multilateral FTAs, including:

- Trans-Pacific Strategic Economic Partnership - Brunei (2005);
- Trans-Pacific Strategic Economic Partnership - Chile (2005);
- Trans-Pacific Strategic Economic Partnership (2005) Singapore - Auxiliary to the bilateral New Zealand and Singapore Closer Economic Partnership;
- Association of Southeast Asian Nations-Australia-NZ FTA (2009);
- Comprehensive and Progressive Agreement for Trans-Pacific Partnership includes Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, Peru, Singapore, Vietnam (2018);
- Digital Economy and Partnership Agreement (DEPA) was signed by New Zealand, Chile and Singapore in June 2020 and entered into force for New Zealand and Singapore on 7th January 2021;
- UK-USA Agreement (Five Eyes) between United States, Australia, United Kingdom, Canada, and New Zealand.

There are several multilateral FTAs currently being negotiated with New Zealand, such as the NZ–Pacific Alliance FTA, and NZ–Gulf Cooperation Council FTA. In addition, changes have been made to existing multilateral agreements. For example, in 2020 the Regional Comprehensive Economic Partnership (RCEP) was concluded by fifteen countries in the Asia-Pacific region, including Australia, China, Indonesia, Japan, New Zealand, the Philippines, Republic of Korea, and Vietnam. This agreement will reduce tariffs on goods for the 15 participating economies by 90 per cent over two decades, and provide a framework for strengthening co-operation in

the areas of standards, technical regulations, conformity assessment procedures, rules of origin, and border processes for perishable goods. New Zealand is also an included partner in the CPTPP, for which New Zealand took over from Singapore as the chair in 2023, hosting a year-long programme of meetings and events. The centrepiece of New Zealand's host year was the Seventh Commission Meeting in July in Auckland, which brought together trade ministers and delegations from 10 other economies in the Asia-Pacific region (MFAT, 2023c).

As previously discussed, New Zealand has a relatively diverse profile of trading partners. However, there are some concerns over New Zealand's reliance on China as a trade partner, especially considering the costly recent trade wars between Australia, the United States and China. Trade between New Zealand and China has increased steadily over the last two decades, and New Zealand currently exports approximately NZ$20.1 billion and imports approximately NZ$13.3 billion worth of goods and services to and from China (MFAT, 2023e). Any disruptions to trade, changes in market access, political tensions, or economic downturns, could have significant implications for New Zealand's trading relationship with China. Foreign Minister Nanaia Mahuta outlined the need for New Zealand to diversify its trading relationships and reduce reliance on China for export income (Malpass & Coughlan, 2021).

3.6.3 Geopolitical Relationships

International geopolitical conflict can have significant impacts on world agricultural markets, thereby influencing land use and associated options.

3.6.3.1 Russia-Ukraine war

The Russia-Ukraine War is an ongoing international conflict between Russia and the Ukraine, which commenced in February 2014 when Russia annexed Crimea and began arming and abetting separatists in the Donbas region in the country's south-east. Years of conflict followed, and in February 2022 Russia launched a full-scale invasion of Ukraine with the aim of toppling the Western-aligned government of Volodymyr Zelenskyy (CFR, 2023). The conflict has been affecting the global economy, including global agriculture and food security.

Russia and Ukraine are among the most important producers and exporters of arable crops in the world, particularly of cereals and oilseeds. The production of animal products, however, mainly supplies their domestic markets (OECD, 2022b). Russia and Ukraine are key agricultural players that, combined, export nearly 12 per cent of the food calories traded globally, and are major providers of basic agricultural commodities, including wheat, maize, and sunflower oil. Russia is also the world's largest exporter of fertilisers (EPRS, 2022). Hence, the Russia-Ukraine war has had considerable impacts on global agricultural markets, with decreased exports of commodities such as wheat, maize and sunflower oil leading to an increase in the price of these commodities on the world market. Similarly, reductions in fertiliser exports from this region, in combination with increased energy costs, also led to increased fertiliser prices globally as a result of this conflict (MPI, 2023b; Rabobank, 2022). Despite a sharp incline in commodity prices following the initiation of the conflict (around February 2022), world markets have shown relative resilience, with prices decreasing steadily between March and July 2022, and remaining steady until about April 2023 (MPI, 2023b). The Russia-Ukraine conflict has also placed additional pressure on meat and dairy industries globally through increased input costs, including New Zealand (Rabobank, 2022). Similarly, the OECD (2022b) showed that a reduction in export capacity from Ukraine and Russia, and rising energy and fertiliser prices, have pushed up international food prices, thereby threatening global food security. OECD projections showed that the full loss of Ukraine's capacity to export, together

with a 50 per cent reduction in Russian wheat exports, could lead to a 34 per cent increase in international wheat prices in 2023 (OECD, 2022b).

Various studies have examined the impacts of the Russia-Ukraine conflict on land use change globally. While the total value of damages to Ukraine's agriculture sector exceeds approximately US$6.6 billion, the total value of losses, agriculture-based revenue due to these damage reaches US$34.25 billion. The Ukraine suffered US$11.2 billion in crop losses in 2022. Disruption of agricultural logistics—increased prices of transport and shipping coupled with plummeting domestic prices for export-oriented commodities - resulted in a further US$18.5 billion in losses. Prior to the war, agriculture accounted for approximately 20 per cent to Ukraine's GDP, with agricultural exports contributing over 40 per cent of total exports. In 2022, Ukraine's GDP was down 30 per cent, predominantly due to losses in the agricultural sector (CSIS, 2023).

The war has caused widespread and severe damage to the environment and inflicted both immediate and longer-term impacts on human health, ecosystems, and the Ukrainian economy and beyond (OECD, 2022c). Martinho (2022) noted that the war has had severe impacts on land use management, especially in agricultural production. The author pointed out that this could deserve special attention, as Ukraine is a major producer of cereals and wheat (Martinho, 2022).

Alexander et al. (2023) used a scenario modelling approach to quantify possible outcomes of the Russia-Ukraine conflict on human health and the environment through increased food prices internationally, including potential impacts on land use. The authors found evidence for a potential expansion of agricultural land (with associated carbon and biodiversity loss) through reduced land use intensification associated with higher input costs as a result of the conflict, including a potential 60 to 100 per cent increase in food costs (Alexander et al., 2023).

Similarly, Carriquiry et al. (2022) used a trade modelling approach to demonstrate the emergence of higher commodity prices for arable crops as a result of reduced exports and production from Russia and Ukraine during the conflict, suggesting that this could act as a signal for farmers to increase cropland expansion in these commodities. Across a number of scenarios, the authors demonstrated that land conversion and increased arable production could increase carbon emissions and remove natural vegetation without compensating with improvements in global food security (Carriquiry et al., 2022).

Mottaleb et al. (2022) examined the potential impacts of the Russia-Ukraine conflict on global wheat food security, including wheat price, consumption and calorie intake, using data from 163 countries. The authors found that a 50 per cent reduction in wheat exports from Russia and Ukraine could result in a 15 per cent increase in wheat producer prices, and reductions in both wheat consumption and dietary energy intake of approximately 8 per cent globally (Mottaleb et al., 2022).

There is limited evidence to suggest that this war has had significant impacts on New Zealand. In 2022, New Zealand imposed economic sanctions on Russia (as many other countries) – however, Russia is a relatively small trading partner (New Zealand's 27th largest export partner), to which New Zealand mainly exports butter (which can be diverted elsewhere). The main impacts on New Zealand from the war include global market disruption and reduced global economic growth. These aspects could potentially affect medium-term economic prospects for New Zealand. Furthermore, New Zealand imports from Russia (mostly crude oil)

dropped to zero in 2022 (MFAT, 2022a). The most significant impacts on New Zealand of the invasion are therefore indirect - primarily higher fuel and commodity prices, financial market volatility, and the potential drop in global economic activity. However, Russian action towards Ukraine has created significant anxiety, and is testing global financial and commodity markets. The price of a wide range of globally-traded commodities, particularly oil and wheat, have already risen and are likely to increase further. The flow-on financial effects could affect the value of the New Zealand dollar and raise the cost of some imported goods (particularly fuel), placing additional pressure on already high domestic inflation. Overall, there appears to be little impact on New Zealand land-use changes from the war. MPI (2023b) noted that the Russia-Ukraine conflict may have contributed to a decreased milk supply, driven by increases in input costs (e.g. corn, grain and fertiliser) for New Zealand dairy producers, as well as a decreased international demand for wool, driven by manufacturing disruptions in China (MPI, 2023b).

3.6.3.2 Australia and New Zealand's relationship with China

New Zealand and Australia have in recent years been involved in growing confrontations between the 'West' and China. New Zealand has pursued closer economic ties with China, and successive governments have emphasised the importance of FTAs that improve firm competitiveness and provide opportunities for growth (Köllner, 2021). In 2008, an FTA between the two countries was signed and was subsequently upgraded in recent years. The upgraded agreement provided better conditions for services exporters, improved market access for goods, reduced export barriers, and offered new areas of cooperation (MFAT, 2023e). While New Zealand has enjoyed close and prosperous economic ties, Australia has recently been embroiled in a costly trade war with China. This was caused by several factors, precipitated by the imposition of an import ban on Australian southern rock lobster that were claimed to contain high amounts of heavy metals. This led to a range of retaliatory actions between the two countries, that ultimately led to the introduction of trade barriers and other costs on Australia equivalent to an estimated AU$2.3 billion (Dobson, 2021). However, tensions are slowly easing. In May 2023, China lifted a de facto ban on Australian timber imports. In addition, in the first quarter of 2023, Australia's exports to China surged to record highs due to increased iron and coal exports to China, with exports to China rising by 31 per cent from the previous year (Reuters, 2023b). As demonstrated by trade tensions between China and Australia, there can be significant costs associated with geopolitical instability and positioning, which could potentially impact New Zealand's primary sector.

3.6.3.3 United States and China

The relationship between the US and China has also experienced changes in recent years, including a costly trade war. The US-China trade war of 2018-19 reduced US exports to China drastically. In 2018, former President Donald Trump cited unfair Chinese trade practises and intellectual property rights (IPR) violations. Over the coming months, a series of tariffs were put in place by both sides on a variety of goods and services. This trade war had a considerable impact on the US agricultural sector. US exports of agricultural products to China declined by 63 per cent between 2017 and 2018, from US$15.8 billion to US$5.9 billion (Chinn & Plumley, 2020). In 2019, a deal titled *Phase One* was signed, in which China pledged to increase US exports and improve IPR rules (BBC, 2020).

Trump and President Xi Jinping announced a truce in January 2020, at which point China pledged to increase its imports from the United States by US$200 billion over two years. By 2021, China did not meet its pledged target, and US exports to China barely reached pre-trade

war levels by 2021 (USDA, 2021). The US has yet to remove US tariffs on US$380 billion worth of Chinese goods entering the US, citing that Beijing has failed to meet aspects of the Phase One deal. Therefore, it remains unclear how trade will proceed between the two countries. Despite uncertainty, the US agricultural sector has avoided further impacts. The USDA has forecasted that a record US$39.0 billion worth of agricultural products will be shipped to China in 2022 (USDA, 2021). The implications of further trade wars between China and the United States could influence demand for New Zealand products from the primary sector.

Further to this, in 2022 President Biden has continued to maintain tariffs on Chinese goods and introduced new trade restrictions. However, diplomatic relations continue to deteriorate, especially following the discovery of a potentially Chinese high-altitude balloon in North American airspace in February 2023. While China has denied its involvement, the US has claimed this to be a Chinese spy balloon. Nevertheless, trade between the US and China hit a record value of US$690.6 billion in 2022, the main export drivers of which were agricultural commodities (Reuters, 2023a). Also, driven by higher global prices due to multiple factors, including Russia's war on Ukraine, US farm exports to China were 16 per cent higher than in 2021. Despite high levels of trade, US export data analysis shows evidence of China's economic decoupling from the United States. While this only represents half of the trade relationship, recent US imports from China tell a similar story, and through trade, the two economies appear to be becoming less directly interdependent (Bown & Yang, 2023).

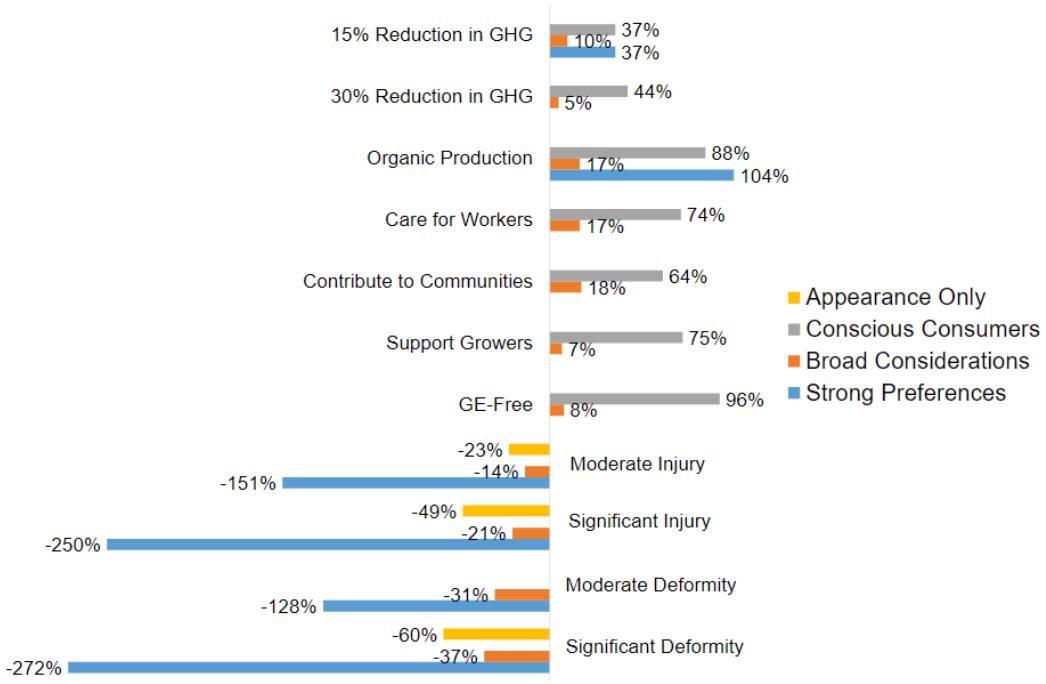
3.7 Consumer Demand for Social and Environmental Attributes

New Zealand has a biological economy, and a large proportion of economic activity is related to the land. Marketing social, cultural and environmental characteristics to consumers in export markets can help achieve greater value for New Zealand producers and their land-based export products. The Agribusiness and Economics Research Unit (AERU) has conducted a number of surveys and choice experiments across different countries and commodities to value consumers' willingness-to-pay (WTP) for certain product credence attributes (refer to *Appendix A*). The following section updates results reported in the previous iteration of this report (Driver et al., 2022), presenting international consumer WTP values for a range of social and environmental attributes of important New Zealand land-based exports in key overseas markets.

Tait et al. (2022a) investigated Californian consumer preferences for the attributes of New Zealand apple products. Four distinct consumer segments were identified in this study, including *appearance only* (those largely focused on apple appearance), *conscious consumers* (those with a greater focus on environmental and ethical attributes), *broad considerations* (those with a broad range of preferences) and *strong preferences* (those with the strongest positive and negative WTP for a range of attributes). The study examined apple product attributes related to environmental condition (reductions in GHG emissions), production methods (organic production, GE-free), social responsibility (care for workers, contribute to communities, support growers), and product appearance (moderate or significant injury, moderate or significant deformity). Figure 3-08 below shows the range of premiums that identified Californian consumer segments would be willing to pay for selected attributes of apple products. This shows that those in the *conscious consumers* segment value the broadest range of social and environmental apple attributes. Similarly, those in the *broad considerations* segment also value these attributes, but to a much lesser extent, and indicate

a negative WTP for injured or deformed apples. In addition, those in the *strong preferences* segment indicated relatively high WTP for organic apples (104 per cent premium) and a 15 per cent reduction in GHG emissions from production (37 per cent premium), as well as strong negative WTP for injured or deformed apples. Furthermore, those in the *appearance only* segment have only indicated a negative WTP for injured or deformed apples, with these values intensifying with the level of injury or deformity (Tait et al., 2022a).

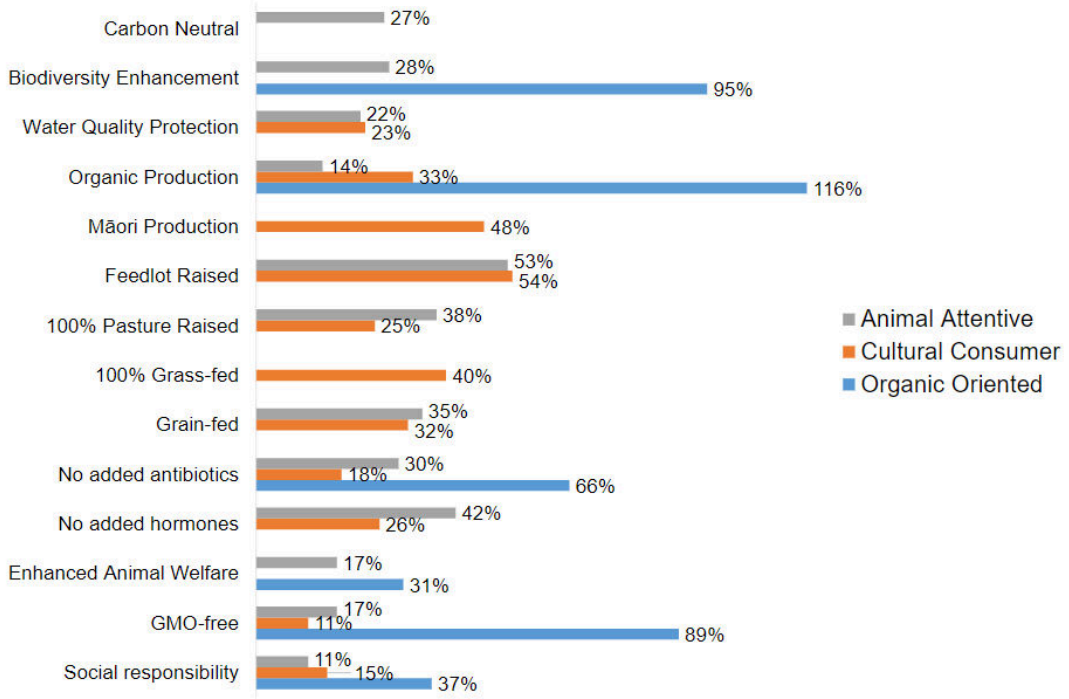
Figure 3-08. Californian consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of apples (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022a.

In the same programme, Tait et al. (2022b) investigated Beijing consumer preferences for the attributes of New Zealand beef tenderloin products. Three distinct consumer segments were identified in this study, including *animal attentive* (those focused on animal-based production attributes), *cultural consumer* (those who positively valued Māori production), and *organic oriented* (those with a stronger preference for organic production). The study examined apple product attributes related to environmental condition (carbon neutral, biodiversity enhancement, water quality protection), production methods (organic production, feedlot raised, 100% pasture raised, 100% grass fed, grain-fed, no added antibiotics, no added hormones, GMO-free), and social, ethical and cultural attributes (Māori production, enhanced animal welfare, social responsibility). Figure 3-09 below shows the range of premiums that identified Beijing consumer segments would be willing to pay for selected attributes of beef tenderloin products. This shows that those in the *animal attentive* segment value a broad range of attributes, but particularly those related to animal production (i.e. type of feed, no additives). Similarly, those in the *cultural consumer* segment also value a range of attributes, indicating a positive premium for Māori production and 100% grass-fed products. Furthermore, those in the *organic oriented* segment indicated a strong preference for organic production (116 per cent premium), biodiversity enhancement (95 per cent premium) and GMO-free (89 per cent) (Tait et al., 2022b).

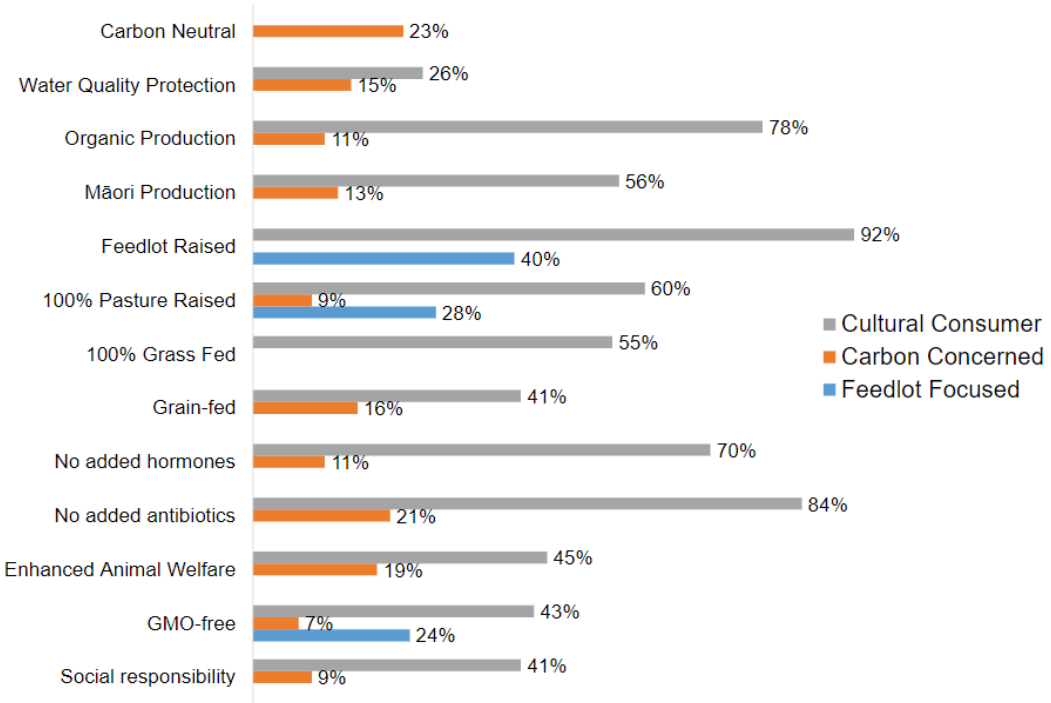
Figure 3-09. Beijing consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of beef tenderloin (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022b.

Similarly, Tait et al. (2022c) investigated United Arab Emirates (UAE) consumer preferences for the attributes of New Zealand beef mince products. Three distinct consumer segments were identified in this study, including *cultural consumer* (those who most valued Māori production), *carbon concerned* (those who positively valued carbon neutral), and *feedlot focused* (those who most positively valued the feedlot raised attribute). The study examined beef mince product attributes related to environmental condition (carbon neutral, water quality protection), production methods (organic production, feedlot raised, 100% pasture raised, 100% grass fed, grain-fed, no added hormones, no added antibiotics, GMO-free), and social, ethical and cultural attributes (Māori production, enhanced animal welfare, social responsibility). Figure 3-10 below shows the range of premiums that identified UAE consumer segments would be willing to pay for selected attributes of beef mince products. This shows that those in the *cultural consumer* segment value Māori production the highest of all identified segments, with a willingness to pay high premiums for a range of attributes, particularly those relating to production processes. On the other hand, those in the *carbon concerned* segment showed a positive WTP for carbon neutral beef mince products, as well as a broad range of other attributes. Furthermore, those in the *feedlot focused* segment indicated WTP only for select production-based attributes, including feedlot raised (40 per cent premium), 100% pasture raised (28 per cent premium) and GMO-free (24 per cent) (Tait et al., 2022c).

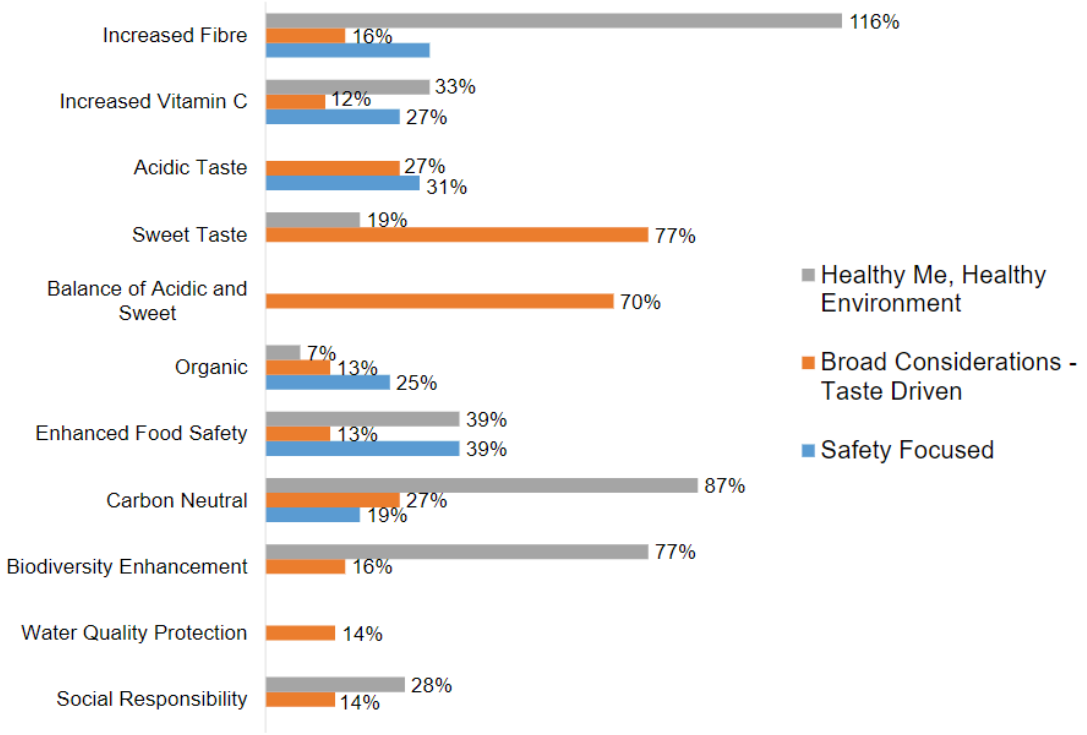
Figure 3-10. United Arab Emirates consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of beef mince (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022c.

Tait et al. (2022d) also investigated Japanese consumer preferences for the attributes of New Zealand kiwifruit. Three distinct consumer segments were identified in this study, including *healthy me/healthy environment* (those who highly valued health and environmental attributes), *broad considerations/taste driven* (those who most highly valued taste attributes), and *safety focused* (those who most highly valued food safety and similar attributes). The study examined kiwifruit attributes related to environmental condition (carbon neutral, water quality protection, biodiversity enhancement), production methods (organic), food safety (enhanced food safety), social responsibility, and other physical and health attributes (increased fibre, increased Vitamin C, acidic taste, sweet taste, balance of acidic and sweet). Figure 3-11 below shows the range of premiums that identified Japanese consumer segments would be willing to pay for the selected kiwifruit attributes. This shows that those in the *healthy me/healthy environment* segment valued key health and environmental attributes the highest, including increased fibre (116 per cent premium), carbon neutral (87 per cent premium), and biodiversity enhancement (77 per cent premium). Those in the *broad considerations/taste driven* segment indicated the highest WTP for taste attributes (sweet taste, balance of acidic and sweet), as well as lower WTP for broad range of other attributes. Furthermore, those in the *safety focused* segment indicated WTP only for limited attributes, including enhanced food safety (39 per cent premium) (Tait et al., 2022d).

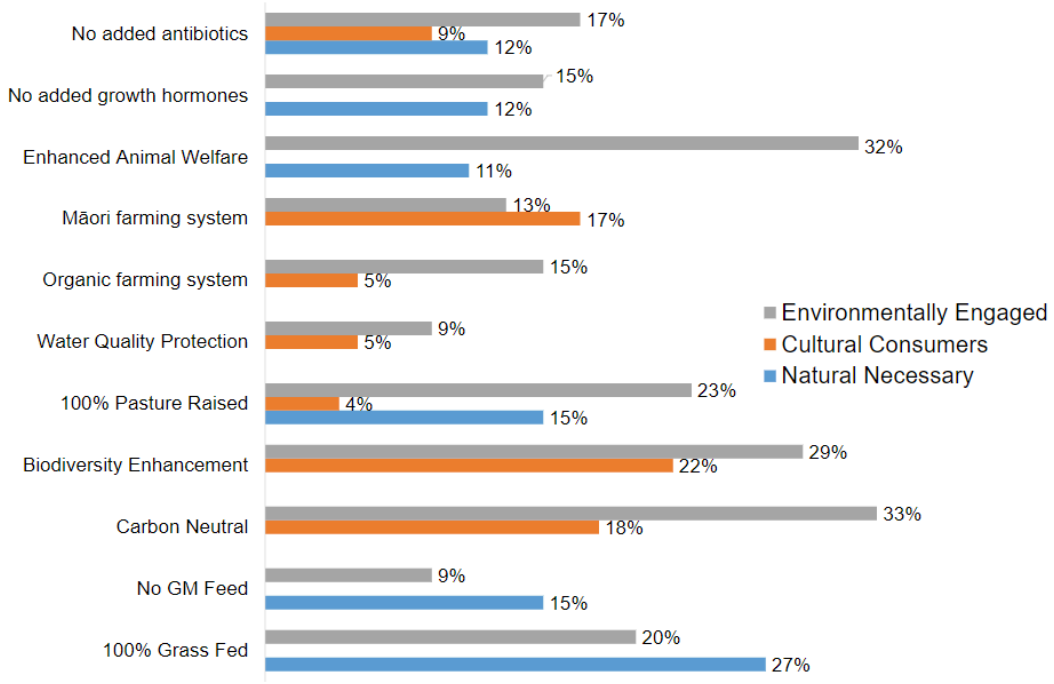
Figure 3-11. Japanese consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of kiwifruit (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022d.

Tait et al. (2022e) also investigated United Kingdom (UK) consumer preferences for the attributes of New Zealand lamb leg products. Three distinct consumer segments were identified in this study, including *environmentally engaged* (those who most highly valued environmental attributes), *cultural consumers* (those who most positively valued Māori production), and *natural necessary* (those who most highly valued a range of "natural" attributes, such as 100% grass fed). The study examined lamb leg attributes related to environmental condition (carbon neutral, water quality protection, biodiversity enhancement), production methods (organic farming system, no added antibiotics, no added growth hormones, 100% pasture raised, no GM feed, 100% grass fed), and ethical and cultural attributes (enhanced animal welfare, Māori farming system). Figure 3-12 below shows the range of premiums that identified UK consumer segments would be willing to pay for the selected lamb attributes. This shows that those in the *environmentally* segment valued key environmental and ethical attributes the highest, including carbon neutral (33 per cent premium), enhanced animal welfare (32 per cent premium), and biodiversity enhancement (29 per cent premium). Those in the *cultural consumers* segment indicated the highest WTP for Māori farming systems (17 per cent premium), as well as a range of environmental and production attributes. Furthermore, those in the *natural necessary* segment indicated WTP for a broad range of attributes, but particularly production system attributes, including 100% grass fed (27 per cent premium), no GM feed (15 per cent premium), and 100% pasture raised (15 per cent premium) (Tait et al., 2022e).

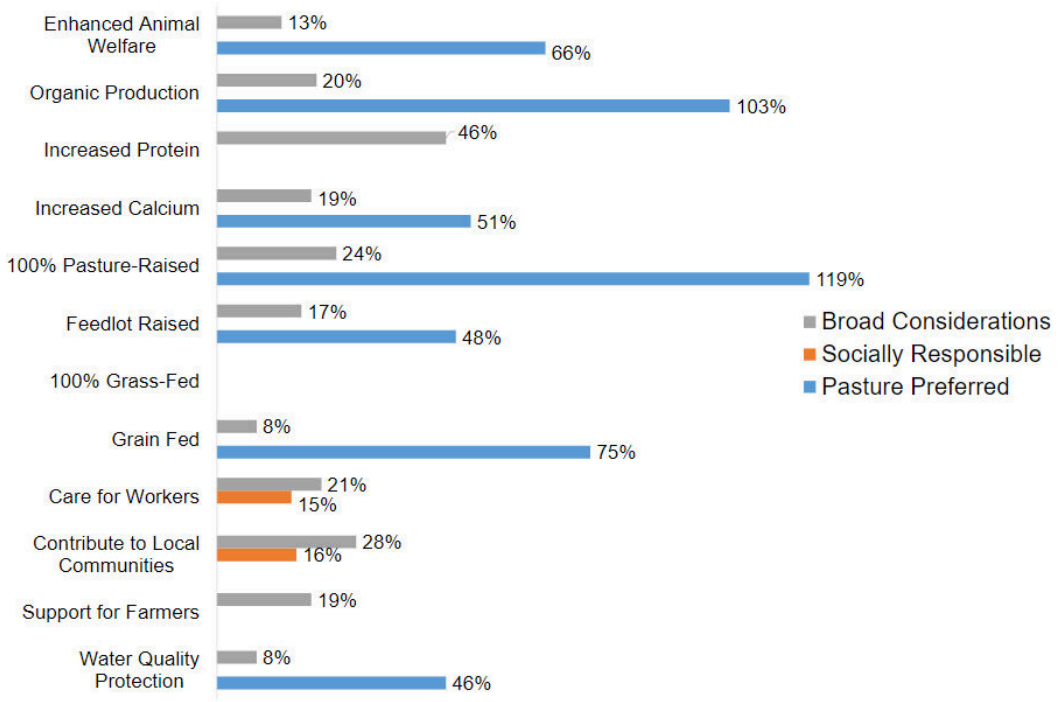
Figure 3-12. United Kingdom consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of lamb leg (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022e.

Tait et al. (2022f) also investigated Beijing and Shanghai consumers' preferences and WTP for the attributes of New Zealand UHT milk products. Two distinct consumer segments were identified in both cities, including *broad considerations* (those with relatively small WTP across a range of attributes), and *pasture preferred* (those with a strong preference for the pasture-raised attribute). The authors also identified a unique additional segment in each city – *socially responsible* in Beijing (those who only valued social attributes), and *strong preferences* in Shanghai (those who indicated high WTP for a wide range of attributes). The study examined UHT milk product attributes related to environmental condition (water quality protection), production methods (organic production, 100% pasture-raised, feedlot raised, 100% grass fed, grain fed), social and ethical considerations (enhanced animal welfare, care for workers, contribute to local communities, support for farmers), and health attributes (increased protein, increased calcium). Figure 3-13 below shows the range of premiums that Beijing consumers within identified segments would be willing to pay for the selected UHT milk product attributes. This shows that consumers in the *broad considerations* segment valued a broad range of attributes, indicating the highest WTP for increased protein (46 per cent premium). Those in the *pasture preferred* segment, on the other hand, indicated high WTP for a range of environmental, ethical and production attributes – particularly 100% pasture-raised (119 per cent premium) and organic production (103 per cent premium). Furthermore, those in the *socially responsible* segment indicated WTP for only two attributes, both of which related to social responsibility (care for workers, contribute to local communities) (Tait et al., 2022f).

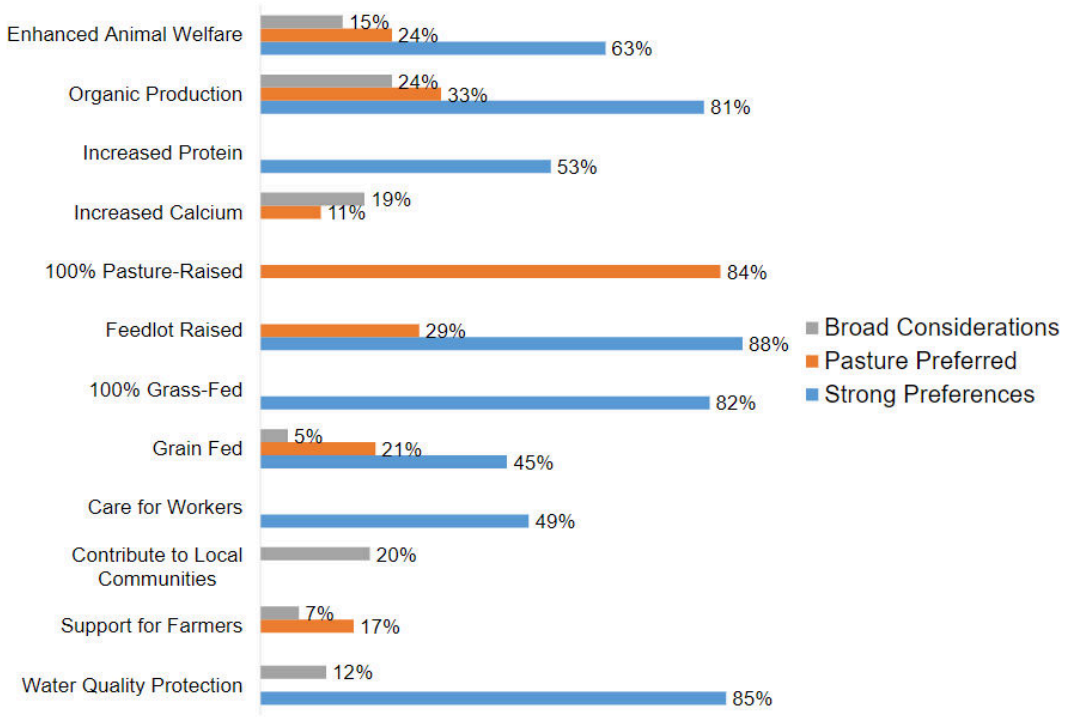
Figure 3-13. Beijing consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of UHT milk (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022f.

Figure 3-14 below shows the range of premiums that Shanghai consumers within identified segments would be willing to pay for the selected UHT milk product attributes. This shows that consumers in the *broad considerations* segment valued a broad range of attributes, indicating the highest WTP for contributing to local communities (20 per cent premium) relative to other segments. Those in the *pasture preferred* segment, on the other hand, indicated high WTP for 100% pasture-raised (84 per cent premium) products, as well as smaller premiums for a range of other attributes. Furthermore, those in the *strong preferences* segment indicated high WTP for a broad range of environmental, ethical and production attributes, particularly feedlot raised (88 per cent premium) and water quality protection (85 per cent premium) (Tait et al., 2022f).

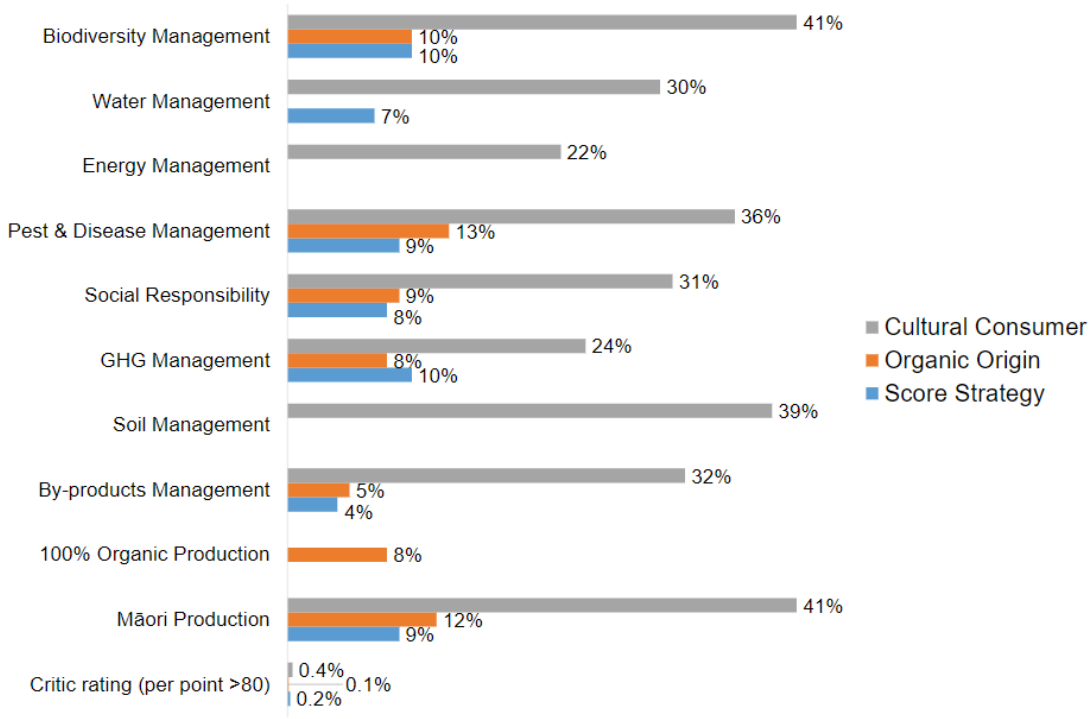
Figure 3-14. Shanghai consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of UHT milk (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022f.

Finally, Tait et al. (2022g) investigated Californian consumers' WTP for the attributes of New Zealand Sauvignon blanc wine products. Three distinct consumer segments were identified in both cities, including *cultural consumer* (those who most positively valued Māori production), *organic origin* (those who valued 100% organic production), and *score strategy* (those with a broader range of preferences). The study examined Sauvignon blanc wine attributes related to environmental condition (biodiversity management, water management, energy management, greenhouse gas emissions management, by-products management), production methods (pest and disease management, soil management, 100% organic production), Māori production, and product quality (critic ratings per point over 80). Figure 3-15 below shows the range of premiums that Californian consumers within identified segments would be willing to pay for the selected Sauvignon blanc wine product attributes. This shows that consumers in the *cultural consumer* segment valued a broad range of attributes, indicating the highest WTP for Māori production (41 per cent premium). Those in the *organic origin* segment, on the other hand, indicated high WTP for a range of attributes, but were the only segment to indicate positive WTP for 100% organic production (8 per cent premium). Furthermore, those in the *score strategy* segment indicated relatively low WTP for a range of most environmental attributes (Tait et al., 2022g).

Figure 3-15. Californian consumers' willingness-to-pay (WTP) as a percentage of product price paid for selected attributes of sauvignon blanc wine (by consumer segment), 2021



Source: AERU, 2023; Tait et al., 2022g.

As shown above, an increasing number of international consumers are considering the sustainability, ethical and cultural attributes of the food products that they buy. An updated literature review of studies examining consumer WTP for a range of environmental and ethical attributes in food products can be found in Appendix A of this report.

4. Conclusion

Enhancing primary sector production and productivity while maintaining and improving our land and water quality for future generations is a key outcome of the Our Land and Water National Science Challenge. It is therefore important to identify the hierarchy of international and national issues to provide an evidence base to inform the Challenge Research Strategy. This report presents an overview of the international and domestic drivers that have the potential to influence land use change/practice In New Zealand. This report also looks to inform the strategic direction of the Our Land and Water National Science Challenge by identifying the likely impact of these drivers in the future.

The current report has been informed by four previous iterations, in which workshops,85uture85lder surveys and extensive literature review produced a series of 32 key drivers of land use change/practice. This was later expanded to 35 key drivers. Links to updated summaries of the key drivers are provided, along with an evidence base comprising 1,500 unique sources (1,152 international and 348 domestic sources) across the four iterations of this project, are included in this report.

The current report modified and extended a survey of New Zealand primary sector stakeholders, designed to identify which drivers they believed to be the most important for land use change/practice domestically and internationally. The survey was distributed to 3,815 individuals in total, receiving 283 completed surveys.

The survey asked participants (unprompted) to identify important domestic and international issues that could influence New Zealand land use change/practice. Climate change was viewed as the most critical international issue, while other critical issues included consumer preferences, trade/market access, and climate policy. These findings were consistent with findings from the prior surveys, with increased importance observed for issues such as geopolitics and food security. Climate change was also viewed as the most critical domestic issue, while government policy and water quality were also regarded as significant issues. Other critical issues included social license to operate, environmental policy, extreme weather events, and biodiversity.

Survey participants provided their perspectives on the impact that key international drivers/issues would have on land use change/practise in New Zealand. Most individuals viewed climate change as likely having a high impact on land use change/practise. Extreme weather events, greenhouse gas emissions and trade agreements were also viewed by a large proportion of participants as having a high impact. Survey participants also provided their perspectives on the impact key domestic drivers/issues would have on land use change/practise in New Zealand. Similar to the international drivers/issues above, most individuals viewed climate change as likely having a high impact land use change/practise. Extreme weather events, water quality, agricultural policy and the condition of the environment were also viewed by a large proportion of individuals as having a high impact.

The survey prompted participants to consider the importance of primary product attributes in achieving higher product value from lower volume. Most participants viewed the attributes of high quality, lower environmental impact of production, food safety and taste as very important. The survey followed on by asking individuals to provide an indication of their participation in agribusiness schemes. The findings showed that approximately 21 per cent of the sample group were involved in a scheme. These schemes often had an environmental and social dimension, and in some cases did increase the prices received for their goods/services.

This report also addressed some of the future trends and challenges that would likely impact land use change/practice in New Zealand. These were grouped under seven broad headings: climate change, New Zealand's environmental policy, COVID-19, global trends and challenges, emerging technologies, international trading environment, and consumer demand for social and environmental attributes.

Climate change is likely to have a significant impact on future land use change/practice in New Zealand. It will likely produce more frequent and intense extreme weather events and influence domestic and international policy. Climate change is pushing the banking and investment sector towards sustainable finance and investing using ethical, social and governance (ESG) criteria. International institutions are also seeking to enable and direct finance/capital towards initiatives and investments likely to influence land use change/practise. New Zealand has developed and implemented a suite of new environmental policy largely focused on addressing climate change mitigation and adaptation, but also water quality, biodiversity, and similar environmental issues. COVID-19 disrupted the global agricultural industry and placed existing supply chains under considerable stress, revealing their vulnerabilities to external shocks. The economic impacts of the COVID-19 pandemic are still being experienced in global markets. Although the pandemic presented significant challenges for New Zealand's primary sector, the sector has shown considerable resilience compared to other sectors. The impacts of food waste continue to be important in relation to addressing environmental, social and economic goals, including the Sustainable Development Goals (SDGs), with the emergence of the circular economy and bioeconomy as models for addressing the issues of waste and GHG emissions in a global and Aotearoa New Zealand context. Emerging technologies are likely to enhance access to data and improve practices, both on-farm and in-market, including artificial intelligence (AI), plant sensors, and technology for GHG emissions mitigation. The international trading environment will continue to be crucial for New Zealand's primary product exports, including new and existing bilateral and multilateral free trade agreements (FTAs). However, the maintenance of geopolitical relations is an important aspect of maintaining trade access and can influence land-use change or practise, as demonstrated by recent international conflicts. Finally, international consumers in key export markets for New Zealand's food and fibre products continue to value social and environmental attributes highly, and have indicated that they are willing to pay a range of premiums for the inclusion of these attributes in the products that they buy.

The mission statement of the Our Land and Water Challenge is to "enhance primary sector production and productivity while maintaining and improving our land and water quality for future generations". This report has examined the impact of domestic and international drivers on New Zealand land use change/practice and has utilised the knowledge and expertise of those involved in the primary sector to help inform these. The likely impact of future trends and challenges on land use change/practice in New Zealand was also examined. The86uturee of sustainable and productive primary land use will likely require identifying and adapting to the issues, trends and drivers outlined in this report.

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Water Services Entities Act 2022.

Water Services Entities Amendment Act 2022.

Water Services Legislation Bill 2023.

Appendix A: Review of international consumer preferences studies – choice experience (CE) and willingness-to-pay (WTP) case studies

It is important to value the range of premiums that international consumers are willing to pay for the inclusion of attributes in products. One method to assess this is the use of choice experiments. A choice experiment (CE) is an economic valuation method used to assess willingness-to-pay (WTP) for different attributes of goods or services that can (but does not have to be) traded in markets. This belongs to the category of stated preference non-market valuation methods (Hanley et al., 2013; Hensher et al., 2015). CE can be used to explore consumer preferences for attributes that do not currently exist in-market (Teratanavat and Hooker, 2006) for application in product development or market access, and to simulate real markets and the product choices involving trade-offs (Carlsson et al., 2005; Mueller Loose and Remaud, 2013; Poelmans and Rousseau, 2016).

This chapter updates a literature review of consumer WTP for a series of basic and credence attributes relating to the international and domestic drivers included in this report. This review complements previous large-scale literature reviews produced as part of the Maximising Export Returns (MER) research programme by Agribusiness and Economics Research Unit (Miller et al., 2014), as well as Stages 1-4 of the Drivers Project for the Our Land and Water component of the National Science Challenge (Saunders et al., 2016; 2018; Driver et al., 2019, 2021), and covers mainly academic CE literature published between 2003 and 2021. Previous reviews identified food safety as a key credence attribute across all markets, including positive WTP with high associated premiums in some cases (e.g. food safety credentials on food products in China). This is understandable due to widespread public concerns regarding previous food safety incidents around the world.

Previous reviews also identified product quality (and associated indicators) as another credence attribute. Examples of this include the freshness of milk products or tenderness of steak products. Product quality can also extent to aspects of a product's origin, whereby a common finding is that people prefer domestically-produced over imported food products. There is also a range of case studies considering production methods, typically comparing organic, genetically modified (GM) and conventional production practices. Regarding GM production, evidence is mixed, while WTP for organic production (for dairy, fruit and vegetable, wine, oil and flour products) was found to be consistently positive. It has also been shown that consumers can associate organic foods with a range of benefits, such as increased healthiness and limited use of pesticides.

Similarly, functional foods (i.e. food products that offer health benefits beyond basic nutrition) have also shown some positive WTP. In China and Singapore, for example, there is growing interest in these types of products, such as those intended to enhance the immune system, supplement basic nutrition or assist with aspects of beauty, among other effects.

Finally, previous reviews found some evidence that consumers are concerned with environmental or animal welfare issues, particularly in relation to the ethical dimensions of production. For example, studies indicate that consumers in the UK, China and India are willing to pay for reduced water pollution, reduced greenhouse gas (GHG) emissions and improved biodiversity in agricultural production (Saunders et al., 2013). Likewise, research has indicated that many consumers are concerned about the health and welfare of animals, potentially influencing their purchase decisions. The CE studies have included general animal welfare or free range attributes alongside other types of attributes related to animal health and welfare.

A1.1 Meat and seafood products

The current review includes 50 CE and other WTP studies examining the attributes of meat and seafood products in Europe, North America, Asia and other regions. The most commonly examined markets across these studies include Germany, the United Kingdom (UK), the United States (US) and China. Attributes examined in these studies include animal health and/or welfare, organic, different production methods, traceability, local food, country-of-origin, nutritional content, functional foods, social responsibility, environmental condition, certification, carbon/GHG emissions associated with production, water use and genetic modification (GM), as well as generic attributes such product quality, appearance and taste.

General studies

Yang and Renwick (2019) conducted a meta-analysis of credence attributes for livestock products. To do this, the authors conducted a systematic literature review and applied a meta-regression analysis in an effort to introduce some generality to WTP studies. The authors initially identified 566 WTP estimates from 94 studies. However, 11 of these were negative and excluded from the meta-analysis, but controlled for using a dummy variable in the meta-regression. Table A1 shows the frequency of estimates across a number of variables.

Table A1: Frequency of study characteristics (papers N=94) (estimates N=555)

Category	Variable	Frequency[a]
Product	Beef	283
	Lamb	44
	Dairy	206
	Other products	22
Labelling & perception	Labelled	399
	Perceived	156
Data collection time	Before 2000	22
	2000-2004	116
	2005-2009	239
	After 2010	178
Estimation method	Choice experiment	276
	Contingent valuation	39
	Conjoint analysis	63
	Hedonic	26
	Others	151
Valuation method	Hypothetical	405
	Non-hypothetical	150
Credence attribute	Environment-friendly	42
	Animal welfare	108
	Organic	62
	Hormone/antibiotic free	38
	Grass-based	49
	Food safety	43
	PDOs/PGIs	27
	ROOs/COOs	102
	Traceability[b]	18
	Mixed attributes	66
Region	North America	152
	Europe	280
	Asia	72
	Australasia	6
	Other regions	45

Notes: (a) Frequency refers to the number of observations in each category. (b) Traceability is sometimes relevant to geographical information, but it is different from GIs. This attribute can also be called 'identity preservation', and is defined as the ability of a system to maintain a credible custody of identification for animals or animal products through various steps, from the farm to the retailer.

The authors (Yang and Renwick, 2019) created two subsamples within the data to separate red meat from dairy. The applied regression model highlighted that in the red meat sample there is a higher WTP for beef products than for lamb, with organic production associated with the highest price premium, and environmentally friendly attributes values the least by consumers. In terms of dairy products, food safety was associated with the highest price premium, and environmentally friendly the lowest. In addition, WTP estimates were modelled based on the meta-regression results with the study year was set after 2010 to capture recent market demand for livestock products. Table A2 shows the results WTP results for the whole model, red meat, and dairy estimates, with a 95 per cent confidence interval.

Table A2: WTP estimates of a price premium for livestock products (%)

Model credence attributes	Whole sample model	Red meat model	Dairy model
Environment-friendly	24.1 [6.1, 42.1]	18.9 [3.7, 34.2]	25 [11.2, 38.9]
Animal welfare	31.9 [5.6, 58.2]	19.3 [3, 35.6]	31 [0.5, 61.5]
Organic	35.8 [8.1, 63.5]	31.37 [8.1, 54.5]	28.5 [9.2, 47.9]
Hormone/ antibiotic free	32.2 [4.5, 60]	24 [1.5, 46.6]	34.3 [3.8, 64.8]
Grass-based	24.9 [-3.8, 53.6]	22.3 [0.5, 44.1]	25.1 [4.5, 45.7]
Food safety	29.9 [5.3, 54.6]	23 [2.4, 43.6]	39.2 [18.8, 59.6]
PDOs/PGIs	24.7 [7.3, 42]	22.4 [6.1, 38.7]	25.7 [4.3, 47]
COOs/ROOs	29.8 [9.4, 50.3]	22.5 [7.8, 37.2]	29.9 [11.3, 48.4]
Traceability	20.1 [-2.5, 42.7]	17.7 [-3.3, 38.7]	26.1 [-1.8, 50.3]
Mixed attributes	25.68 [1.7, 49.7]	19.2 [1.8, 36.6]	25.8 [2.2, 48.8]

Source: Yang and Renwick, 2019.

Alsubhi et al. (2022) conducted a systematic review of studies reporting in consumer WTP experiments regarding healthier food products, presenting broad results across a range of countries and product categories. Studies consistently found positive WTP for healthier food options, with consumers willing to pay an average premium of 30.7 per cent (ranging between 5.6 and 91.5 per cent) for healthier food products (Alsubhi et al., 2022).

European studies

The current review includes 24 CE and other WTP studies examining the attributes of meat and seafood products in Europe, including studies conducted in Germany, Denmark, Portugal, Spain, France, UK, Sweden, Italy, Netherlands and Belgium. Attributes examined in these studies include animal health and/or welfare, organic, different production methods, traceability, local food, country-of-origin, nutritional content, functional foods, social responsibility, environmental condition, certification, carbon/GHG emissions associated with production, water use and genetic modification (GM), as well as generic attributes such product quality, appearance and taste.

Clark et al. (2017) conducted a review of international WTP literature regarding farm animal welfare for pigs, chickens, cattle and fish. The authors estimated a weighted mean WTP (in Euros) for the provision of higher standards of farm animal welfare across a range of studies, measures and differences in WTP by type of production animal. As shown in Table A3, the authors found higher mean WTP for beef cows and fish compared to pigs and broiler chickens. This indicates that consumers prefer the provision of farm animal welfare depending on the type of animal involved in production.

Table A3: Willingness-to-pay for farm animal welfare, international literature review

Animal Type	No. of Measures	No. of Studies	Weighted Mean WTP (€)
Pig	90	13	0.54
Layer Hen	47	10	0.09
Broiler Chicken	26	8	1.24
Dairy Cow	27	7	0.50
Beef Cow	24	7	5.00
More than one type	6	2	11.20
Fish	6	3	3.53

Source: Clark et al., 2017.

Denver et al. (2017) conducted a WTP study to value Danish consumers' WTP for the provision of relative levels of animal welfare for pigs in pork production. The study was designed to assess consumers' WTP for trade-offs between standard, medium and high levels of animal welfare in production. Table A4 shows that there is a small difference between WTP for medium and high levels, with many consumers not willing to pay additional premiums to move beyond the medium level of animal welfare.

Table A4: Willingness-to-pay for animal welfare in relation to pork, Denmark (N=396)

Attribute Level	Market price premiums	Stated WTP for welfare pork	
		Respondents usually buying standard or medium level welfare pork	*Respondents usually buying high level welfare pork*
Standard	0%	Base (WTP not estimated)	
Medium (relative to standard)	17-75% higher	80% higher	170% higher
High (relative to medium)	14% higher	0% higher	15% higher

Source: Denver et al., 2017.

Risius and Hamm (2017) examined the effects of exposure to communication materials on German consumers' WTP for organic and animal husbandry attributes in relation to beef products. The authors tested consumer preferences and WTP for beef products before and after being shown communication materials regarding different animal husbandry and production methods. Prior to being shown material, participants indicated a preference for enhanced husbandry practices and organic production. Participants were then shown either an image film, a documentary film or a leaflet giving further information regarding each type of production method or husbandry practice (including organic production, extensive suckler cow husbandry and pasture-based husbandry). As shown in Table A5, following the presentation of this information, consumer preferences and WTP for each system changed based on the type of information presented.

Table A5: Willingness-to-pay (€) for organic and animal husbandry attributes following presentation of communication materials (image film, documentary film and leaflet), Germany (N=676)

Communication material	Attributes		
	Organic	*Extensive suckler cow husbandry*	*Pasture-based husbandry*
Image film	2.98	3.79	0.98
Documentary film	2.67	5.93	0.27
Leaflet	4.22	4.68	-0.31

Source: Risius and Hamm, 2017.

Kallas et al. (2019) used a discrete choice experiment to determine Spanish consumers' WTP for health-enhancing properties in pork patty products before and after a hedonic taste test of product types. Specifically, this involved innovative pork patty products with enhanced health claims through the addition of Porcini (added dietary fibre) and blueberries (added antioxidants). Initially, the researchers determined the "food neophobia" (degree of aversion to innovative food products) of the participants, subsequently segmenting participants into three groups – low, average and high food neophobic (LN, AN and HN respectively). WTP values were calculated prior to and following taste testings of each of the products, deriving

a range of premiums associated with each product – these are shown in Table A6 below. This showed a generally higher WTP for both traditional and innovative pork products by consumers with lower food neophobia, as well as a perceived higher WTP prior to tasting for those innovative products including blueberries over Porcini (Kallas et al., 2019).

Table A6: Willingness-to-pay (€) for traditional and innovative pork products before and after tasting, Spanish consumers (2018) (N = 121)

Segment	Product Type	WTP (€) Expected Before Tasting	WTP (€) Experienced After Tasting
Low Food Neophobia (LN) (n = 24)	Traditional Pork Product	3.87	4.31
	Innovative Pork Product 1 – Porcini	3.60	2.70
	Innovative Pork Product 2 – Blueberries	4.60	2.34
Average Food Neophobia (AN) (n = 41)	Traditional Pork Product	3.71	3.38
	Innovative Pork Product 1 – Porcini	3.50	2.79
	Innovative Pork Product 2 – Blueberries	3.71	1.86
High Food Neophobia (HN) (n = 55)	Traditional Pork Product	2.88	3.43
	Innovative Pork Product 1 – Porcini	2.88	2.41
	Innovative Pork Product 2 – Blueberries	3.34	1.89

Source: Kallas et al., 2019.

Calvo Dopico et al. (2016) examined European fish consumers' (Portugal, Spain, France, UK and Germany) preferences and WTP for the provision of traceability information with fish products. Table A7 shows that while around half of participants stated that they would not be willing to pay a premium for this (particularly Portuguese and Spanish participants).

Table A7: Willingness-to-pay for traceability programme, European countries

Country	Sample	WTP: No	WTP: Yes	WTP for traceability programme	
				Premium	*% participants*
Spain	410	262 (63.9%)	148 (36.1%)	€0–0.25	10.2
				€0.26–0.50	8.8
				€0.51–0.75	6.3
				€0.76–1	5.9
				€ > 1	4.9
UK	302	147 (48.68%)	155 (51.32%)	€0–0.25	9.93
				€0.26–0.50	18.87
				€0.51–0.75	9.27
				€0.76–1	7.28
				€ > 1	5.96
Portugal	728	553 (75.96%)	175 (24.04%)	€0–0.25	7.69
				€0.26–0.50	7.42
				€0.51–0.75	4.67
				€0.76–1	3.02
				€ > 1	1.24
France	335	160 (47.8%)	175 (52.2%)	€0–0.25	14.93
				€0.26–0.50	17.31
				€0.51–0.75	9.25
				€0.76–1	7.46
				€ > 1	3.28
Germany	300	126 (42%)	174 (58%)	€0–0.25	6.00
				€0.26–0.50	21.33
				€0.51–0.75	16.00
				€0.76–1	11.00
				€ > 1	3.67

Source: Calvo Dopico et al., 2016.

Hempel and Hamm (2015) examined German consumers' preferences and WTP for organic and local attributes across a range of food products, including beef steak, butter, apples and flour products. Based on a series of questions regarding preferences for organic and local products, the authors segmented participants into two groups – organic-minded consumers (OMC) and non-organic-minded consumers (NOMC). Table A8 shows differences in WTP for local and organic attributes between OMC and NOMC, with both groups indicating the highest WTP for local beef steak products (as opposed to 'from a neighbouring country')

Table A8: Willingness-to-pay (€) for organic and local attributes, Germany (N=638)

	Organic-minded consumers (N=221)			**Non-organic-minded consumers (N=427)**		
	Organic	*Local (as opposed to "from Germany")*	*Local (as opposed to "from a neighbouring country")*	*Organic*	*Local (as opposed to "from Germany")*	*Local (as opposed to "from a neighbouring country")*
Apples (/kg)	1.22	0.63	4.25	-0.13	0.17	2.07
Butter (/250g)	0.31	0.37	1.26	-0.01	0.12	0.56
Flour (/kg)	0.97	0.36	3.44	-0.03	0.23	1.28
Steak (/200g)	2.46	1.26	5.56	0.46	1.94	4.80

Source: Hempel and Hamm, 2015

Lagerkvist et al. (2017) examined Swedish consumers' WTP for a range of credence attributes in relation to beef products using a discrete choice experiment. Attributes included country-of-origin labelling, traceability to various parts of the supply chain, animal health and welfare, human health, social responsibility, and production methods. As shown by Table A9 below, participants indicated a range of positive WTP values for all attributes, particularly to move from basic to slightly improved levels (e.g. Price 1 to Price 2) (Lagerkvist et al., 2017).

Table A9: Willingness-to-pay (SEK) for a range of attributes in beef products (discrete price level), Sweden (N=440) (base price=200 SEK/kg)

Attribute	**Price 2: 225 SEK/kg**	**Price 3: 250 SEK/kg**	**Price 4: 275 SEK/kg**	**Price 5: 300 SEK/kg**	**Price 6: 325 SEK/kg**
Reference code	2.09	0.79	0.42	0.28	0.23
Traceability to specific slaughterhouse	1.46	0.55	0.30	0.20	0.16
Traceability to group or specific animal	2.00	0.75	0.41	0.27	0.22
Traceability to specific breeder	1.49	0.56	0.30	0.20	0.17
Animal welfare	2.89	1.09	0.59	0.39	0.32
Animal medication used for preventative purposes	2.52	0.95	0.51	0.34	0.28
Organic production	2.03	0.76	0.41	0.28	0.22
Environmental impact	1.68	0.63	0.34	0.23	0.19
Health impact	1.71	0.64	0.35	0.23	0.19
Social responsibility	1.96	0.74	0.40	0.27	0.22
Type of animal feed used	1.44	0.54	0.29	0.20	0.16

Source: Lagerkvist et al., 2017.

Balcombe et al. (2016) examined UK consumers' WTP for country-of-origin, production methods, product quality and certification attributes in 12 types of poultry, beef, pork and sheep meat products. Table A10 presents mean estimates of WTP for the range of products and attributes mentioned above. Results show that participants were willing to pay a premium for each of the attributes across most products, with negative WTP uniformly shown for products of non-UK origin.

Table A10: Mean willingness-to-pay (£) for a range of attributes in meat products, UK (N=2,951 – approx. N=490 per choice experiment)

Product Type	**Attributes**							
	*Choice**	*Premium**	*Organic*	*UK Origin*	*EU Origin*	*Origin Outside EU*	*Freedom Food Label*	*Intl. Quality Label*
Pork sausages (/450g)	0.17	1.08	0.91	0.84	-0.27	-0.73	0.33	0.87
Pork joint (/1.5kg)	0.46	2.40	2.62	3.15	-1.09	-2.28	1.68	2.42
Beef lasagne (/600g)	0.87	2.55	1.92	1.68	-1.0	-0.71	0.96	1.68
Bacon (/300g)	0.35	0.88	0.93	0.67	-0.62	-1.04	0.6	0.85
Beef burger (/450g)	0.49	1.02	0.67	0.65	-0.77	-0.86	0.48	0.85
Chicken curry (/400g)	0.4	1.45	1.29	1.16	-0.41	-0.87	0.52	1.19
Leg lamb (/1.5kg)	0.5	1.69	2.03	2.85	-2.62	0.03	1.68	1.43
Chicken breasts (/500g)	0.63	1.4	2.06	2.23	-0.38	-1.99	1.41	1.7
Pepperoni pizza (/14" pizza)	0.51	1.59	1.48	0.91	-0.95	-0.5	1.35	1.31
Chicken pie (/550g)	0.43	1.37	1.02	0.72	-0.86	-0.76	0.55	1.18
Gammon steaks (/225g)	0.52	1.44	1.06	1.59	-0.64	-1.31	0.8	0.75
Turkey mince (/400g)	0.32	1.05	1.21	1.12	-0.14	-1.01	0.69	1.03

**Choice* refers to improved product quality from the base product; *premium* refers to the top level of product quality.
Source: Balcombe et al., 2016.

Tait et al. conducted several studies of UK consumer preferences and willingness to pay for lamb leg product attributes, including those from New Zealand (Tait et al., 2020c; 2022e; 2022f). In their first study, Tait et al. (2020c) examined UK consumer preferences for lamb leg attributes, including aspects of environmental management, production systems, country-of-origin and ethical attributes. Three consumer groups were identified, comprising

approximately 20 per cent (Group 1), 20 per cent (Group 2) and 60 per cent (Group 3) of the sample respectively. The range of premiums that UK lamb consumers indicated they were willing to pay for various lamb leg attributes are shown in Table A11 below.

Table A11: Consumer WTP (average) for lamb leg attributes, United Kingdom, 2019 (n=~1,000)

	Group 1	Group 2	Group 3
Water quality protection		8%	6%
Organic			14%
Enhanced animal welfare	14%	8%	14%
No GM feed	13%	10%	15%
100% grass fed	21%	25%	34%
100% pasture raised	12%	18%	22%
No added antibiotics		20%	24%
No added growth hormones	18%	21%	24%
Produced in New Zealand	46%	21%	16%
Produced on Māori farms		34%	34%
Produced in Scotland	28%	34%	42%
Produced in Wales	37%	46%	47%
Produced in England	41%	52%	48%

Source: Tait et al., 2020c.

In a follow-up study, Tait et al. (2022e) repeated their study of UK consumer preferences and WTP for lamb leg attributes, specifically during the COVID-19 pandemic. Similarly, three consumer groups were identified, comprising approximately 46 per cent (Group 1), 39 per cent (Group 2) and 15 per cent (Group 3) of the sample respectively. The range of premiums that UK lamb consumers indicated they were willing to pay for various lamb leg attributes are shown in Table A12 below.

Table A12: Consumer WTP (average) for lamb leg attributes, United Kingdom, 2020 (n=~1,000)

	Group 1	Group 2	Group 3
Water quality protection	17%	6%	10%
Organic	17%	21%	
Enhanced animal welfare	20%	20%	
Carbon neutral		13%	
Biodiversity protection			16%
No GM feed	22%	22%	14%
100% grass fed	25%		
100% pasture raised	26%	24%	10%
No added antibiotics	30%	25%	
No added growth hormones	40%		
Produced in New Zealand		42%	31%
Produced on Māori farms	50%	43%	
Produced in England	74%	40%	27%
Produced in Wales		34%	21%
Produced in Scotland	21%	46%	

Source: Tait et al., 2022e.

In a further study of UK lamb consumer preferences and WTP, Tait et al. (2022f) examined consumer WTP for New Zealand lamb leg products. Three distinct consumer segments were identified in this study, including *environmentally engaged* (those who most highly valued environmental attributes), *cultural consumers* (those who most positively valued Māori production), and *natural necessary* (those who most highly valued a range of "natural"

attributes, such as 100% grass fed). The study examined lamb leg attributes related to environmental condition (carbon neutral, water quality protection, biodiversity enhancement), production methods (organic farming system, no added antibiotics, no added growth hormones, 100% pasture raised, no GM feed, 100% grass fed), and ethical and cultural attributes (enhanced animal welfare, Māori farming system). Table A13 below shows the range of premiums that identified UK consumer segments would be willing to pay for the selected lamb attributes. This shows that those in the *environmentally* segment valued key environmental and ethical attributes the highest, including carbon neutral (33 per cent premium), enhanced animal welfare (32 per cent premium), and biodiversity enhancement (29 per cent premium). Those in the *cultural consumers* segment indicated the highest WTP for Māori farming systems (17 per cent premium), as well as a range of environmental and production attributes. Furthermore, those in the *natural necessary* segment indicated WTP for a broad range of attributes, but particularly production system attributes, including 100% grass fed (27 per cent premium), no GM feed (15 per cent premium), and 100% pasture raised (15 per cent premium) (Tait et al., 2022e).

Table A13: Consumer WTP (average) for New Zealand lamb leg attributes, United Kingdom, 2021 (n=~1,000)

	CONSUMER SEGMENTS		
	Environmentally Engaged	Cultural Consumers	Natural Necessary
No added antibiotics	17%	9%	12%
No added growth hormones	15%		12%
Enhanced animal welfare	32%		11%
Māori farming system	13%	17%	
Organic farming system	15%	5%	
Water quality protection	9%	5%	
100% pasture raised	23%	4%	15%
Biodiversity enhancement	29%	22%	
Carbon neutral	33%	18%	
No GM feed	9%		15%
100% grass fed	20%		27%

Source: Tait et al., 2022f.

Gorton et al. (2023) estimated UK consumer WTP for the inclusion of an animal welfare label on chicken meat products (320g pack of chicken breasts), using a discrete choice experiment (DCE) approach. Specifically, the authors examined WTP for two specific quality assurance labels (*Red Tractor* and *RSPCA Assured*), as well as "cause-related cues" or images that described aspects of animal production, including *planting meadows* (an image of a chicken in a green field with accompanying text reading "we are planting meadows on our farms", and *farmer* (an image of a female farmer in overalls standing in a field with the accompanying text "Alison, one of our farmers"). Results are shown in Table A14 below. This shows a positive WTP for all attributes (excluding the absence of cues), particularly the *planting meadows* cause-based cue, followed by the presence of an *RSPCA Assured* logo, suggesting a relative preference among participants for animal welfare attributes in chicken products (Gorton et al., 2023).

Table A14: Consumer WTP values for 320g chicken breast product with associated quality assurance (labels) and cause-related (images) cues, UK (n=35)

Category	Cue	WTP (£)
Quality assurance cues (labels)	None	- £1.77
	Red Tractor	£0.77
	RSPCA Assured	£0.99
Cause-related cues (images)	None	-£1.28
	Planting meadows	£1.08
	Farmer	£0.20

Source: Gorton et al., 2023.

Duckworth et al. (2022) examined UK consumer WTP for a range of salmon and chicken products with sustainability packaging labels, including the attributes *sustainably sourced*, *locally sourced*, *environmentally friendly*, and *low greenhouse gas emissions*, employing a contingency valuation (CV) and multilevel modelling (MLM) approach. The study found that UK consumers would be willing to pay an approximate additional £0.11 premium for identical products containing a "green message" of any kind included on packaging, with participants choosing products with the *sustainably sourced* and *locally sourced* labels approximately 20 per cent more frequently, and an approximate additional £0.04 premium for these attributes (Duckworth et al., 2022).

Kallas et al. (2015) designed a study using a simulated market setting to assess the impact of a possible ban on surgical castration of pigs in the EU. This study also included a sensory parameter by including a scent and taste test between two CEs. As Table A15 shows, participants were willing to pay a small amount for the welfare attribute while the sensory impact resulted in some differences in WTP estimates, such as the WTP for flavour attribute changing from a negative to a positive WTP of 0.66 euros/package (55% premium) after exposure to product tasting. The results also show that participants' WTP was lower for the manufacturer's own brand compared to the private brand.

Table A15: Willingness-to-pay for pork sausage attributes, Spain (N= 150*)

		Pre Sensory CE		Post sensory CE	
		WTP €/package	*Premium (%)**	*WTP €/package*	*Premium (%)**
Flavour (vs. Original/ non-flavoured)	With spices and naturally smoked	-0.558	(-47%)	0.660	(55%)
Castration (vs. none)	Meat from castrated pigs or boars	0.340	(29%)	-	-
Brand (vs. manufacturer)	Private	-0.252	(-21%)	-0.342	(-29%)

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
*Compared to the average of the applied price vector: €1.19/package
Source: Kallas et al. (2015)

Deely et al. (2022) examined Spanish consumers' WTP for beef products that have been produced using more environmentally friendly land management approaches, namely those without the use of uncontrolled land burning practices. The authors found that the average

WTP for no-burn Pasiego beef per kilogram was €24.88, with bids ranging between €23.19 and €27.55. In addition, the average participant indicated that they would be willing to pay an 84 per cent price premium for this attribute, equating to €11.31 more per kilogram of beef with these credentials (Deely et al., 2022).

Animal welfare was also included in the Zanoli et al. (2013) investigation of consumers' beef product preferences in Italy. In particular, the study contrasted animal welfare with production methods, origin and quality indicators (e.g. fat content and colour). Table A16 shows that organic and domestic attributes had the highest relative WTP of between 24 and 26 euros/kg (109% and 206% of base price) respectively (Zanoli et al., 2013).

Table A16: Willingness-to-pay for beef attributes, Italy (N = 145*)

		WTP €/kg	Premium (%)**
Production method (vs. not organic)	Organic	26.25	(109%)
Production method (vs. not conventional)	Conventional	12.76	(106%)
Animal welfare (vs. Box)	Free-range	17.29	(144%)
Place of production (vs. abroad)	Italy	24.69	(206%)
Breed origin (vs. not local)	Local	6.40	(53%)

* Data were gathered from three different locations (medium-sized towns) in northern, central and southern Italy, in 2008.
** Compared to the basic prices reported in study: €24/kg for the organic beef attribute, and €12/kg for other attributes
Source: Zanoli et al. (2013)

Van Loo et al. (2014) combined different environmental and ethical attributes in a CE of chicken products, segmenting participants into income brackets. The attributes were presented in different logos, labels and claims associated with production, with CE results showing a consumer preference for product labels or claims over not having them at all. As Table A16 shows, average WTP is higher for free-range claims (43-93%), with respondents also favouring the introduction of domestic or EU-organic logos, carbon footprint and animal welfare labels.

Table A16: Willingness-to-pay for chicken breast attributes, Belgium (N = 359*)

Attributes		WTP euros/kg	Premium (%)**	WTP euros/kg	Premium (%)**
		Low income		*High Income*	
Organic logo (vs. none)	Biogarantie logo (Belgium)	2.16	(23%)	3.18	(34%)
	EU Organic logo	1.16	(12%)	1.70	(18%)
Animal welfare label (vs. none)	European animal welfare label	2.50	(26%)	3.67	(39%)
Free range claims (vs. none)	Free range	4.12	(43%)	6.06	(64%)
	Traditional free range	4.77	(50%)	7.02	(74%)
	Free range-total freedom	5.99	(63%)	8.81	(93%)
Carbon footprint label (vs. none)	20% CO2-reduction: 5.6 kg CO2e compared to 7 kg CO2	1.73	(18%)	2.54	(27%)
	30% CO2-reduction: 4.9 kg CO2e compared to 7 kg CO2	2.31	(24%)	3.40	(36%)

* Online survey conducted in the northern Belgium, 2012.
** Compared to the average price for conventional chicken breast in Belgium in 2012 (€9.49/kg)
Source: Van Loo et al. (2014)

Viegas et al. (2014) estimated Portuguese consumers' WTP for animal welfare in the context of testing whether premiums paid for credence attributes can justify higher associated production costs. Specifically, the authors hypothesised that WTP for a particular attribute (e.g. animal welfare) is conditional on the presence of other attributes (e.g. environmental quality and/or food safety). The reference alternative included legal minimums and a status quo price. As shown in Table A17 below, the estimated WTP suggests that the highest value was placed on food safety, ranging from 7-16 euros/kg, followed by animal welfare and environmental protection. An important implication was that the WTP for different combinations of attributes should not be obtained from independent valuation and summation due to significant interaction effects. The authors then applied a conditional approach on estimating attribute WTP (Table A17, last column) whereby, for example, the WTP for food safety in the presence of both animal welfare and environmental certification decreases the average WTP (from up to 16 euros to negative or close to zero). This suggests that animal welfare and environmental attributes may be proxies for food safety.

Table A17: Willingness-to-pay for beef attributes, Portugal (N = 613)

Attribute	**Levels**	**Average WTP €/kg (premium %*)**		**Conditional WTP** €/kg (premium %*)**		
		main effects	*main + interaction effects*			
Beef safety (vs. legal standards)	Certified additional level: Reduction/control of the quantity of antibiotic residues in beef	7.31 (42%)	16.23 (93%)	AW =0 ENV = 0 AW = 1 ENV = 0 AW = 0 ENV = 1 AW = 1 ENV = 1	16.23 7.47 7.32 -1.43	(93%) (43%) (42%) (-8%)
Animal welfare (vs. legal standards)	Certified additional level	7.30 (42%)	12.07 (69%)	FS = 0 FS = 1	12.08 3.32	(69%) (19%)
Environmental Protection (vs. legal standards)	Certified additional level: Air, water, soil pollution and reduction/ prevention	4.81 (28%)	7.35 (42%)	FS = 0 FS = 1	7.35 -1.55	(42%) (-9%)

*Compared to average of the applied price vector (€17.98/kg)
** 1 indicates the condition, zero otherwise: AW = Animal Welfare; ENV = Environmental Protection; FS = Food Safety
Source: Viegas et al. (2014)

Gracia (2014) investigated Spanish consumers' WTP for local lamb products using a simulated market environment with an additional objective of reducing the risk of hypothetical bias in the results. The results shown in Table A18 indicate that consumers are willing to pay a premium of between 9 and 13 per cent for local and "Ternasco" lamb, respectively, over unlabelled or "suckling" lamb, respectively.

Table A18: Willingness-to-pay for fresh local lamb attributes, Spain (N = 133)

Attribute		*WTP €/package*	*(Premium %)*
Locally grown label (vs. unlabelled)	Labelled as "Ojinegra from Teruel"	0.29	(9%)
Type of commercial lamb (vs. *"Suckling" lamb*)	"Ternasco" lamb	0.43	(13%)

Source: Gracia, 2014.

Van Wezemael et al. (2014) conducted a European cross-country study exploring consumer preferences and WTP for nutrition and health claims in relation to beef steak. The study tested an information/framing effect in a split-sample approach wherein one sample was shown attributes with nutritional claims only (N sample) and other sample were shown both nutritional and health claims together (NH sample). The results from Table A19 suggest that the valuation of nutritional and health claims varies across countries. Across samples, the NH sample had consistently higher WTP, with the exception of a "rich in protein" claim in the UK. This indicated the existence of country-specific marketing opportunities when considering nutrition and health claims on beef products, such as information regarding product protein levels in the UK.

Table A19: Willingness-to-pay for beef steak attributes, Belgium, France, The Netherlands and UK (N = 600/country*)

N sample			WTP €/kg	Premium (%)**
Iron (vs. no claim)	Nutritional claim: "Source of iron"	Netherlands	5.44	(33%)
		Belgium	4.26	(26%)
		France	4.11	(25%)
		UK	5.04	(31%)
Protein (vs. no claim)	Nutritional Claim: "'Rich in protein''	Netherlands	2.71	(16%)
		Belgium	3.42	(21%)
		France	4.96	(30%)
		UK	5.81	(35%)
Saturated fat (vs. no claim)	Nutritional Claim: ''poor in saturated fat''	Netherlands	5.78	(35%)
		Belgium	5.60	(34%)
		France	6.73	(41%)
		UK	1.20	(7%)
NH sample				
Iron (vs. no claim)	Nutritional claim: "Source of iron" Health Claim: ''Iron contributes to the normal cognitive function''	Netherlands	5.62	(34%)
		Belgium	5.89	(36%)
		France	5.49	(33%)
		UK	4.27	(26%)
Protein (vs. no claim)	Nutritional Claim: "'Rich in protein'' Health Claim: ''Protein contributes to the growth or maintenance of muscle mass.''	Netherlands	4.22	(26%)
		Belgium	6.20	(38%)
		France	9.70	(59%)
		UK	4.39	(27%)
Saturated fat (vs. no claim)	Nutritional Claim: ''poor in saturated fat'' Health Claim: "Consumption of saturated fat increases blood cholesterol concentration. Consumption of foods with reduced amounts of saturated fat may help to maintain normal blood cholesterol concentrations.''	Netherlands	8.45	(51%)
		Belgium	11.66	(71%)
		France	11.71	(71%)
		UK	4.60	(28%)

***** Online survey in 2011 with people consuming beef at least once a month.
**Compared to average of the applied price vector (€16.5/kg)
Source: Van Wezemael et al. (2014)

In Sweden, Lagerkvist et al. (2014) focused on COO and ethical cues in the presence or absence of price attribute, the differences of which should not (in theory) impact on the preferences and structural validity of CE. A large of range attributes with quality and ethical cues were included in the study (see Table A20) where the absence of labelling information was used as a reference point. In addition, a non-parametric test was used to confirm attribute ranking by consumers. A sample of over 1,000 participants completed the survey. The WTP results in

Table A15 are only reported for that part of the sample who saw the CE with the price vector (required for WTP calculation). These results show that consumers were willing to pay an average 10% premium for a verified SR labelling in beef products – approximately four times lower than COO information. COO was also found to be the top ranked attribute in both samples. In regards to the comparison between the inclusion and exclusion of price attributes, one of the results indicated that there was consistently less heterogeneity in the CE without the price attribute.

Table A20: Willingness to pay for beef attributes, Sweden (N = 1,070*; n = 630 "no-price sample" and n = 440 "price sample")

		"Price sample"		**"Price sample"**	**"No-price sample"**
		WTP SEK/kg	*Premium (%)***	*Attribute ranking*	
Origin Information (vs. zone of origin inside or outside EU)	COO (inside or outside EU)	113.7	43%	1	1
Animal specific Reference code (vs. not present)	Information on package	15.0	6%	12	12
Traceability to specific slaughterhouse (vs. not present)	Information on package	32.0	12%	6	6
Traceability to group or specific animal (vs. not present)	Information on package	29.5	11%	7	9
Traceability to specific breeder (vs. not present)	Information on package	32.6	12%	5	4
Verified animal welfare for livestock production (vs. not present)	Information on package	42.1	16%	1	1
Organic production (vs. not present)	Information on package	37.0	14%	4	5
Verified Environmental impact of livestock production (vs. not present)	Information on package	25.6	10%	9	8
Verified health impact from consumption of beef production (vs. not present)	Information on package	21.5	8%	10	10
Verified social responsibility for livestock production (vs. not present)	Information on package	27.4	10%	8	7
Information about medication use (vs. not present)	Information on package	41.2	16%	3	3
Type of animal feed (vs. not present)	Information on package	18.4	7%	11	11

* Online survey in 2012 amongst beef consumers.

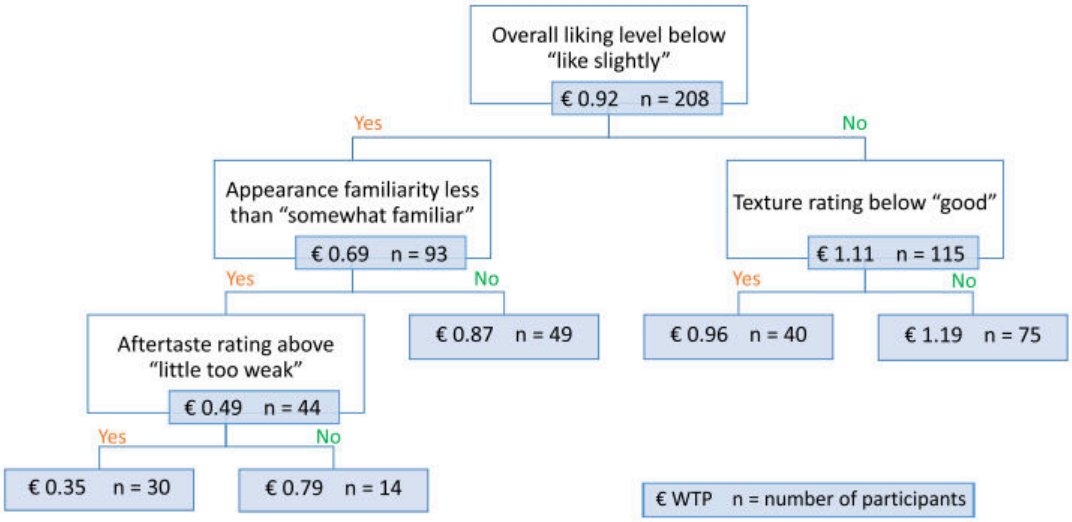
**compared to the average of the applied price vector: 262.5 SEK per kg

Source: Lagerkvist et al. (2014)

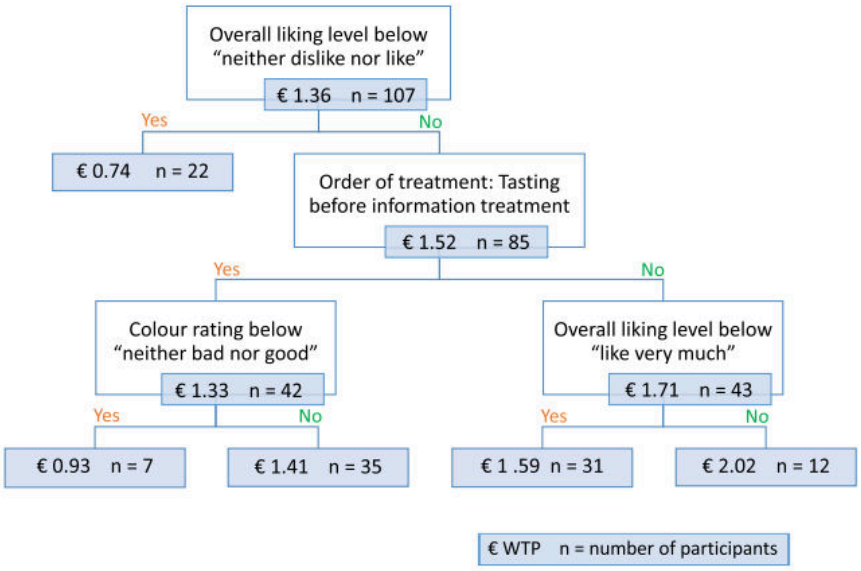
Paci et al. (2018) examined Italian consumers' WTP for the inclusion of environmental and health attributes in fresh fish burger products, finding a WTP of up to an additional 0.57 Euro for the "environment" attribute and 0.37 Euro for the "health" attribute.

Hung and Verbeke (2018) conducted a WTP analysis of the sensory attributes of cooked sausage and cooked ham in Belgium and the Netherlands respectively. They found that WTP was positively influenced by a higher overall liking, appearance familiarity and a better colour, and negatively influenced by a stronger experience of aftertaste and darker colour. Figure A21 shows a pruned regression tree to highlight relative WTP for attributes.

Figure A21: Pruned regression tree showing willingness to pay for sensory attributes of cooked sausage from Belgium (n=208), and cooked ham from the Netherlands (n=107).



Pruned regression trees for predicting the WTP for new cooked sausage in Study 1 (Belgium (BE), n = 208). Complexity parameter (Cp) = 0.0283; cross-validated error = 0.853.



Pruned regression trees for predicting the WTP for new cooked ham in Study 2 (the Netherlands (NL), n = 107). Complexity parameter (Cp) = 0.0245; cross-validated error = 0.822.
Source: Hung and Verbeke (2018)

Dudinskaya et al. (2021) conducted a large scale willingness to pay study for red meat (beef, lamb, and goat) attributes across seven countries (Finland, France, Greece, Italy, Spain, Turkey and the UK). The authors received 2866 valid survey responses, with Beef T-bone, goat chops, lamb chops, and lamb leg cuts the selected cuts in the discrete choice experiment. Results showed that national origin was important to consumers, being one of the most important attributes. New Zealand was used as a reference for origin and EU origin was viewed as preferable to New Zealand meat, with the exception of the UK. Table A22 shows the estimated WTP for all countries in the study.

Table A22: Estimated WTP for red meat label attributes for seven European countries: Finland (n=413); France (n=414); Germany (n=400); Italy (n=417); Spain (n=417); Turkey (n=391); and UK (n=414). In local coin.

Estimates	Countries						
	FI (EUR)	FR (EUR)	GR (EUR)	IT (EUR)	ES (EUR)	TR (TRY)	UK (GBP)
LL[a]	-6587.84	-6864.38	-6984.07	-7018.80	-7071.07	-6696.65	-6858.30
BIC[b]	13,379.88	13,933.02	14,171.57	14,242.03	14,346.58	13,596.18	13,920.87
Adj. Rho-square	0.1711	0.1385	0.0928	0.1255	0.119	0.11	0.1392
Mean estimates (normal distribution)							
Halal	-0.693 (0.011)	-2.041 (0.000)	0.183 (0.493)	-0.542 (0.008)	-1.335 (0.000)	13.230 (0.000)	-0.713 (0.001)
National origin	2.277 (0.000)	3.737 (0.000)	2.299 (0.000)	3.052 (0.000)	2.584 (0.000)	11.070 (0.000)	0.433 (0.038)
EU origin	0.636 (0.022)	1.695 (0.000)	0.082 (0.783)	0.557 (0.018)	1.068 (0.002)	-0.993 (0.575)	0.143 (0.449)
PGI/PDO	0.035 (0.895)	0.357 (0.138)	0.973 (0.000)	0.815 (0.000)	0.472 (0.058)	6.857 (0.000)	0.302 (0.032)
Carbon footprint	0.330 (0.056)	0.495 (0.015)	0.412 (0.027)	-0.032 (0.827)	0.516 (0.022)	3.853 (0.001)	0.047 (0.681)
Organic	0.839 (0.000)	2.058 (0.000)	1.265 (0.000)	0.657 (0.000)	0.463 (0.036)	4.458 (0.000)	0.491 (0.004)
Low fat	0.330 (0.102)	1.134 (0.000)	0.181 (0.245)	0.554 (0.002)	0.357 (0.069)	0.242 (0.856)	0.137 (0.310)
High protein	-0.332 (0.049)	-0.147 (0.496)	-0.147 (0.011)	0.183 (0.257)	-0.150 (0.405)	-3.048 (0.001)	-0.136 (0.260)
Ready to cook	0.310 (0.101)	-0.705 (0.043)	-0.816 (0.000)	-0.200 (0.287)	-1.300 (0.000)	-1.646 (0.222)	-0.285 (0.097)
Standard deviations estimates (normal distribution)							
Halal	2.634 (0.000)	6.167 (0.000)	2.746 (0.000)	1.920 (0.000)	3.802 (0.000)	20.804 (0.000)	2.613 (0.000)
National origin	3.350 (0.000)	4.050 (0.000)	3.296 (0.000)	3.561 (0.000)	3.545 (0.000)	21.133 (0.000)	0.231 (0.826)
EU origin	1.105 (0.029)	1.421 (0.002)	1.803 (0.000)	0.185 (0.013)	2.273 (0.001)	11.164 (0.000)	0.009 (0.981)
PGI/PDO	0.407 (0.337)	0.361 (0.594)	0.893 (0.020)	0.667 (0.000)	0.784 (0.194)	5.862 (0.007)	0.514 (0.220)
Carbon footprint	0.250 (0.755)	1.180 (0.000)	1.536 (0.000)	0.768 (0.015)	1.495 (0.000)	8.220 (0.000)	0.388 (0.047)
Organic	2.101 (0.000)	3.065 (0.000)	1.731 (0.000)	0.987 (0.000)	2.065 (0.000)	6.354 (0.000)	1.449 (0.000)
Low fat	1.562 (0.000)	1.322 (0.000)	1.084 (0.000)	1.264 (0.000)	1.363 (0.000)	4.309 (0.084)	1.019 (0.000)
High protein	0.358 (0.101)	0.914 (0.088)	1.015 (0.019)	-0.083 (0.550)	0.545 (0.074)	0.979 (0.569)	0.194 (0.361)
Ready to cook	1.846 (0.000)	3.302 (0.000)	1.752 (0.000)	2.004 (0.000)	4.043 (0.000)	3.431 (0.001)	1.879 (0.000)

Numbers in parentheses are robust p-values. a LL: Value of Log Likelihood function b BIC: Bayesian information criterion.

North American studies

The current review includes eight CE and other WTP studies examining the attributes of meat and seafood products in the US. Attributes examined in these studies include animal health and/or welfare, organic, different production methods, traceability, country-of-origin, food safety, environmental condition and certification, as well as generic attributes including product quality and appearance.

Li et al. (2016) examined US consumers' household WTP for a programme aimed at reducing Greenhouse Gas (GHG) emissions associated with beef production. The authors created four consumer segments based on their willingness to support a programme certifying "carbon-friendly" beef products – '*does not support*', '*supports but will not pay more*', '*supports and will pay more*', and '*willing to pay specific premium for certified beef*'. For the latter two segments combined, results indicated that participants in these segments would be willing to pay an average US$306 per year to support this programme (equating to 51.6 per cent of their average annual total beef product spend). Across all segments, including those that would not support this programme, average annual WTP was valued at US$64 (just over 10 per cent of all participants' average annual total beef product spend). Average WTP was also shown to be higher for participants that donated to environmental organisations (Li et al., 2016).

Merritt et al. (2018) undertook a choice experiment to examine US consumers' WTP for a range of beef product attributes, including quality assurance, region of origin and various production practices, as well as a combination of these attributes. Specifically, these attributes were *Tennessee Certified Beef*, *Certified Angus Beef*, *grass-fed*, *Master Quality Raised Beef* and *no hormones administered*. In addition, WTP estimates were carried out for two types of beef products – USDA Choice boneless ribeye beef steak, and USB Choice ground beef (85% lean/15% fat). Furthermore, participants undertaking a choice experiment for either product were evenly distributed into either a control treatment (who were shown no additional information about the attributes of each product) or an information treatment (who were shown additional information about the attributes of each product). Estimates of WTP for each attribute within and between each of the above groups is shown in Table A23 and A24 below. Both tables show a generally higher WTP for all attributes by those in the Information Treatment segment, with the highest overall WTP for both product types across both segments to be for a combination of *Tennessee Certified Beef (TCB)* and *grass-fed* attributes (Merritt et al., 2018).

Table A23: Willingness-to-pay for USDA Choice boneless ribeye beef steak product attributes (USD ($) per pound (lb)) (2018) (N = 408 total)

Attribute	Control Treatment (n = 204)	Information Treatment (n = 204)	WTP Treatment Difference
Tennessee Certified Beef (TCB)	2.42	2.89	0.47
Certified Angus Beef (CAB)	1.19	1.43	0.24
Grass-fed	0.95	1.43	-0.48
Master Quality Raised Beef (MQRB)	1.39	1.67	0.28
No hormones administered	2.35	2.71	0.37
TCB and CAB	2.51	3.36	0.85
TCB and grass-fed	3.93	3.56	-0.37
TCB and MQRB	2.62	3.67	1.05
TCB and No hormones administered	4.37	3.28	-1.10

Source: Merritt et al., 2018.

Table A24: Willingness-to-pay for USDA Choice ground beef (85% lean/15% fat) product attributes (USD ($) per pound (lb)) (2018) (N = 408 total)

Attribute	Control Treatment (n = 204)	Information Treatment (n = 204)	WTP Treatment Difference
Tennessee Certified Beef (TCB)	1.15	1.53	0.38
Certified Angus Beef (CAB)	0.41	0.73	0.33
Grass-fed	0.81	0.59	-0.22
Master Quality Raised Beef (MQRB)	0.65	0.91	0.26
No hormones administered	1.27	1.59	0.33
TCB and CAB	1.29	1.61	0.31
TCB and grass-fed	1.76	1.98	0.21
TCB and MQRB	1.45	1.72	0.27
TCB and No hormones administered	1.63	2.41	0.78

Source: Merritt et al., 2018.

Byrd et al. (2017) examined US consumers' WTP for a range of attributes associated with chicken and pork products, including local production, animal welfare and food safety. These attributes were also assessed against a range of certifying bodies, including the USDA, retailers and industry bodies. Table A25 shows a range of premiums that participants were willing to pay in relation to the above, with results indicating the highest positive WTP for pasture access for chicken, particularly when certified by the USDA.

Table A25: Willingness-to-pay for chicken and pork products with associated local, animal welfare and food safety attributes, US (N=825) (US$/lb)

Attribute	Verifier	Chicken breast		Pork chop	
		WTP	*% positive WTP*	*WTP*	*% positive WTP*
Pasture access	USDA	1.78	91.7		
	Retailer	1.47	92.7		
	Industry	1.43	82.3		
Individual crate	USDA			1.98	84.0
	Retailer			0.27	45.5
	Industry			2.34	72.6
Antibiotic use	USDA	1.87	75.0	4.55	85.7
	Retailer	1.33	74.3	1.32	61.7
	Industry	1.11	61.7	1.17	70.0
Local	USDA	2.06	89.6	1.44	9.4
	Retailer	0.49	68.9	1.31	9.9
	Industry	0.49	59.7	3.37	3.9

Source: Byrd et al., 2017.

In another pork CE, Ubilava et al. (2011) compared US consumers' WTP for the *certification* of credence attributes for branded and non-branded products. Selected credence attributes included antibiotic use, animal welfare and environmental friendliness in the production process where, in a split-sample, some CEs also included a product brand (*Hormel, Tyson, Store brand* or *no brand*). Table A26 reports the WTP results which range from 4 to 28 per cent (0.2 to 1 $/lb) for certified antibiotic-free, environmentally-friendly and animal welfare attributes. The study also reported a greater variation in WTP for the non-branded case, which could be related to an increased uncertainty when no brand information is provided; while it also appears that the attributes as *bundles* (i.e. attribute interactions) influenced consumer preferences.

Table A26: Willingness-to-pay for pork chop attributes, USA (N = 839*: brand CEs n = 642, non-brand CEs n = 197)

		Choices with brands		Choices without brands	
	By brand	*WTP $/lb*	*Premium (%)***	*WTP $/lb*	*Premium (%)***
3rd party certified antibiotic-free production (vs. no certification)	Hormel	0.78	22%	0.63	18%
	Tyson	0.35	10%		
	Store Brand	0.61	18%		
	No brand	0.98	28%		
3rd party certified environment-friendly production: water and air quality (vs. no certification)	Hormel	0.76	22%	0.24	7%
	Tyson	0.26	7%		
	Store Brand	0.15	4%		
	No brand	0.32	9%		
3rd party certified animal welfare in the production process (vs. no certification)	Hormel	0.58	17%	0.42	12%
	Tyson	0.41	12%		
	Store Brand	0.18	5%		
	No brand	0.67	19%		
ANTI*ENV	Tyson	0.45	13%	0.37	11%
	Store Brand	0.25	7%		
ANTI*WEL	Hormel	0.37	11%	0.31	9%
	Tyson	0.40	12%		
	Store Brand	0.29	8%		
ENV*WEL	Tyson	0.35	10%	0.48	14%
	Store brand	0.54	16%		
	No brand	0.37	11%		

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
ANTI = antibiotic-free production; ENV = environment-friendly production; WEL = animal welfare
* A mail survey in 2004 with a sample of 9,600 randomly selected households.
** Compared to the average of the applied price vector: US$ 3.475/lb
Source: Ubilava et al. (2011)

Similarly, Paudel et al. (2022) examined US consumer WTP for pork chops produced with different levels of antibiotics, different production methods, and the use of synthetic growth promoters, using a discrete choice experiment (DCE) approach. Specifically, the study examined participants' preferences regarding either *minimal antibiotic use* (disease treatment), *conventional antibiotic use* or *no antibiotic use*, as well as *pasture-raised* or *confinement* production methods, and whether synthetic growth promoters had been used in production. The DCE was conducted using two sub-samples – an *information treatment* (in which participants received additional information about antibiotic and synthetic growth promoters use, as well as different production methods) and a *control treatment* (in which participants received comparatively minimal information). Results are shown in Table A27 below. This shows that those in the information treatment group generally exhibited higher positive and negative WTP values for the range of attributes relative to those in the control treatment group, suggesting that exposure to information about these production practices influenced WTP in this instance (Paudel et al., 2022).

Table A27: US consumer WTP (US$ per pound) for pork chops produced using different levels of antibiotics, different production systems, and synthetic growth promoters (n=660)

	Control treatment (n = 328)	*Information treatment (n = 332)*
Conventional use of antibiotics	$0.51*** [$0.19, $1.16]	$0.51*** [$0.20, $1.54]
Minimal use of antibiotics	$0.66*** [$0.34, $1.42]	$1.27*** [$1.47, $2.95]
Antibiotic-free	$2.88*** [$3.10, $4.57]	$3.46*** [$4.73, $7.25]
Confinement production method	-$1.07*** [-$0.87, -$1.91]	-$1.29*** [-$1.42, -$2.89]
Pasture-raised production method	$2.33*** [$2.44, $3.84]	$2.38 [$3.10, $5.21]
Use of synthetic growth promoters	-$1.19*** [-$1.00, -$2.09]	-$1.06*** [-$1.17, -$2.39]
No use of synthetic growth promoters	$1.16*** [$0.93, $2.20]	$1.19*** [$1.25, $2.97]
Neither	-$4.92*** [-$5.25, -$7.99]	-$3.27*** [-$4.19, -$7.27]
Price	-$0.77*** [-$0.62, -$0.91]	-$0.60*** [-$0.46, -$0.73]

***Statistical significance at 1 per cent.
Source: Paudel et al., 2022.

In the United States, Lim et al. (2014) focused on the valuation of COO information alongside trade-offs such as quality (e.g. tenderness), production practices (use of hormones and antibiotics), food safety (identified by testing and/or traceability), and price of beef. A nationwide survey was conducted with a sample size of 1000. WTP was only estimated for the COO attribute, either independently or taking into account the respondent specific attitudes toward food safety[1]. The results in Table A28 show that, on average, consumers preferred domestic beef, with negative WTP shown for imported products indicating a compensation of around $5-$7/lb to achieve these levels. A further analysis show that, ceteris paribus, COO preferences were related to the perceived food-safety level of the country. For example, consumers who had a high risk perception or distrust about the safety of Australian products were willing to pay less for imported beef from Australia, or that people who were risk-averse in regards to food safety had an overall lower WTP for imported products.

Table A28: Willingness-to-pay for beef attributes, USA (N = 1,000*)

Attribute	Levels	WTP US$/lb	Premium (%)**
Country of Origin (vs. USA)	Canada	−5.75	(-53%)
	Australia	−7.33	(-68%)

* A nationwide online survey in 2010.
** Compared to average (USD 10.75) from a vector of low-to-high-end actual market prices
Source: Lim et al. (2014)

[1] General food safety attitudes and perceptions were explored in a Likert scale question.

Van Loo et al. (2011) assessed US consumers' WTP for different organic label types on chicken products. Their analysis focused not just on average WTP but also WTP by different consumer segments based on the purchase-frequency of organic meat ('*non-buyers'*, '*occasional buyers'*, and '*habitual buyers'*) and on demographics (gender, age, education, household income and number of children). Table A29 shows positive premiums for both types of organic labelling, with higher premiums associated with the USDA organic label ($3.6/lb or 104% premium) over the generic label ($1.2/lb or 35%). Further analysis showed that WTP differs between demographic groups as well as between different organic buyers. Most respondents (59%) were occasional buyers; around one fourth of the respondents had never bought organic chicken; and only a small group of respondents (15%) bought organic chicken always or often. As expected, the premiums that consumers were willing to pay for organic chicken increased by the frequency of purchase. Consumer WTP estimated for each demographic group showed, for example, that females had a higher WTP than males, and that having more children reduced WTP, while higher income increased WTP for products with organic labels.

Table A29: Willingness-to-pay for chicken meat attributes, USA (N = 256 non-buyer, N = 571 occasional buyers, N = 149 habitual buyers)

		WTP full sample $/lb	Premium (%)**	By the type of buyer	WTP $/lb	Premium (%)**
Label (vs. no label)	USDA organic label	3.55	(104%)	Non-buyer Occasional Habitual	0.90 3.33 8.37	(26%) (97%) (244%)
	Generic organic label	1.19	(35%)	Non-buyer Occasional Habitual	-1.01 1.22 5.02	(-30%) (36%) (147%)

*Online survey amongst the members of a consumer database in Arkansas.
** Compared to the average price for boneless chicken breast ($3.424/lb)
Source: Van Loo et al. (2011)

Compared to meat products, consumer preferences towards the credence attributes of seafood products is relatively unexplored. In United States, Ortega et al. (2014) explored consumer WTP for imported seafood products for which past food contamination and adulteration incidents may have impacted on consumer preferences for Chinese tilapia. Two surveys were conducted (for shrimp and Chinese tilapia products) with 335 respondents each. The corresponding CEs included a variety of credence attributes: COO (US, China and Thailand) information was considered only for shrimps and the verification entity (US government, Chinese Government, US Third Party) was considered only for Chinese tilapia. The estimation process included attribute interactions between the credence attributes and COO for shrimps, and between credence attributes and verification entity for Chinese tilapia. The results in Table A30 shows that consumers were willing to pay more for enhanced food safety: $10.65/lb for domestic shrimp, $3.71/lb shrimp from China, and $4.12/lb shrimp from Thailand. The respective premiums were 118 per cent, 41 per cent and 46 per cent. A similar relationship was found for no-antibiotic use and environmentally friendly production, which were both associated with a higher WTP for the US product by US consumers.

WTP assessments for Chinese Tilapia, as presented in Table A31, show that consumers were, on average, willing to pay between $4 and $6 per pound (or 89-120 per cent of the base price) for enhanced food safety when verified by a US entity. Likewise for no-antibiotic use and environmental friendly production claims, the only statistically significant evidence was associated with US verification bodies. Overall, the government verification system was

valued slightly higher relative to third-party verification. These results are consistent with the shrimp CE results wherein US consumers had a higher WTP for domestic over overseas seafood products and verification systems (Ortega et al., 2014).

Table A30: Willingness-to-pay for seafood (shrimps) attributes, USA (N = 335*)

			WTP $/lb	*Premium (%)***
Food safety (vs. no claim)	Enhanced	US product	10.65	(118%)
		Chinese product	3.71	(41%)
		Thai product	4.12	(46%)
Antibiotic use (vs. permitted)	Not permitted	US product	9.83	(109%)
		Thai product	2.84	(32%)
Production practice (vs. conventional)	Eco-friendly	US product	5.40	(60%)

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* An online survey in 2011.
** Compared to average of the applied price vector (US$9/lb)
Source: Ortega et al. (2014)

Table A31: Willingness-to-pay for seafood (imported tilapia) attributes, USA (N = 335*)

			WTP $/pound	*Premium (%)***
Food safety (vs. no claim)	Enhanced	US government verified	6.02	(120%)
		US third party verified	4.43	(89%)
Antibiotic use (vs. permitted)	Not permitted	US government verified	5.39	(108%)
		US third party verified	2.75	(55%)
Production practice (vs. conventional)	Eco-friendly	US government verified	2.67	(53%)

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* An online survey administered by a market research company in 2011.
** Compared to the lowest given price option ($5.00/pound) in the price vector
Source: Ortega et al. (2014)

Asian studies

The current review includes ten CE and other WTP studies examining the attributes of meat and seafood products in Asia, including the markets of China, Japan, Korea and India. Attributes examined in these studies include animal health and/or welfare, organic, different production methods, traceability, country-of-origin, food safety, environmental condition, certification, water use and GM production, as well as the generic attributes of product quality and appearance.

In Asia, Tait et al. (2020a) examined Beijing (China) consumer preferences and WTP for a range of attributes associated with beef tenderloin products. The choice experiment highlighted three distinct beef tenderloin consumer groups in Beijing representing 71 percent, 17 per cent, and 12 per cent of those surveyed respectively. Table A32 shows the results of the WTP analysis, broken down by consumer group.

Table A32: Consumer WTP for attributes of New Zealand beef tenderloin products (% of product price), Beijing, China, 2019 (n=1,001)

	Group 1	Group 2	Group 3
Organic	15%		30%
Enhanced animal welfare	8%		
GMO-free	19%		
Carbon neutral	21%	70%	
Biodiversity enhancement	24%		
Water quality protection		42%	
Feedlot raised	94%	74%	
100% pasture raised	17%	37%	
No added antibiotics			
No added hormones	16%	8%	20%
Social responsibility		30%	
Traceability		13%	20%
100% grass-fed	111%		8%
Grain-fed	8%		
Chilled	9%	55%	
Fresh	13%	48%	
Raised in China	56%		
Raised in Australia	42%	135%	
Raised in USA	43%		
Raised in Argentina	33%		53%
Raised in NZ	52%		99%
Raised on Māori farms in NZ	22%	45%	98%

Source: Tait et al., 2020a.

In a follow-up to the above study, Tait et al. (2022b) also examined Beijing (China) consumer preferences and WTP for a range of attributes associated with New Zealand beef tenderloin products. Three distinct consumer segments were identified in this study, including *animal attentive* (those focused on animal-based production attributes), *cultural consumer* (those who positively valued Māori production), and *organic oriented* (those with a stronger preference for organic production). The study examined beef product attributes related to environmental condition (carbon neutral, biodiversity enhancement, water quality protection), production methods (organic production, feedlot raised, 100% pasture raised, 100% grass fed, grain-fed, no added antibiotics, no added hormones, GMO-free), and social, ethical and cultural attributes (Māori production, enhanced animal welfare, social responsibility). Table A33 below shows the range of premiums that identified Beijing consumer segments would be willing to pay for selected attributes of beef tenderloin products. This shows that those in the *animal attentive* segment value a broad range of attributes, but particularly those related to animal production (i.e. type of feed, no additives). Similarly, those in the *cultural consumer* segment also value a range of attributes, indicating a positive premium for Māori production and 100% grass-fed products. Furthermore, those in the *organic oriented* segment indicated a strong preference for organic production (116 per cent premium), biodiversity enhancement (95 per cent premium) and GMO-free (89 per cent) (Tait et al., 2022b).

Table A33: Consumer WTP for attributes of New Zealand beef tenderloin products (% of product price), Beijing, China (n=~1,000)

	CONSUMER SEGMENT		
	Animal Attentive	Cultural Consumer	Organic Oriented
Carbon neutral	27%		
Biodiversity enhancement	28%		95%
Water quality protection	22%	23%	
Organic production	14%	33%	116%
Māori production		48%	
Feedlot raised	53%	54%	
100% pasture raised	38%	25%	
100% grass fed		40%	
Grain-fed	35%	32%	
No added antibiotics	30%	18%	66%
No added hormones	42%	26%	
Enhanced animal welfare	17%		31%
GMO-free	17%	11%	89%
Social responsibility	11%	15%	37%

Source: Tait et al., 2022b.

Wu et al. (2015) explored consumer preferences and WTP for a traceability and certification information for pork meat. The sample consisted of consumers in seven Chinese cities that had been designated by the China Ministry of Commerce as pilot cities for a meat and vegetable traceability system. Each respondent was classified by their level of income and education, which was used in the WTP analysis. As shown in Table A34, estimated WTP across the full sample ranged from 2.31 Yuan/kg to 15.80 Yuan/kg (or 19% to 32% premiums) for the different product attributes. The provision of product traceability information had the highest WTP (ranging from 42% to 91% premiums of base price) for the full traceability over no information. Only those consumers with low income/education level were willing to pay for the minimum level of traceability information. Likewise, regarding quality certification, most consumers were willing to pay more (ranging from 104% to 149% premiums of base price) for government certification over no certification. The high profile consumers were the only group that valued third-party certification (over no certification), which is consistent with findings that higher education and income are related to the WTP for traceability certification (Zhang et al. 2012). It was also found that product freshness had a significant impact on respondents' meat choice preferences.

A separate consumer class-based analysis generated four distinct consumer classes based on the respondents' choices, thus further supporting the preference heterogeneity in the sample. These were labelled as '*certification-preferred*', '*price-sensitive*', '*appearance-preferred*' and '*scared*' consumers, whereby the first class included over half of the respondents. Overall, the findings presented in Table A35 complement those presented above, including that WTP for quality certification appears slightly higher than for others, apart from the '*appearance preference*' class; and that there are obvious class-specific preferences. The '*scared*' class was different to the others in that they preferred the possibility to opt-out in the given alternatives. Furthermore, for this class, no WTP values are reported here (as the price attribute was not statistically significant) (Wu et al., 2015).

Table A34: Willingness-to-pay for pork attributes, China (n=1,489)

Attribute		WTP full sample yuan/500g (premium %**)	WTP by age and income/education level yuan/500g (premium %**)				
				High	*Medium*	*Low*	*High income Low education*
Traceability Information *** (vs. none)	Full	8.32 (69%)	Age = 35	10.95 (91%)	7.94 (66%)	6.70 (56%)	9.44 (79%)
			Age = 45	9.78 (82%)	6.76 (56%)	5.53 (46%)	8.26 (69%)
			Age = 60	8.01 (67%)	5.00 (42%)	- -	6.49 (54)%
	Partial	5.72 (48%)	Age = 35	8.13 (68%)	5.72 (48%)	5.00 (42%)	7.96 (66%)
			Age = 45	7.96 (66%)	5.55 (46%)	4.83 (40%)	7.78 (65%)
			Age = 60	7.71 (64%)	5.29 (44%)	4.57 (38%)	7.43 (62%)
	Minimum	2.31 (19%)	Age = 45	-	-	2.29 (19%)	- -
			Age = 60	-	-	2.84 (24%)	-
Quality Certification (vs. no certification)	Government	13.83 (115%)	Age = 35	11.35 (95%)	14.01 (117%)	15.16 (126%)	12.84 (107%)
			Age = 45	12.42 (104%)	15.09 (126%)	16.23 (135%)	13.92 (116%)
			Age = 60	14.04 (117%)	16.70 (139%)	17.85 (149%)	15.53 (129%)
	Domestic third-party	15.80 (132%)	Age = 35	11.22 (94%)	10.12 (84%)	10.33 (86%)	13.17 (110%)
			Age = 45	10.19 (85%)	9.09 (76%)	9.30 (78%)	12.15 (101%)
			Age = 60	8.64 (72%)	7.54 (63%)	7.75 (65%)	10.60 (88%)
	International third-party	-	Age = 35	12.03 (100%)	-	-	-
			Age = 45	10.86 (91%)	-	-	-
			Age = 60	9.11 (76%)	-	-	-
Appearance (vs. Bad-looking but edible)	Very fresh-looking	13.74 (115%)					
	Fresh-looking	11.34 (95%)					
	Passable-looking	-					

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.

* In-store intercept interviews, in 2013, in seven cities across different regions of China.

**Compared to the average price of pork hindquarters (12 yuan/500g) as reported in the study

*** Full traceability information covering farming, slaughter and processing, circulation and marketing; Partial traceability information covering farming, slaughter and processing; Minimum traceability information covering only farming.

Source: Wu et al. (2015)

Table A35: Willingness-to-pay for pork attributes, China (N = 1,489)

Attribute		Class 1* *certification-preferred*	Class 2* *price-sensitive*	Class 3* *appearance-preferred*	Class 4* *scared consumers*
	Class probability	52.7%	12.6%	20.8%	13.9%
		WTP Yuan/500g (premium %**)			
Traceability Information *** (vs. none)	Full	5.24 (44%)	-	3.40 (28%)	-
	Partial	2.68 (22%)	0.50 (4%)	2.37 (20%)	-
	Minimum	-1.30 (-11%)	-	-	-
Quality Certification (vs. no certification)	Government	8.82 (74%)	0.78 (7%)	3.05 (25%)	-
	Domestic third-party	6.28 (52%)	-	2.71 (23%)	-
	International third-party	4.06 (34%)	0.54 (5%)	3.64 (30%)	-
Appearance (vs. Bad-looking but edible)	Very fresh-looking	5.16 (42%)	0.69 (6%)	10.95 (91%)	-
	Fresh-looking	4.76 (40%)	-	9.49 (79%)	-
	Passable-looking	-4.18 (-35%)	-	-6.21 (-52%)	

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* In-store intercept interviews, in 2013, in seven cities across different regions of China.
**Compared to the average price of pork hindquarters (12 yuan/500g) as reported in the study
*** Full traceability information covering farming, slaughter and processing, circulation and marketing; Partial traceability information covering farming, slaughter and processing; Minimum traceability information covering only farming.
Source: Wu et al. (2015)

Wu et al. (2016) examined Chinese consumers' WTP for the provision of traceability information in relation to pork products using real choice experiments (RCE) and experimental auctions (EA). In particular, the authors examined WTP for different types of traceability information, including farming, slaughter and processing, distribution and marketing, and government certification information against a base of a pork product without traceability information. Consistent with previous studies, Table A36 shows that mean WTP was positive but varied between the two methods used (RCE and EA) and the types of information provided, with consumers showing higher WTP across both experiments for government certification information and farming information (Wu et al., 2016).

Table A36: Willingness-to-pay for traceability information in relation to pork, China (N=108)

Information Type	Mean WTP (Yuan/500g) *(95% confidence interval)*	
	RCE	*EA*
Farming information	4.375	2.405
Slaughter and processing information	1.565	1.215
Distribution and marketing information	1.071	0.735
Government certification information	4.934	2.785

Source: Wu et al., 2016.

Lai et al. (2018) used a series of choice experiments to determine Chinese consumers' (Beijing and Shanghai) WTP for a range of attributes of pork products, including environmental, food safety and animal welfare standards, as well as country of origin. Results showed a range of premiums associated with different attributes, as shown in Table A37 below. This shows generally higher WTP for all attributes from Shanghai participants, with *food safety*, *Chinese*

origin and *environmental standards* having the highest associated WTP values (Lai et al., 2018).

Table A37: Willingness-to-pay for pork product certification attributes by Chinese consumers (Beijing and Shanghai) (2018) (N = 480 total)

Attribute	Mean WTP (RMB) – Beijing (N = 259)	Mean WTP (RMB) – Shanghai (N = 221)
Food Safety	32.01	32.32
Animal Welfare	7.65	13.11
Environmental Standards	11.81	20.73
Country of Origin: United States	4.31	9.61
Country of Origin: China	13.26	30.11

Source: Lai et al., 2018.

Wang et al. (2018) used a discrete choice experiment to determine urban Chinese consumers' WTP for pork products with certified attributes. Specifically, this included certified labels for organic production, green food production, food safety, location of origin, and free from veterinary drug residues. Choice experiments were carried out in two Chinese provinces (Jiangsu and Anhui) with results reported for each – these are shown in Table A38 below. This shows a greater WTP for all attributes by Jiangsu consumers, with generally higher WTP for *organic food*, followed by *green food* and *free from veterinary drug residues* across both provinces.

Table A38: Willingness-to-pay for pork certification attributes, Jiangsu and Anhui provinces, China (2018) (Yuan/550g)

Attribute	Jiangsu (N = 475)	Anhui (N = 369)
Safe Food	8.10	7.21
Green Food	20.22	17.63
Organic Food	26.78	18.94
Location of Origin shown	12.77	10.99
Free from veterinary drug residues	23.18	15.40

Source: Wang et al., 2018.

Ortega et al. (2015) explored consumer preferences and WTP for chicken, pork and egg product attributes across various retail channels in China. Retail channel types included wet markets, domestic supermarkets, and international supermarkets, wherein the products may vary in terms of food safety and other attributes such as animal welfare, organic, "green" foods and price. Three hundred consumers were interviewed for each food product (pork, chicken and eggs) with an equal number of participants from each retail channel. Results presented in Table A39 show that while consumer WTP for food safety was mostly similar across the different retail channels, with premiums from 165 per cent to 267 per cent compared to the base price, these varied across product types. "Green food" certification was valued higher (up to 20 RMB/product or 195% premium) than organic certification across all products and retailers. Some differences across retail types can be observed for the WTP for the animal welfare attribute as this was significant only for pork and chicken products and not for wet markets.

Table A39: Willingness-to-pay for chicken, pork and eggs attributes, China (N= 300/product*)

		Pork		Chicken		Eggs	
		WTP RMB/product			*Premium (%)***		
Enhanced food safety claim (vs. no claim)	Wet market	27.73	(213%)	19.94	(199%)	9.93	(199%)
	Domestic supermarket	23.68	(182%)	26.69	(267%)	9.58	(192%)
	International supermarket	25.50	(196%)	21.45	(215%)	8.23	(165%)
Animal welfare claim (vs. no claim)	Wet market	-	-	-	-	-	-
	Domestic supermarket	7.36	(57%)	-	-	-	-
	International supermarket	-	-	-	-	2.28	(46%)
Organic certification (vs. no claim)	Wet market	-	-	-	-	3.28	(66%)
	Domestic supermarket	11.48	(88%)	15.44	(154%)	5.37	(107%)
	International supermarket	12.11	(93%)	-	-	3.89	(78%)
Green food claim (vs. no claim)	Wet market	-		-		5.07	(191%)
	Domestic supermarket	11.79	(91%)	19.69	(197%)	6.76	(135%)
	International supermarket	19.29	(148%)	16.27	(163%)	6.63	(133%)

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
***** In-store (at the point of purchase) interviews in Beijing, 2013.
**Compared to average of the applied price vector (pork: RMB 13/jin, chicken: 10 RMB 10/jin and eggs:, and RMB 5/jin
Source: Ortega et al. (2015)

Yin et al. (2022) examined Chinese consumers' WTP for food safety attributes in white shrimp. Specifically, the study examined WTP for a range of food safety-related attributes, including the presence or absence of organic certification, traceability information, brand, or geographical indicators, as well as types maricultural production (marine water aquaculture or fresh water aquaculture). Marginal WTP estimates were based on a price of US$5.50 per 500g. The study identified six groups of participants based on attribute non-attendance (ANA), or those participants that ignored one particular attribute – Group 1 (non-ANA); Group 2 (ANA organic label); Group 3 (ANA traceability information); Group 4 (ANA brand); Group 5 (ANA geographic information), and; Group 6 (ANA production methods). Table A40 below reports marginal WTP values (percentage of product premium) for different white shrimp attributes by participant group. This shows a range of premiums that consumers in each group would be willing to pay for these attributes, including an organic label (14.20-30.61%), traceability information (12.85-36.61%), brand (8.41-26.46%), geographical indications (8.01-28.63%), and marine water aquacultural production methods (5.26-16.18%) (Yin et al., 2022).

Table A40: Consumer marginal WTP for white shrimp attributes, China (n=556)

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Organic label	26.22%	14.20%	30.61%	21.98%	19.34%	26.32%
Traceability information	29.48%	36.61%	13.20%	33.90%	27.93%	21.20%
Brand	18.39%	19.92%	26.46%	8.41%	25.79%	20.04%
Geographical indication	12.95%	21.89%	16.83%	28.63%	11.08%	10.95%
Marine water aquaculture	12.95%	7.38%	16.18%	15.09%	15.91%	5.35%

Source: Yin et al., 2022.

Chung et al. (2012) focused on heterogeneity in WTP for beef attributes. Countries-of-origin of interest included Korea (i.e. domestic), USA and other exporting countries (e.g. New

Zealand). They conducted 1,000 interviews amongst Korean consumers, with heterogeneity of preferences and WTP explored using a consumer segment-based approach. As Table A41 shows, the analysis resulted in three consumer segments based on the respondent's choices regarding concerns in relation to GM-beef and the use of antibiotics in production. These segments were labelled as '*very concerned*' (59% of the sample), '*moderately concerned*' (32%) and the smallest group of '*not too concerned*' (9%). Thus, over half of the sample were very concerned about the use of GM and antibiotics with WTP around $4.4/lb (20 per cent premium), and about product's origin with WTP around -$8/lb (37 per cent premium) for imported meat. This '*very concerned*' segment held generally higher WTP values than other segments, and generally these were higher than the weighted averages. Overall, these results suggest that there exists major heterogeneity in Korean (Seoul) consumer preferences towards meat choices, in particular, regarding the use of GM ingredients and antibiotics in production.

Table A41: Willingness-to-pay for beef attributes, Korea (N = 1,000*)

		Very Concerned	**Moderately Concerned**	**Not too Concerned**	
Class probability		59%	32%	9%	
		WTP $/lb Premium (%)**			**Weighted Average WTP US$/lb Premium (%)****
Marbling Grade (vs. C)	Extra premium	3.01 (13%)	1.58 (7%)	0.88 (4%)	2.35 (7%)
	Premium	2.13 (9%)	1.05 (5%)	0.93 (4%)	1.67 (7%)
Marbling Grade (vs. not A)	A	2.04 (9%)	0.91 (4%)	0.62 (3%)	1.55 (7%)
Marbling Grade (vs. not B)	B	0.92 (4%)	0.39 (2%)	-	0.66 (3%)
Freshness (vs. low)	High	2.94 (13%)	1.69 (8%)	1.14 (5%)	2.37 (11%)
	Medium	1.09 (5%)	0.76 (3%)	0.56 (2%)	0.93 (4%)
Chilled versus frozen (vs. yes)	No - freshly chilled	0.63 (3%)	0.53 (2%)	0.24 (1%)	0.56 (2%)
Free of antibiotics (vs. no)	Yes	4.39 (20%)	1.06 (5%)	0.81 (4%)	3.00 (13%)
Free of GM-feed ingredients (vs. no)	Yes	4.35 (19%)	0.95 (4%)	0.59 (3%)	2.92 (13%)
Country-of-origin (vs. Korea)	United States	-8.38 (-37%)	-3.74 (-17%)	-2.85 (-13%)	-6.39 (-28%)
	Other exporting countries	-7.25 (-32%)	-3.47 (-15%)	-2.19 (-10%)	-5.57 (-25%)

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* In-store intercept interviews in Seoul, 2007.
**Compared to the average of the applied price vector: US$ 22.50/lb
Source: Chung et al. (2012)

Uchida et al. (2014) examined Japanese consumer preferences for salmon, taking into account two-way interactions motivated by consumer valuations of different product attributes in

relation to ecolabel characteristics. The study included a split-sample CE across three types of information effects regarding fisheries (specifically overfishing and the decline of fish-stock): (1) minimal information without the source of the claim; (2) Food and Agriculture Organization (FAO) based information with charts and graphics; and (3) scientific information accompanied by a diagram. Hence, instead of using a conventional approach of "no information" vs. "some information", the authors applied minimum information as the baseline. Likert-scales were used to understand general attitudes, information credibility, and the respondents' level of interest. A nationwide survey included in total 3,370 responses. As shown in Table A42, Japanese consumers were willing to pay a 27 per cent premium (90 yen/package) for the domestic fish compared to imported fish, with a similar premium found for the ecolabel. Considering these attributes together, the WTP was 149 yen/package which is slightly less than sum of the independent WTP values (90 + 89 = 179). Overall, the interaction effects revealed that the value of eco-labels increased value for the wild product, in particular for the domestic product. The findings from the information effect testing revealed that compared to baseline, added information increased the value of the eco-label, although marginally, when the FAO or science-based information were considered credible and interesting.

Table A42: Willingness-to-pay for salmon attributes, Japan (N = 3,370*: "minimal information" n = 1,122, "FAO information", n = 1,118, and "Science information" n = 1,130)

		*Premium (%)***
Product origin (vs. Chile)	Hokkaido (domestic)	(26%)
	Alaska	(8%)
	Norway	(7%)
Production (vs. farmed)	Wild	(10%)
Ecolabel (vs. no label)	Labeled	(26%)
Country of origin x Wild***	Ecolabel x Hokkaido	(44%)
	Ecolabel x Alaska	(27%)
	Ecolabel x Norway	(28%)
	Ecolabel x Wild	(37%)
	Hokkaido x Wild	(52%)
	Alaska x Wild	(36%)
	Norway x Wild	(37%)
Information treatments x Perceptions***	Ecolabel x FAO	22%
	Ecolabel x Science	20%
	Ecolabel x FAO x Credible	30%
	Ecolabel x Science x Credible	28%
	Ecolabel x FAO x Interesting	29%
	Ecolabel x science x Interesting	27%
	Ecolabel x FAO x Interesting	36%
	Ecolabel x Science x Interesting	34%

* A nationwide online survey in 2009.
**Reported in the study
***Base levels: Country of origin and wild: ''Chilean farmed salmon with no ecolabel"; and Treatments and perceptions: ''Minimal information perceived neither credible nor interesting''
Source: Uchida et al. (2014)

Other regions

The current review includes five CE and other WTP studies examining the attributes of meat and seafood products in other regions, including Australia, Peru and Lebanon. Attributes examined in these studies include animal welfare, local foods, production quality and certification.

Mugera et al. (2017) examined Australian consumers' WTP for chicken and yogurt products based on their preferences for a range of attributes, including local production, free range, product quality and the size of the producer. This was based on whether a product carried a local food label, was certified free range, or contained other information relating to the attributes listed. The authors examined WTP for a combination of the above attributes, as shown in Table A43. This also shows a range of additional premiums for each of the product types and attributes based on a range of demographic variables, including gender and type of area.

Table A43: Willingness-to-pay for chicken and yoghurt products based on local production, free range, size of producer (relative to medium) and demographic variables, Australia (N=333)

Attribute 1	Attribute 2	Demographic variable 1	Demographic variable 2	WTP for product type ($AUD)	
				Skinless chicken breast	*Fruit yoghurt*
Local	Australian firm				5.15
	Overseas firm				3.67
		City		6.16	
		Country		8.32	
Not local	Australian firm				3.84
	Overseas firm				2.36
		City		3.74	
		Country		5.91	
Free range		City	Female	5.86	
			Male	3.77	
		Country	Female	4.27	
			Male	2.17	
Small producer				1.55	2.64
Large producer				-1.84	-2.8

Source: Mugera et al., 2017.

Chalak and Abiad (2012) studied Lebanese consumers' preferences and purchasing behaviour in context of shawarma sandwiches[2], a Lebanese fast food, which is considered to contain a high potential for food safety risk. The study attributes included food safety certification (International Organization for Standardization [ISO] and "ServSafe" food handling program), and contextual factors such as location, serving size and price. The sample included 284 respondents, wherein the information-effect was tested in a split-sampling approach by providing half of the sample with additional descriptions of each type of safety certification. WTP results, as summarised in Table A44, suggest that, overall, consumers appreciated the convenience in buying sandwich from "around the corner", and that they also preferred to pay extra 46 per cent for larger sandwich size (around US$1.12 (LBP 1,677)). The information effect was apparent in this study, as this increased the average WTP for food safety certification from a 282 to 314 per cent premium to a 320-431 per cent premium compared

2 "Shawarma is a Middle Eastern beef, lamb or chicken-based fast food" (Chalak and Abiad 2012 p. 82).

with the average price of a small sandwich. WTP for certification was highest for the ISO 22000 type.

Table A44: Willingness-to-pay for sandwich attributes, Lebanon (N = 284*: informed n = 145, uninformed n = 139)

	Levels		WTP LBP/sandwich	Premium (%)**
Location/ Convenience (vs. Round the corner < 5 min walk)	Within walking distance (5+ min walk)		-445	(-12%)
	Need to go there by car		-4,181	(-115%)
	Delivery order		-1,009	(-28%)
Certification (vs. none)	ISO 9001	Uninformed	10,278	(282%)
		Informed	11,667	(320%)
	ISO 22000	Uninformed	11,466	(314%)
		Informed	15,719	(431%)
	ServSafe	Uninformed	1 0,372	(284%)
		Informed	14,366	(394%)
Portion size (vs. Typical small-sized sandwich)	Medium-sized sandwich		1,677	(46%)

LBP = Lebanese pounds; US$1 = LBP1,515

* The survey was conducted in Beirut, 2011, excluding participants who had never purchased shawarma sandwiches.

** Compared to an average of LBP3,650 (USD2.41) for a small-sized shawarma sandwich

Source: Chalak and Abiad (2012)

Morales and Higuchi (2018) investigated how consumer beliefs about health and nutrition affect the WTP more for fish than beef, chicken, and pork in Modern Metropolitan Lima, Peru. Factors explored were all in relation to fish, *exploring knowledge, health and nutrition, familiarity, taste preference, negative effects, and price*. Based upon this it was found that higher household income increases premiums for beef and chicken, while larger household sizes had the opposite effect. In addition, those who were older were less likely to be willing to pay a premium for fish. Taste preference was a significant driver for an increase in WTP for fish versus chicken and pork, while perceptions of health and nutrition for the family increased the WTP for fish compared to beef and chicken. A summary of the WTP extra is shown in Table A45.

Table A45: Willingness to pay for fish versus other meat in Peru (N=444)

	Model I: Fish vs. beef		**Model II: Fish vs. chicken**		**Model III: fish vs. pork**	
	Coef.	FC/OR	Coef.	FC/OR	Coef.	FC/OR
Constant	1.625***	5.078***	1.628***	5.094***	2.200***	9.025***
Socio-demographic characteristics						
Gender	0.055	1.057	0.106	1.111	0.018	1.018
Age	0.002	1.002	0.004	1.005	0.000	1.000
Years of education	0.017	1.017	0.028*	1.028*	0.005	1.005
Have children	0.056	1.057	-0.090	0.914	0.133	1.142
Household size	-0.036	0.964	-0.063*	0.939*	-0.099***	0.906***
Household income (in hundred PEN)	0.005***	1.005***	0.005*	1.005***	0.003	1.003
Belief factors						
BF1: Knowledge of fish	0.019	1.019	0.056	1.057	0.043	1.044
BF2: Health and nutrition of eating fish	0.082*	1.086*	0.103**	1.109**	0.026	1.026
BF3: Familiarity with fish	0.030	1.030	-0.010	0.990	0.053	1.054
BF4: Taste preference of fish	0.032	1.032	0.086**	1.090**	0.174***	1.190***
BF5: Negative affects of fish	0.001	1.001	0.003	1.003	0.030	1.031
BF6: Price of fish	-0.036	0.964	-0.036	0.965	-0.020	0.980
Over dispersion coefficient	-1.078***		-0.962***		-1.154***	
Mean willingness to pay extra (PEN)	7.214		8.777		5.732	
Total observations	444		444		444	

PEN = Sol. The currency of Peru; USD 1 = PEN 4.06

FC/OR is factor change in the expected premium/odds ratio of being an always-zero respondent versus being a non-always-zero respondent for the negative binomial and logistic components, respectively. *, **, and *** indicate the coefficient is statistically significant at 10%, 5% and 1% level, respectively.

Source: Morales and Higuchi (2018)

Hastie, Ashman, Torrico, Ha and Warner (2020) compared perceptions towards sheepmeat and beef in Australia. The authors used a mixed methods approach combining perceptual mapping and sensory methodologies. Whilst not the CE method, the research offers an interesting comparison of dry-aged and wet-aged meat, as well as different animal species within a WTP framework. In terms of sensory perceptions, the authors asked consumers about *tenderness, overall liking, flavour, juiciness, odour liking, quality, healthiness, and premiumness*. Concentrating on quality, the authors combined WTP and likelihood to purchase for dry-aged and wet-aged meat, as shown below in Table A46. Wet-aged beef was most likely to be rated as “better than everyday quality”, while the dry-aged beef was most likely to be rated as “good everyday quality”. This pattern was also seen in sheepmeat consumption. On average, consumers were willing to pay up to 50–60 AUD per kg for premium quality beef, and 30–40 AUD per kg for premium quality sheepmeat, with prices decreasing with quality grade (Hastie et al., 2020).

Table A46: Willingness to pay and Likelihood to Purchase based on quality and price, Australia (n=75)

Meat Species	Quality Grade	Relative frequency of quality grade selection (%)		Median price category (AUD Per kg)	Average likelihood of purchasing (%)
		Dry-aged	Wet-aged		
Sheep	Unsatisfactory	0	3	0-10	16
	Good everyday quality	47	22	20-30	53
	Better than everyday quality	33	56	30-40	53
	Premium quality	19	19	30-40	58
Beef	Unsatisfactory	3	8	10-20	32
	Good everyday quality	42	21	20-30	58
	Better than everyday quality	25	44	30-40	66
	Premium quality	31	28	50-60	67

Source: Hastie et al (2020)

Tait et al. (2022c) examined United Arab Emirates' (UAE) consumer preferences and WTP for New Zealand beef mince product, eliciting a range of premiums across a range of product attributes. Three distinct consumer segments were identified in this study, including *cultural consumer* (those who most valued Māori production), *carbon concerned* (those who positively valued carbon neutral), and *feedlot focused* (those who most positively valued the feedlot raised attribute). The study examined beef mince product attributes related to environmental condition (carbon neutral, water quality protection), production methods (organic production, feedlot raised, 100% pasture raised, 100% grass fed, grain-fed, no added hormones, no added antibiotics, GMO-free), and social, ethical and cultural attributes (Māori production, enhanced animal welfare, social responsibility). Table A47 below shows the range of premiums that identified UAE consumer segments would be willing to pay for selected attributes of beef mince products. This shows that those in the *cultural consumer* segment value Māori production the highest of all identified segments, with a willingness to pay high premiums for a range of attributes, particularly those relating to production processes. On the other hand, those in the *carbon concerned* segment showed a positive WTP for carbon neutral beef mince products, as well as a broad range of other attributes. Furthermore, those in the *feedlot focused* segment indicated WTP only for select production-based attributes, including feedlot raised (40 per cent premium), 100% pasture raised (28 per cent premium) and GMO-free (24 per cent) (Tait et al., 2022c).

Table A47: Consumer WTP for beef mince product attributes, United Arab Emirates (n=~1,000)

	CONSUMER SEGMENT		
	Cultural Consumer	Carbon Concerned	Feedlot Focused
Carbon neutral		23%	
Water quality protection	26%	15%	
Organic production	78%	11%	
Māori production	56%	13%	
Feedlot raised	92%		40%
100% pasture raised	60%	9%	28%
100% grass fed	55%		
Grain-fed	41%	16%	
No added hormones	70%	11%	
No added antibiotics	84%	21%	
Enhanced animal welfare	45%	19%	
GMO-free	43%	7%	24%
Social responsibility	41%	9%	

Source: Tait et al., 2022c.

Cross-regional studies

Tait et al. (2016) conducted a cross-country analysis between developed and developing economies (UK vs. China and India). The authors explored preferences across certified environmental attributes (GHG, biodiversity, and water quality), animal welfare, food safety, country-of-origin (COO) label and price in relation to lamb products. A generic framing on the product, including a percentage price increase, was used to make the cross-country comparison more straightforward. Results reported in Table A48 show that food safety, followed by animal welfare, appeared to be the most valued attributes with WTP values of between 9% and 49% more for a certified product. Another similarity across the countries was that of different environmental attributes, the GHG certification was valued most, although not by much. Key differences included that while UK consumers preferred domestic products, consumers in developing markets were not likely to choose the domestic product or pay for it. Another difference was that the Indian respondents had higher WTP for environmental attributes compared with UK and Chinese consumers. Overall, this study shows there can be cross-country differences when looking into food attribute preferences but also that similarities might exist, for example, in terms of which attributes are valued the highest (Tait et al., 2016).

Table A48: Willingness-to-pay for lamb attributes, China, India, UK (N = 2,067*: China *n* = 686, India *n* = 695 and UK *n* = 686)

		WTP (in %)**		
		China	*India*	*UK*
Food safety (vs. not certified)	Certified	34%	49%	15%
Farm animal welfare (vs. not certified)	Certified	9%	29%	18%
Water management (vs. not certified)	Certified	7%	21%	6%
Greenhouse Gas (GHG) minimisation (vs. not certified)	Certified	8%	28%	6%
Biodiversity enhancement (vs. not certified)	Certified	5%	26%	4%
Country of origin (vs. no label)	Domestic	-27%	-	5%
	Foreign	-	13%	-5%

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* Online survey in in 2012 with regular grocery shoppers who had purchased lamb at least once recently (last month). ** Reported in the study
Source: Tait et al. (2016)

A1.2 Dairy products

The current review includes eleven CE and other WTP studies examining the attributes of dairy products in Europe, North America and Asia. Attributes examined in these studies include country-of-origin, environmental condition, carbon/GHG emissions associated with production, local foods, organic, functional foods, product health claims, brand and food safety.

European studies

The current review includes four CE and other WTP studies examining the attributes of dairy products in Europe, including studies conducted in Germany, France, Italy, Norway, Spain and the UK. Attributes examined in these studies include country-of-origin, environmental condition, carbon/GHG emissions associated with production, local foods, organic, functional foods and product health claims.

Aichner et al. (2017) examined German consumers' WTP for ice cream and tea products based on their associated country-of-origin. The researchers selected an ice cream product from the USA with a Scandinavian name (Häagen-Dasz) as well as a German tea product with an English name (Milford) in order to gauge German consumers' WTP for the product(s) before and after their country-of-origin was revealed. Table A49 shows reductions in WTP for both product types following the reveal of the products' respective country-of-origin, including minimum, maximum and mean WTP ranges (Aichner et al., 2017).

Table A49: Willingness-to-pay for ice cream and tea products before and after COO information provided, Germany (N=100)

	Häagen-Dasz (ice cream)			Milner (tea)		
	Minimum (€)	*Maximum (€)*	*Mean (€)*	*Minimum (€)*	*Maximum (€)*	*Mean (€)*
Actual product price	4.99	5.99	5.05	1.85	2.39	1.89
WTP before COO was revealed	4.99	10.00	5.35	1.85	3.00	1.98
WTP after COO was revealed	2.00	6.50	4.48	0.90	2.50	1.74

Source: Aichner et al., 2017.

Feucht and Zander (2017) examined European consumers' (France, Germany, Italy, Norway, Spain and the UK) WTP for "climate-friendly" milk products (i.e. products with a lower carbon footprint), including products that displayed two types of CO_2 label, as well as product claims relating to "climate-friendliness", local production and organic production (EU organic label). Table A50 shows participants WTP for the inclusion of each of the above in relation to milk products, showing the highest indicated WTP for local production and organic production.

Table A50: Willingness-to-pay for milk products, environmental attributes, European countries (Euro per 1-litre UHT milk product)

	France (N=1,000)	**Germany (N=1,001)**	**Italy (N=1,003)**	**Norway (N=1,001)**	**Spain (N=1,002)**	**UK (N=1,000)**
CO_2 Label 1	0.11	0.13	0.24	0.14	0.14	0.10
CO_2 Label 2	0.03	0.03	0.09	0.00	0.11	0.06
"Climate friendly"	0.06	0.05	0.14	0.09	0.15	0.04
Local	0.19	0.20	0.27	0.27	0.15	0.15
Organic	0.12	0.10	0.23	0.14	0.16	0.09

Source: Feucht and Zander, 2017.

In Germany, Bechtold and Abdulai (2014) estimated consumer WTP for functional dairy products (yoghurt and cream cheese) by linking the choice data with demographics and general attitudes information. The choice alternatives were described as bundles of functional ingredients, health claims and product prices. The data included 1,309 responses where each respondent answering a CE for both yoghurt and cheese products. The data was analysed using the consumer segment based approach with the class determinants including the socioeconomic and attitudinal variables, the latter generated from principal component analysis (PCA). The results in Tables A51 and A52 show evidence for the class-specific preference heterogeneity when taking into account respondent attitudes, where the Class 2 was found with the most amount of statistically significant attitude and respondent-type associated determinants in relation to the reference group. For example, it was confirmed that "f*unctional food skeptics*" preferred non-functional dairy products, and vice versa by the "f*unctional food advocates*". Furthermore, the majority of consumers valued dairy products with functional ingredients, such as omega-3, highly. These WTP varied from €0.13 to €0.31/serving of yoghurt and €0.35/serving of cream cheese, or premiums of between 10 and 23 per cent (Bechtold and Abdulai, 2014).

Table A51: Willingness-to-pay for yoghurt attributes, Germany (N = 1,309*)

		Class 1*** Functional food sceptics	Class 2*** Functional food advocates	Class 3*** Functional food neutrals (reference group)
Class probability		(21.5%)	(40.5%)	(38%)
		WTP €/200g Premium (%)**		
Functional Food ingredient	Omega-3 fatty acids	0.31 (24%)	0.24 (19%)	0.13 (10%)
	Oligosaccharides	-	0.10 (8%)	0.11 (9%)
	Bioactive	-	-0.10 (-8%)	-0.11 (-9%)
	Polyphenols			
Non-functional alternative		0.47 (36%)	-1.77 (-137%)	-
Health claim	Healthy blood vessels.	-	-0.41 (-32%)	-0.13 (-10%)
	Healthy blood vessels and metabolism	-	0.23 (18%)	-0.08 (-6%)
	One property depending on the ingredient	-	-0.18 (-14%)	0.11 (9%)
	Two properties depending on the ingredient	-	-	-

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
***** Nationwide mail survey, 2010-2011.
**Compared to the base price for conventional non-functional food as provided in the study: €1.29/500g
***Class determinants: **Class 1** Reward from using Functional Foods (FF), Safety of FF, General health interest, Natural product interest, Hysteria; **Class 2** Age, Education, Reward from using FF, General health interest, Natural product interest, Hysteria, Necessity for FF, Specific health interest
Source: Bechtold and Abdulai (2014)

Table A52: Willingness-to-pay for cream cheese attributes, Germany (N = 1,309*)

		Class 1*** Functional food sceptics	Class 2*** Functional food advocates	Class 3*** Functional food neutrals (reference group)
Class probability		(24.8%)	(33.9%)	(41.3%)
		WTP €/200g Premium (%)**		
Functional Food ingredient	Omega-3 fatty acids	0.35 (23%)	0.35 (23%)	-
	Oligosaccharides	-	0.05 (3%)	-
	Bioactive	-	-0.18 (-12%)	-
	Polyphenols			
Non-functional alternative		0.97 (65%)	-1.86 (-125%)	-0.02 (-1%)
Health claim	Healthy blood vessels.	-	-0.38 (-26%)	-
	Healthy blood vessels and metabolism	-	0.24 (16%)	-
	One property depending on the ingredient	-	-0.24 (-16%)	-
	Two properties depending on the ingredient			

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
***** Nationwide mail survey, 2010-2011.
**Compared to the base price for conventional non-functional food as provided in the study: €1.49/200g
***Class determinants: **Class 1** Children aged < 12, General health interest, Natural product interest, Hysteria, Necessity for Functional Food (FF), Confidence in FF, Safety of FF; **Class 2** Gender, Children < 12years, Reward from using FF, General health interest, Natural product interest, Hysteria, Necessity for FF, Specific health interest, Confidence in FF
Source: Bechtold and Abdulai (2014)

Yormirzoev et al (2021) investigated whether milk certification makes a difference to consumers by examining WTP for organic versus all-natural milk in Russia. Six-hundred-and-eight consumers were surveyed about the variables of *frequency of consumption, awareness of organic farming, belief of Russian certification adherence, belief of Western certification adherence, food safety versus money saving, and risk attitudes*. The authors found that 51 per cent of respondents had a positive WTP for organic versus conventional milk. The major factors in this being perceived health and environmental benefits. However, there was no statistical difference between all-natural and organic milk – highlighting a lack of awareness of the two products with them being used interchangeably.

North American studies

The current review includes two CE and other WTP studies examining the attributes of dairy products in North America (Canada and USA).

Zou and Hobbs (2010) explored consumers' functional food choices and a labelling effect in a context of Omega-3 enriched milk in Canada. The different health claims included heart health, generic health claims and more specific risk reduction claims (RRC) and disease prevention claims (DPC). The authors separated these claims from the visual cues (a red heart symbol included in a choice set) and labelled them as full and partial functional food

attributes, respectively. The CE also considered certification and product price. The data analysis used two approaches, the standard model (Table A44) and the segmented-based approach (Table A53). These initial results suggest that consumers respond positively to health claim labels, as well as the verification entities for these claims. Consumers were willing to pay, on average, between $0.12 and $0.51 for different health claims (or 6% to 26% more of the conventional milk price), being highest for the RRC. They were also willing to pay, on average, around 12 per cent more for verification (vs. none) with little difference on WTP across the type of verification entity. The study also found some sociodemographic influences, such as income, increased WTP for the Omega-3 attribute.

The second analysis confirmed these preferences were consumer group-specific (Table A54). Overall, the full health claims seemed to have a higher absolute WTP (over no claim) when compared to the WTP value of the visual claim (over none), apart from the "*health claim challengers*" group, who were minority of the sample (7%). Looking specifically at the functional ingredient attribute, people were willing to pay, on average, $0.20/litre premium for Omega-3 enriched milk over regular milk, and this WTP was even higher for people with higher income and those with positive attitudes toward functional food in general (Zou and Hobbs, 2010).

Table A53: Willingness-to-pay for milk attributes, Canada (N = 740*)

		WTP $/2 Litres	*Premium (%)***
Omega-3 (vs. regular milk)	Contains Omega-3	0.20	(10%)
Health Claims (full labelling) (vs. none)	Function Claim: "Good for your heart health"	0.19	(10%)
	RRC: "Reduces the risk of heart disease and cancer"	0.51	(26%)
	DPC: "Helps to prevent Coronary Heart Disease and Cancer"	0.33	(17%)
Symbol (partial labelling) (vs. none)	Heart Symbol	0.12	(6%)
Verification Organization (vs. none)	Government	0.24	12%
	Third party	0.23	12%

* Online survey conducted in 2009.

** Compared to the lowest price in the given price vector: $1.99/2 litres of conventional milk.

Source: Zou and Hobbs (2010)

Table A54: Willingness-to-pay for milk attributes: The latent class approach, Germany (N = 740*)

		WTP $/2 Litres Premium (%)**			
		Conventional milk consumers	*Functional food believers*	*Functional milk lovers*	*Health claim challengers*
Class probabilities		48.9%	21.7%	22.1%	7.3%
Omega-3 (vs. regular milk)	Contains Omega-3	-	0.25 (13%)	1.64 (82%)	0.29 (15%)
	Omega3 x Factor1	0.11 (6%)	4.84 (243%)	0.48 (24%)	0.74 (37%)
	Omega3 x Factor2	-	-0.25 (-13%)	-	-0.23 (-12%)
	Omega3 x Income	1.39 (70%)	3.85 (193%)	8.94 (449%)	-4.37 (-220%)
	Omega3 x Gender	0.12 (6%)	3.09 (155%)	0.96 (48%)	0.96 (48%)
Health Claims (full labelling) (vs. none)	Function Claim	-	0.16 (8%)	0.49 (25%)	-
	RRC	-	0.37 (19%)	1.83 (92%)	-
	RRC x Factor1	-	-0.14 (-7%)	0.36 (18%)	0.26 (13%)
	RRC x Factor3	-	-	0.36 (18%)	-
	RRC x Heart disease	-	-	-0.58 (-29%)	-
	RRC x Education	-	-	-0.29 (-15%)	-
	DPC	-	0.46 (23%)	1.74 (87%)	-
Symbol (partial labelling) (vs. none)	Heart Symbol	-	-	0.31	0.27
Verification Organization (vs. none)	Government	-	0.17 (9%)	0.98 (49%)	0.37 (19%)
	Government x Factor3	-	0.09 (5%)	0.25 (13%)	0.33 (17%)
	Third party	-	0.33 (17%)	0.70 (35%)	-

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* Online survey in 2009.
** Compared to the lowest price in the given price vector: $1.99/2 litres of conventional milk.
*** Heart disease: "respondent self-reports having heart disease"; Factor 1 "positive attitudes toward and experience consuming functional food"; Factor 2 "more awareness of health and healthy diet behaviours"; Factor 3 "higher levels of trust in health claims and nutrition labels" (Zou and Hobbs 2010 p. 10 Table 2).
Source: Zou and Hobbs (2010)

Grashuis and Magnier (2018) used two choice experiments to assess US consumers' WTP for a range of attributes associated with cheese and cereal products. Specifically, this included type of company ownership (cooperative, firm), product origin (local, Wisconsin/Iowa), and family ownership status. The researchers assessed consumers' WTP using three models for each choice experiment, rendering different sets of results for each (i.e. Model 1 includes the

main attributes, Model 2 includes more detailed analysis of ownership type in combination with origin, and Model 3 includes more detailed analysis of ownership type in combination with family-owned status). Results are shown in Tables A55 and A56 below. In general, WTP for both products was shown to be higher for firm-owned production, with generic *local* production favoured over specified locations (Grashuis and Magnier, 2018).

Table A55: Willingness-to-pay for cheese attributes, US (N = 298)

Attribute	Mean WTP (USD/8oz) (Model 1)	Mean WTP (USD/8oz) (Model 2)	Mean WTP (USD/8oz) (Model 3)
Ownership: Cooperative	0.766	1.374	0.655
Ownership: Firm	1.453	1.908	1.365
Origin: Local	0.728	1.156	0.735
Origin: Local (Cooperative)		-0.672	
Origin: Local (Firm)		-0.489	
Origin: Wisconsin	0.406	1.186	0.410
Origin: Wisconsin (Cooperative)		-1.289	
Origin: Wisconsin (Firm)		-0.916	
Family-Owned	0.501	0.504	0.385
Family-Owned (Cooperative)			0.211
Family-Owned (Firm)			0.170

Source: Grashuis and Magnier, 2018.

Table A56: Willingness-to-pay for cereal attributes, US (N = 394)

Attribute	Mean WTP (USD/12oz) (Model 1)	Mean WTP (USD/12oz) (Model 2)	Mean WTP (USD/12oz) (Model 3)
Ownership: Cooperative	1.001	1.014	1.400
Ownership: Firm	1.153	1.099	1.257
Origin: Local	0.411	0.335	0.404
Origin: Local (Cooperative)		0.253	
Origin: Local (Firm)		-0.139	
Origin: Iowa	0.067	-0.255	0.063
Origin: Iowa (Cooperative)		0.092	
Origin: Iowa (Firm)		0.648	
Family-Owned	0.513	0.580	0.885
Family-Owned (Cooperative)			-0.894
Family-Owned (Firm)			-0.327

Source: Grashuis and Magnier, 2018.

Asian studies

The current review includes five CE and other WTP studies examining the attributes of dairy products in Asia (namely China).

In China, Zhu et al. (2023) examined consumer preferences and WTP for a range of organic labels on milk products using a choice experiment approach. Specifically, the authors examined Chinese consumer WTP for a range and combination of labels, including the Chinese government Protected Eco-Origin Product (PEOP) label alongside Chinese, EU and US organic labels, and a series of brands - *Gao Yan Zhi Bao* (not well-known in China), *Guang Ming* (well-known in China) and *Yi Li* (well-known in China). The study examined the effect of these labels and brands on WTP for a 250mL carton of milk, as well as interaction effects (the presence of two or three labels/brands) on marginal WTP. The results shown in Table A57 below indicate

average premia of ¥5.70 for a Chinese organic-labelled carton of milk (approximately 173 per cent of the retail price of an equivalent non-organic product), ¥10.25 for the Chinese and EU organic-labelled carton of milk (approximately 331 per cent of the retail price of an equivalent non-organic product), and ¥11.56 for the Chinese, EU and US organic-labelled carton of milk (approximately 350 per cent of the retail price of an equivalent non-organic product). However, negative WTP values were associated with the combination of any number of organic labels and the PEOP label, suggesting a possible negative accumulation effect when placed in combination on milk carton packaging (Zhu et al., 2023).

Table A57: Consumer marginal WTP for milk product (250mL carton of milk) attributes (labels and brands), China (n=737)

Attribute(s)	WTP (in RMB) [95% confidence intervals]
Chinese organic label	¥5.70 [4.04, 7.46]
Both Chinese and EU organic labels	¥10.25 [8.36, 12.36]
Chinese, EU and US organic labels	¥11.56 [9.25, 13.66]
Protected Eco-Origin Product (PEOP) label	¥8.20 [6.61, 9.96]
Guang Ming brand	¥15.89 [14.07, 17.96]
Yi Li brand	¥14.65 [12.92, 16.67]
Chinese organic label + PEOP label	-¥1.94 [-0.01, -3.94]
Chinese and EU organic labels + PEOP label	-¥3.43 [-1.40, -5.52]
Chinese, EU and US organic labels + PEOP label	-¥3.88 [-2.15, -5.70]

Source: Zhu et al., 2023.

Wu et al. (2014) assessed consumers' WTP for organic infant formula, as well as respondents' food safety risk perceptions and level of knowledge. The CE attributes included organic label, COO brand (including two Chinese ("unknown" *Dele*, and well-known *Yili*) and two foreign brands (European *Topfer*, and North American *Enfamil*)) and product price. The design also included two-way interaction effects between the attributes in order to explain variance in preferences. The study was conducted in Shandong province (China's third most populous province), resulting in 1,254 completed responses. The result show, firstly, that the respondents' knowledge and understanding of organic food were relatively low while the perception regarding the food safety risk were relatively high. The CE results in Table A58 show that consumers had a higher average WTP of $5-$10 (or 36-69 per cent of the base price) for the EU and US-based organic labels than for the Chinese label (vs no label). These WTP estimates increased if the level of knowledge and the level of perceived food safety risk were higher, up to 112 per cent and 86 per cent, respectively. Furthermore, Chinese consumers preferred imported products and brands over domestic ones which is consistent with previous studies (Saunders et al. 2013). Lastly, the study highlighted two of the significant and positive findings from the attribute interactions (between the US organic label and China-COO, and

between *Enfamil* and China-COO), which imply a potential complementary relationship whereby adding these labels/brands to formula produced in China could improve their value (Wu et al., 2014).

Table A58: Willingness-to-pay for infant formula attributes, China (N = 1,254*)

		Full sample		By level of knowledge			By level of risk perception	
		WTP US$/400g	*Premium (%)***		*WTP US$/400g*		*Premium (%)***	
Organic label (vs. no label)	Chinese	3.23	(22%)	Low	3.49	(23%)	3.84	(26%)
				Medium	3.84	(26%)	4.28	(29%)
				High	1.95	(13%)	4.20	(28%)
	EU	5.36	(36%)	Low	3.81	(25%)	3.75	(25%)
				Medium	6.93	(46%)	6.02	(40%)
				High	6.04	(40%)	6.25	(42%)
	US	10.40	(69%)	Low	10.66	(71%)	9.93	(66%)
				Medium	16.87	(112%)	12.58	(84%)
				High	16.55	(110%)	12.89	(86%)
Brand (vs. Dele)	Yili	4.40	(29%)					
	Topfer	6.17	(41%)					
	Enfamil	7.08	(47%)					
Country of origin (vs. Germany)	China	-2.42	(-16%)					
	the US	3.53	(24%)					

* In-store interviews, in 2012.

** Compared to the average of the applied price vector: US$ 15/400g

Source: Wu et al. (2014)

Tait et al. (2020d) examined Beijing (China) consumer preferences and willingness to pay for the attributes of UHT milk products. Three consumer groups were identified, comprising 38 per cent (Group 1), 31 per cent (Group 2) and 32 per cent (Group) of the sample respectively. The range of premiums that Beijing consumers indicated they would be willing to pay for UHT milk product attributes (by group) are shown in Table A59 below.

Table A59: Consumer WTP for attributes of UHT milk products (% of product price), Beijing, China, 2019 (n=~1,000)

	Group 1	Group 2	Group 3
Enhanced animal welfare		12%	27%
Organic		44%	18%
Increased protein		12%	11%
Increased calcium		32%	23%
Care for workers		15%	10%
Contribute to local communities	33%		23%
Support for farmers		15%	
Carbon neutral		50%	
Biodiversity enhancement	35%		56%
Water quality protection	13%		
100% pasture-raised		24%	
Feedlot raised	16%		
100% grass-fed	12%		
Grain-fed	15%	16%	14%

Source: Tait et al., 2020d.

In a follow-up study, Tait et al. (2022g) examined Beijing and Shanghai (China) consumer preferences and willingness to pay for the attributes of New Zealand UHT milk products. Three distinct consumer segments were identified in both cities, including *broad considerations* (those with relatively small WTP across a range of attributes), and *pasture preferred* (those with a strong preference for the pasture-raised attribute). The authors also identified a unique segment in each city – *socially responsible* in Beijing (those who only valued social attributes), and *strong preferences* in Shanghai (those who indicated high WTP for a wide range of attributes). The study examined UHT milk product attributes related to environmental condition (water quality protection), production methods (organic production, 100% pasture-raised, feedlot raised, 100% grass fed, grain fed), social and ethical considerations (enhanced animal welfare, care for workers, contribute to local communities, support for farmers), and health attributes (increased protein, increased calcium). Table A60 below shows the range of premiums that Beijing consumers within identified segments would be willing to pay for the selected UHT milk product attributes. This shows that consumers in the *broad considerations* segment valued a broad range of attributes, indicating the highest WTP for increased protein (46 per cent premium). Those in the *pasture preferred* segment, on the other hand, indicated high WTP for a range of environmental, ethical and production attributes – particularly 100% pasture-raised (119 per cent premium) and organic production (103 per cent premium). Furthermore, those in the *socially responsible* segment indicated WTP for only two attributes, both of which related to social responsibility (care for workers, contribute to local communities) (Tait et al., 2022g).

Table A60: Consumer WTP for attributes of New Zealand UHT milk products (% of product price), Beijing, China, 2021 (n=~1,000)

	CONSUMER SEGMENT		
	Broad Considerations	**Socially Responsible**	**Pasture Preferred**
Enhanced animal welfare	13%		66%
Organic production	20%		103%
Increased protein	46%		
Increased calcium	19%		51%
100% pasture-raised	24%		119%
Feedlot raised	17%		48%
100% grass-fed			
Grain fed	8%		75%
Care for workers	21%	15%	
Contribute to local communities	28%	16%	
Support for farmers	19%		
Water quality protection	8%		46%

Source: Tait et al., 2022g.

Table A61 below shows the range of premiums that Shanghai consumers within identified segments would be willing to pay for the selected UHT milk product attributes. This shows that consumers in the *broad considerations* segment valued a broad range of attributes, indicating the highest WTP for contributing to local communities (20 per cent premium) relative to other segments. Those in the *pasture preferred* segment, on the other hand, indicated high WTP for 100% pasture-raised (84 per cent premium) products, as well as smaller premiums for a range of other attributes. Furthermore, those in the *strong preferences* segment indicated high WTP for a broad range of environmental, ethical and

production attributes, particularly feedlot raised (88 per cent premium) and water quality protection (85 per cent premium) (Tait et al., 2022g).

Table A61: Consumer WTP for attributes of New Zealand UHT milk products (% of product price), Shanghai, China, 2021 (n=~1,000)

	CONSUMER SEGMENT		
	Broad Considerations	**Pasture Preferred**	**Strong Preferences**
Enhanced animal welfare	15%	24%	63%
Organic production	24%	33%	81%
Increased protein			53%
Increased calcium	19%	11%	
100% pasture-raised		84%	
Feedlot raised		29%	88%
100% grass-fed			82%
Grain fed	5%	21%	45%
Care for workers			49%
Contribute to local communities	20%		
Support for farmers	7%	17%	
Water quality protection	12%		85%

Source: Tait et al., 2022g.

Similarly, Tait et al (2018) explored Chinese consumers WTP for New Zealand yogurt products. This study was targeted specifically to consumers in Shanghai, with a sample size of 837. The attributes included in the choice experiment were enhanced *animal safety, enhanced animal welfare, organic production, environmental sustainability, social responsibility, COO, price per kg, and yogurt type.* Based on these, Table A62 highlights the willingness to pay of these attributes. This is expressed in the local currency, and as a percentage of the average price used in the choice experiments (prices were determined by the distribution of observed market prices in Shanghai, December 2017).

Table A62: Shanghai consumer WTP for selected yogurt attributes (n=837)

Attributes	**WTP ¥/kg**
Enhanced food safety	¥44 (54%)
Enhanced animal welfare	¥37 (45%)
Environmentally sustainable	¥39 (47%)
Social responsibility	¥31 (38%)
Organic	¥42 (51%)
China	¥77 (93%)
Germany	¥70 (85%)
Spain	¥48 (58%)
Thailand	¥-9 (-11%)
New Zealand	¥118 (143%)

Note: ¥ average WTP (95 per cent confidence interval)
Source: Tait et al (2018)

A1.3 Fruit & vegetable products

The current review includes 14 CE and other WTP studies examining the attributes of fruit and vegetable products in Europe, Asia and other regions. Attributes examined in these studies include organic, local foods, country-of-origin, social responsibility, carbon/GHG emissions associated with production, food safety, production methods and product quality.

European studies

The current review includes three CE and other WTP studies examining the attributes of fruit and vegetable products in Europe, including the markets of Denmark, France, UK and the Netherlands. Attributes examined in these studies include organic, local foods, country-of-origin, social responsibility and carbon/GHG emissions associated with production.

Denver and Jensen (2014) focused on the organic and local food (apples) preferences in Denmark. The study combined CE and PCA, where the latter was used to aggregate attitudinal Likert-scale responses. The CE included attributes of food origin ranging from domestic (local or domestic) to imported apples (within or outside of the EU); production method (organic vs. conventional); alongside colour and taste/texture. The survey included in total 637 respondents. The PCA show two components - one related to organic products and the other to locally produced products. While no WTP was calculated, the authors provided an indication of WTP for these two attributes (Table A63). The participants were willing to pay 5.40 DKK/kg premium for organic apples and 19 DKK/kg for local food. These numbers increased by 97 percentage points if the respondents hold "maximum perception" of the organic attributes based on the PCA. This suggests that, in the case of apples, consumers with positive perceptions of organic food can also have relatively strong preferences for local food but not necessarily vice versa. The authors suggest that this asymmetry needs to be explored further.

Table A63: Willingness-to-pay for the local apple attribute, Denmark (N = 637*)

		Full sample		**Those with maximum perception of the organic attributes**	
		WTP DKK/kg	*Premium (%)***	*WTP DKK/kg*	*Premium (%)***
Production method (vs. conventional)	Organic	5.40	77%	12.20	174%
Origin (vs. outside EU)	Local	19.00	(271%)	22.60	(323%)

* Online survey in 2010.
**Compared to current price (status quo option) of a conventional apple 7 DKK/kg
Source: Denver and Jensen (2014)

In another European study, Akaichi et al. (2015) assessed consumers WTP for fair-trade (FT), organic and carbon footprint attributes (collectively known as ethical attributes) in bananas. A particular objective was to identify if these attributes compete in different markets. For the study, in total 247 consumers were interviewed in three countries. The CE results (Table A64) show that consumers were willing to pay between €0.08 and €0.14 for fair trade and organic bananas with French participants indicating a slightly higher, and statistically significant, WTP compared to Scottish and Dutch participants. All respondents were also willing to pay, on average, €0.10 (77% premium of the lowest price) to reduce carbon footprint (1kg on the transport). These WTP values were statistically significantly higher by Dutch over Scottish participants. In order to explore these trade-offs, a within-sample test of WTP differences was applied. These results show that, in Scotland, consumers were willing to pay significantly more

for fair trade bananas compared to other attributes, but also that they would choose organic bananas if the FT price too high. In the Netherlands sample, there was no evidence for different WTP for attributes; thus these attributes are competing and the price of attribute determines choices. Lastly, French participants were willing to pay significantly more for organic bananas than fair trade bananas, if the price is not too high. Overall, consumers in all countries show positive WTP for all claims/labels, and although generally these ethical claims may not be competing, this study identified that under some circumstances this may change.

Table A64: Willingness-to-pay for the banana attributes, Scotland, France and the Netherlands (n = 247*: 100 in Edinburgh, 95 in Clermont-Ferrand and 52 in Amsterdam)

	WTP by all respondents		**WTP by Country**		
	€/banana	*Premium (%)***		*€/banana*	*Premium (%)***
Fairtrade Label (vs. no label)	0.10	77%	Scotland	0.14	108%
			Netherland	0.13	100%
			France	0.09	69%
Organic Label (vs. no label)	0.09	69%	Scotland	0.08	62%
			Netherland	0.09	69%
			France	0.13	100%
Carbon footprint/ reduction per kg	0.10	77%	Scotland	0.09	69%
			Netherland	0.12	92%
			France	0.12	92%

* Intercept survey at public places and retail stores with occasional buyers, at minimum, of bananas
** Compared to the lowest amount of the price vector: €0.13/banana
Source: Akaichi et al. (2015)

Ceschi et al. (2018) used a choice experiment to analyse Italian consumers' WTP for apple attributes, specifically their variety, production method(s) and region(s) of production. As shown in Table A65 below, the authors found a range of premiums associated with specific regions of production, with consumers willing to pay a higher premium for apples produced in Trentino-Adige (+€1.44 per kg) and Emilia-Romagna (+€1.41 per kg) over imported apples (-€2.12 per kg). Similarly, the organic attribute was shown to have only marginal increased WTP relative to conventional apples (+€0.18 per kg) (Ceschi et al., 2018).

Table A65: Willingness-to-pay for apple attributes, Italy (N = 301)

Attribute	**WTP (€/kg)**
Organic	+0.18
Bicolour	-0.34
Green	-1.00
Red	-0.94
Trentino-Alto Adige	+1.49
Emilia-Romagna	+1.44
Imported	-2.12

Source: Ceschi et al., 2018

North American studies

There have been some, but limited, studies of consumer WTP for attributes of fruit and vegetable products in North American countries. The current review includes three CE and other WTP studies examining the attributes of fruit and vegetable products in North America (USA, particularly California).

Grebitus et al. (2018) used a series of online choice experiments to determine US consumers' WTP for Medjool dates with associated GMO, pesticide use and region of origin credentials. In general, this showed that participants were willing to pay positive premiums for all attributes, particularly those with GMO- and pesticide-free status, as well as a preference for dates grown in the state of Arizona over California. Table A66 below shows the range of premiums associated with the above attributes.

Table A66: Willingness-to-pay for date attributes, US (N = 1,411)

Attribute	Mean WTP (US$/ounce)
Arizona grown	+0.14
California grown	+0.03
Pesticide-free	+0.55
GMO-free	+0.17
GMO- and pesticide-free	+0.53

Source: Grebitus et al., 2018.

Tait et al (2021) investigated apple consumption by Californian consumers. The researchers investigated a number of consumer preferences such as brand, sensory and credence attributes before conducting a WTP analysis using a choice experiment methodology. Attributes explored in this were *appearance, social responsibility, organic production, reduction in greenhouse gas emissions, genetic engineering, and price*. The choice experiment highlighted three distinct apple consumer groups in California representing 17 percent, 27 per cent, and 56 per cent of those surveyed. Table A67 shows the results of the WTP analysis, broken down by consumer group.

Table A67: Willingness to pay for apple attributes (USD per pound), California, USA (n = 1000)

Consumer Group	Attribute		WTP (USD)
One	Appearance	Moderately blemished	-0.51
		Significantly blemished	-1.19
		Moderately misshapen	-0.59
		Significantly misshapen	-1.75
	Reduction of GHG	15% less GHG	-
		30% less GHG	-
	Organic	Organic	0.54
	Social responsibility	Care for workers	-
		Contribute to local communities	-
		Support farmers	0.30
Two	Appearance	Moderately blemished	-
		Significantly blemished	-0.29
		Moderately misshapen	-0.16
		Significantly misshapen	-0.56
	Reduction of GHG	15% less GHG	-
		30% less GHG	0.26
	Organic	Organic	0.32
	Social responsibility	Care for workers	0.20
		Contribute to local communities	0.41
		Support farmers	-
Three	Appearance	Moderately blemished	-2.72
		Significantly blemished	-4.99
		Moderately misshapen	-2.59
		Significantly misshapen	-3.88
	Reduction of GHG	15% less GHG	-
		30% less GHG	1.42
	Organic	Organic	1.85
	Social responsibility	Care for workers	1.11
		Contribute to local communities	1.35
		Support farmers	1.80

Source: Tait et al (2021)

In a follow-up to the above study, Tait et al. (2022a) examined Californian apple consumer preferences and WTP for the attributes of New Zealand apples. Four distinct consumer segments were identified in this study, including *appearance only* (those largely focused on apple appearance), *conscious consumers* (those with a greater focus on environmental and ethical attributes), *broad considerations* (those with a broad range of preferences) and *strong preferences* (those with the strongest positive and negative WTP for a range of attributes). The study examined apple product attributes related to environmental condition (reductions in GHG emissions), production methods (organic production, GE-free), social responsibility (care for workers, contribute to communities, support growers), and product appearance (moderate or significant injury, moderate or significant deformity). Table A68 below shows WTP results for the above attributes by consumer segment, presented as an additional percentage of the usual product price paid for the inclusion of these attributes in the New Zealand apples they purchased. This shows that those in the *conscious consumers* segment

value the broadest range of social and environmental apple attributes. Similarly, those in the *broad considerations* segment also value these attributes, but to a much lesser extent, and indicate a negative WTP for injured or deformed apples. In addition, those in the *strong preferences* segment indicated relatively high WTP for organic apples (104 per cent premium) and a 15 per cent reduction in GHG emissions from production (37 per cent premium), as well as strong negative WTP for injured or deformed apples. Furthermore, those in the *appearance only* segment have only indicated a negative WTP for injured or deformed apples, with these values intensifying with the level of injury or deformity (Tait et al., 2022a).

Table A68: Willingness to pay for New Zealand apple attributes (% of product price), California, USA (n=~1000)

	CONSUMER SEGMENT			
	Appearance Only	Conscious Consumers	Broad Considerations	Strong Preferences
15% reduction in GHG emissions		37%	10%	37%
30% reduction in GHG emissions		44%	5%	
Organic production		88%	17%	104%
Care for workers		74%	17%	
Contribute to communities		64%	18%	
Support growers		75%	7%	
GE-free		96%	8%	
Moderate injury	-23%		-14%	-151%
Significant injury	-49%		-21%	-250%
Moderate deformity			-31%	-128%
Significant deformity	-60%		-37%	-272%

Source: Tait et al., 2022a.

Asian studies

The current review includes six CE and other WTP studies examining the attributes of fruit and vegetable products in Asia, including China, Japan, Thailand, and Malaysia.

In a developing economy context, Wongprawmas and Canavari (2017) examined Thai consumers' WTP for fresh produce with associated food safety credentials, including a product's freshness, brand and food safety information. For product freshness, a range between 0 and 2 days post-harvest was indicated. Food safety labels used in the CE included a generic "safe produce" claim, the well-recognised Q Mark label, as well as well-known and trusted produce brands "Royal Project" and "Doctor's Vegetables", both of which may also use the Q Mark label. Table A69 shows a range of WTP for different brand and food safety information credentials in relation to Chinese cabbages among Thai consumers, with trusted private brands Royal Project and Doctor's Vegetables receiving the highest WTP.

Table A69: Willingness-to-pay for Chinese cabbage with food safety credentials, Thailand (n=350)

Attribute	WTP (Thai Baht/kg)
Claim "safe produce"	39.23
Q mark	68.44
Royal Project and Q mark	74.56
Doctor's Vegetables and Q mark	79.06

Source: Wongprawmas and Canavari, 2017.

Joya et al. (2022) examined Malaysian consumers' WTP for the food safety-related credentials of tomatoes (production methods, retailer type, third-party certification and appearance) using a discrete choice experiment (DCE) approach. Specifically, the study examined consumer WTP for tomato appearance (*wholesome* or *slightly damaged*), production system (*organic* or *conventional*), type of market (*supermarket* or *wet market*), and Malaysian Good Agricultural Practice (myGAP) certification (*certified* or *not certified*). Estimates of marginal willingness-to-pay (MWTP) for tomato attributes are shown in Table A70 below. This shows that consumers would be willing to pay an additional RM4.18 for a *wholesome* rather than a *slightly damaged* tomato, an additional RM2.75 for an *organic* rather than a *conventionally-produced* tomato, an additional RM2.30 for a *myGAP-certified* (rather than *not certified*) tomato, and an additional RM1.29 for a tomato purchased from a *supermarket* rather than a *wet market* (Joya et al., 2022).

Table A70: Consumer marginal WTP (Malaysian Ringgit (RM)) for food safety-related attributes of tomatoes, Malaysia (n=490)

Attribute	Marginal WTP (Standard Error)
Appearance: Wholesome	4.18 (0.2755)
Production system: Organic	2.75 (0.2321)
Type of market: Supermarket	1.29 (0.2193)
myGAP: Certified	2.30 (0.1887)

Source: Joya et al., 2022.

While not strictly a fruit and vegetable product, Gao et al. (2019) used a series of choice experiments to examine urban Chinese consumers' WTP for country of origin and genetically modified organism status of different orange juice products (*orange juice drink* (OJD), *orange juice from concentrate* (FCOJ) and *orange juice not from concentrate* (NFC)). As shown in Table A71 below, WTP estimates were produced against alternatives (e.g. a series of origins versus Chinese origin), producing a range of premiums associated with different orange juice product attributes. In particular, the results show a range of discounts associated with country of origin and GM status, with price premiums associated only with changes in product types (Gao et al., 2019).

Table A71: Willingness-to-pay for orange juice products by type, production method and country of origin, China (N = 646)

Category	Attribute	Mean WTP (RMB)
Product Type (vs 10% Orange Juice Drink)	50% Orange Juice Drink	5.38
	Orange Juice From Concentrate	9.81
	Orange Juice Not From Concentrate	13.27
Conventional Juice (Imported vs China)	US	-4.61
	Brazil	-1.55
	Israel	-2.13
	Australia	-3.70
GM Juice (GM vs conventional juice from the same country)	US	-4.87
	Brazil	-13.60
	Israel	-14.52
	Australia	-4.59
	China	-12.12
Brand and Manufacturer Country of Origin (other vs Chinese brand, made in China)	US brand, made in United States	-3.05
	US brand, made in China	-4.66
	US brand, made in Florida	-5.47
	Taiwanese brand (China), made in China	-1.45
	Australian brand, made in Australia	-0.05

Source: Gao et al., 2019.

Nishimura (2021) investigated the effect of greenhouse pollination methods on consumers WTP for tomatoes in Japan. The study was driven by the phasing out of non-native bumblebees as greenhouse tomato pollinators in Japan. This was largely related to the ecological risks of non-native species and the results of the WTP survey of 1250 consumers found that consumers valued the use of non-native bumblebees' more than hormonal treatment, and native more than non-native bees. This WTP was further increased by informing consumers of the ecological risks of non-native bumblebees to the Japanese ecosystem. The attributes used in this research were *cultivation method, pollination method, functional ingredients, and price.* The results of the WTP are shown in Table A72.

Table A72: WTP for greenhouse pollination methods of Japanese tomatoes. (N=1250).

	WTP estimates (Japanese ¥)			
	No information	Only information on quality improvement	Only information on ecological risk	Information on both
HALVE	18.24	21.76	17.55	23.72
	[12.84, 23.63]	[17.71, 25.81]	[13.45, 21.66]	[16.39, 31.04]
HORMONE	-16.95	-17.00	-9.48	-13.59
	[-23.25, -10.66]	[-22.45, -11.55]	[-14.68, -4.29]	[-21.28. -5.90]
NATIVE	9.81	14.57	20.29	30.64
	[4.63, 15.00]	[9.30, 19.83]	[14.38, 26.20]	[20.22, 41.05]
ENRICHED	8.29	7.50	4.56	6.59
	[4.40, 12.19]	[3.64, 11.35]	[0.84, 8.27]	[1.52, 11.67]

The value of each WTP is presented with 95% confidence intervals for the mean in brackets. All values for WTP are in Japanese yen.
Source: Nishimura (2021)

Tait et al. (2022d) examined Japanese consumer preferences and WTP for the attributes of New Zealand kiwifruit. Three distinct consumer segments were identified in this study, including *healthy me/healthy environment* (those who highly valued health and environmental attributes), *broad considerations/taste driven* (those who most highly valued taste attributes), and *safety focused* (those who most highly valued food safety and similar attributes). The study examined kiwifruit attributes related to environmental condition (carbon neutral, water quality protection, biodiversity enhancement), production methods (organic), food safety (enhanced food safety), social responsibility, and other physical and health attributes (increased fibre, increased Vitamin C, acidic taste, sweet taste, balance of acidic and sweet). Table A73 below shows the range of premiums that identified Japanese consumer segments would be willing to pay for the selected kiwifruit attributes. This shows that those in the *healthy me/healthy environment* segment valued key health and environmental attributes the highest, including increased fibre (116 per cent premium), carbon neutral (87 per cent premium), and biodiversity enhancement (77 per cent premium). Those in the *broad considerations/taste driven* segment indicated the highest WTP for taste attributes (sweet taste, balance of acidic and sweet), as well as lower WTP for broad range of other attributes. Furthermore, those in the *safety focused* segment indicated WTP only for limited attributes, including enhanced food safety (39 per cent premium) (Tait et al., 2022d).

Table A73: Consumer WTP for New Zealand kiwifruit attributes, Japan (n=~1,000)

	CONSUMER SEGMENT		
	Healthy Me, Healthy Environment	Broad Considerations – Taste Driven	Safety Focused
Increased fibre	116%	16%	
Increased Vitamin C	33%	12%	27%
Acidic taste		27%	31%
Sweet taste	19%	77%	
Balance of acidic and sweet		70%	
Organic	7%	13%	25%
Enhanced food safety	39%	13%	39%
Carbon neutral	87%	27%	19%
Biodiversity enhancement	77%	16%	
Water quality protection		14%	
Social responsibility	28%	14%	

Source: Tait et al., 2022d.

Wang, Wang and Huo (2019) conducted a double hurdle analysis to investigate consumers' WTP of organic fruits in China. A total of 407 surveys were collected across nine Chinese cities and the Willingness-to-pay a premium was modelled as a function of a series of demographic, socio-economic variables, plus fruit attributes, perceptions of fruit safety, and risk attitudes. The results showed that the most important factors influencing willingness to pay a premium involved positive attitudes toward organic label, attention to fruit safety, the perception of importance of fruit attributes. Moreover, the more income consumers earn, the more likely they would be willing to pay a premium for organic fresh fruits. In terms of fruit attributes, two consumer groups were identified; those willing to pay a premium (n=250) and those unwilling to pay a premium (n=157). Taste and appearance were regarded as the most important attributes in both groups. Purchase convenience and the variety of fruits were perceived as the second most important attributes by WTP consumers (60.4%). The respondents in the WTP group rated the nutritional value (47.6%) comparatively highly when compared to the UWTP group (18.5%). Further, the majority of UWTP believed that sales price

was very important (72.0%), potentially explaining their unwillingness to pay for organic fruit (75.8%), stating it was unimportant in contrast to WTP consumers (42.0%). In addition, wrapping appears to be less acute for all interviewees (Wang et al., 2019).

Other regions

The current review includes two CE and other WTP studies examining the attributes of fruit and vegetable products in other regions, including Peru and West African nations (Benin, Ghana and Burkina Faso). Attributes examined in these studies include organic, local foods, food safety and production methods.

Blare et al. (2017) conducted a CE to determine Peruvian consumers' WTP for locally grown tree fruits (avocadoes, apples and pears). Table A74 shows the percentage of participants willing to pay a range of premiums (0%, 10%, 20%, 30%, 40% and 50% more) for locally-produced apples, avocadoes and pears, with highest overall premiums shown for local apples, followed by pears and avocadoes.

Table A74: Percentage of participants willing-to-pay for locally-grown tree fruits, Peru (N=300)

	WTP range					
	0%	*10%*	*20%*	*30%*	*40%*	*50%*
Apples (%)	26	17	24	16	6	11
Avocadoes (%)	24	29	30	12	1	4
Pears (%)	25	21	26	16	8	4

Source: Blare et al., 2017

Probst et al. (2012) explored the potential for marketing certified organic vegetables in three West African cities (Cotonou in Benin, Accra in Ghana and Ouagadougou in Burkina Faso). In particular, certified organic production was examined as a potential strategy to improve food safety. Two separate CEs were developed - one for the food vendors' choices of tomatoes (a common ingredient in meals) and another for consumer meal choices of (continental or traditional) when eating out. The vendor CE included trade-offs across appearance (freshness, colour and neatness), production method and price attributes, while the consumer CE included trade-offs across taste, production method and price attributes. Both CEs targeted different types of retailers ranging from street food vendors to restaurants, where the interviews resulted in 180 vendor responses and 360 consumer responses. There were some differences in sample demographics between vendors and consumers, such as consumer sample being predominantly female whereas the vendors were mostly male. In both CEs, the WTP was only reported for the organic production attribute. As shown in Table A75, the vendors were willing to pay, at median, US$0.85 for organic certification of the fresh tomatoes, which equals to a premium between 12 and 53 per cent of typical retail price. These WTP across the cities vary depending on the season. Next, Table A76 shows they consumers were willing to pay, at median, just over US$1 per meal if the food served contained only certified organic vegetables. This equates to around a 19 per cent premium on average meal price for restaurants, 75 per cent premium for small food businesses, and 177 per cent premium on average meal price for street food vendors.

Table A75: Willingness-to-pay for basket of tomatoes attributes (by vendors), Benin, Ghana and Burkina Faso (N = 180*, n = 60/city)

			By City	Lean season	Peak season
		WTP US$/3 kg basket		*(premium %)***	*(premium %)***
How vegetables were grown (vs. not organic)	Certified organic	$0.848	Benin	(16%)	(39.9%)
			Burkina Faso	(26.7%)	(53.4%)
			Ghana	(12.1%)	(23.9%)

Note: The WTP values were not estimated for all attributes.
* Intercept interviews, in 2009, with street food vendors, small food businesses and restaurants.
** Reported in the study.
Source: Probst et al. (2012)

Table A76: Willingness-to-pay for meal attributes (by consumers), Benin, Ghana and Burkina Faso (N = 360*)

		WTP US$/plate	*By retailer*	*(% premium)***
How vegetables added to the meal were grown (vs. not organic)	Certified organic vegetables	$1.044	Street food vendor	177%
			Small food business	75%
			Restaurant	19%

* Intercept interviews, in 2009, with customers of the street food vendors, small food businesses and restaurants.
** Reported in the study.
Source: Probst et al. (2012)

A1.4 Wine products

The current review includes 15 CE and other WTP studies examining the attributes of wine products in Europe, North America, Asia and other regions. Attributes examined in these studies include sustainability (generic), country- and region-of-origin, grape variety, vintage, brand, social responsibility, organic, carbon/GHG emissions associated with production, environmental condition, reduced packaging and taste.

General studies

Schaufele and Hamm (2017) conducted a review of international WTP literature regarding WTP for the inclusion of a range of sustainability credentials in wine products. The authors found that consumers across different countries showed a willingness to pay a premium for wine products with associated sustainable production methods, including environmental friendly, local and organic production methods (Schaufele and Hamm, 2017).

North American studies

The current review includes three CE studies examining the attributes of wine products in North America (USA).

Tait et al. examined US consumer preferences and WTP for wine (sauvignon blanc) in New York and Texas (Tait et al., 2020e; 2020f). This included a range of product attributes related to environmental condition, production methods, country of origin, Māori production, and

product quality. Each study identified three distinct consumer groups. In the New York study, these groups comprised 47 per cent (Group 1), 22 per cent (Group 2) and 31 per cent (Group 3) of the sample respectively, while in the Texas study, these groups comprised 40 per cent (Group 1), 25 per cent (Group 2) and 35 per cent (Group 3) of the sample respectively. Tables A77 and A78 below show the results of these studies, describing a range of premiums that US wine consumers in New York and Texas would be willing to pay for the outlined range of sauvignon blanc product attributes.

Table A77: Consumer WTP (average) for New Zealand sauvignon blanc attributes, New York, USA, 2019 (n=~1,000)

	Group 1	Group 2	Group 3
Biodiversity management	9%		24%
Water management			
By-product management			
Energy management	9%		
Pest and disease management	13%	16%	15%
Social responsibility	12%	6%	
GHG management	14%	8%	21%
Made with organic grapes			
100% organic	14%	21%	
Critic rating (per point >80)		2%	2%
Made in New Zealand	138%	151%	45%
Made in NZ by Māori enterprise	121%	160%	35%
Made in USA	107%	141%	47%
Made in France	134%	120%	37%
Made in Australia	121%	132%	34%
Made in Italy	90%	133%	

Source: Tait et al., 2020e.

Table A78: Consumer WTP (average) for New Zealand sauvignon blanc attributes, Texas, USA, 2019 (n=~1,000)

	Group 1	Group 2	Group 3
Biodiversity management	7%	14%	16%
Water management			12%
By-product management	11%		
Energy management	5%		
Pest and disease management	12%		14%
Social responsibility	13%	14%	7%
GHG management	11%	17%	21%
Made with organic grapes			
100% organic	13%	14%	
Critic rating (per point >80)		3%	4%
Made in New Zealand	74%	60%	133%
Made in NZ by Māori enterprise	71%	84%	166%
Made in USA	54%	49%	134%
Made in France	66%	28%	124%
Made in Australia	72%	46%	133%
Made in Italy	40%	28%	112%

Source: Tait et al., 2020f.

Following the above, Tait et al. (2022h) examined Californian consumer preferences and WTP for the attributes of New Zealand wine (sauvignon blanc). Three distinct consumer segments were identified in both cities, including *cultural consumer* (those who most positively valued Māori production), *organic origin* (those who valued 100% organic production), and *score*

strategy (those with a broader range of preferences). The study examined Sauvignon blanc wine attributes related to environmental condition (biodiversity management, water management, energy management, greenhouse gas emissions management, by-products management), production methods (pest and disease management, soil management, 100% organic production), Māori production, and product quality (critic ratings per point over 80). Table A79 below shows the range of premiums that Californian consumers within identified segments would be willing to pay for the selected sauvignon blanc wine product attributes. This shows that consumers in the *cultural consumer* segment valued a broad range of attributes, indicating the highest WTP for Māori production (41 per cent premium). Those in the *organic origin* segment, on the other hand, indicated high WTP for a range of attributes, but were the only segment to indicate positive WTP for 100% organic production (8 per cent premium). Furthermore, those in the *score strategy* segment indicated relatively low WTP for a range of most environmental attributes (Tait et al., 2022h).

Table A79: Consumer WTP (average) for New Zealand sauvignon blanc attributes, California, USA, 2021 (n=~1,000)

	CONSUMER SEGMENTS		
	Cultural Consumer	Organic Origin	Score Strategy
Biodiversity management	41%	10%	10%
Water management	30%		7%
Energy management	22%		
Pest and disease management	36%	13%	9%
Social responsibility	31%	9%	8%
GHG management	24%	8%	10%
Soil management	39%		
By-products management	32%	5%	4%
100% organic production		8%	
Māori production	41%	12%	9%
Critic rating (per point >80)	0.4%	0.1%	0.2%

Source: Tait et al., 2022h.

European studies

The current review includes four CE and other WTP studies examining the attributes of wine products in Europe, including the markets of Spain, France, Germany and the UK. Attributes examined in these studies include sustainability (generic), region-of-origin, grape variety, social responsibility, organic, carbon/GHG emissions associated with production and reduced packaging.

Sellers (2016) examined Spanish consumers' WTP for sustainable wine products based on their market segment and levels of knowledge of wine culture. As shown in Table A80, premiums that Spanish consumers are willing to pay may be based on their level of knowledge of wine culture, with less participants with higher levels of knowledge of wine culture willing to pay a premium as well as a generally lower average percentage of premium price paid. In addition, Table A81 shows that Spanish consumers in different segments may be willing to pay higher premiums than others. For example, a higher percentage of urban-based consumers may be willing to pay a higher premium than consumers in the 'traditional segment'. This study shows that relative levels of expertise as well as socio-demographic segmentation may affect WTP for sustainability wine products in Spain (Sellers, 2016).

Table A80: Willingness-to-pay (€) for sustainable wine by level of knowledge of wine culture, Spain (N = 553)

	(1) Beginner	*(2)*	*(3)*	*(4)*	*(5) Expert*	*Global*
% of consumers willing to pay a premium price	87.2	76.5	81.2	75	61.6	77.9
Average % of premium price	18.72	15.02	10.97	8.1	5.08	12.87

Source: Sellers, 2016

Table A81: Willingness-to-pay (€) for sustainable wine by market segment, Spain (N = 553)

	Traditional	*Urban*	*Trendy*	*Routine*	*Occasional*	*Social*	*Global*
% of consumers willing to pay a premium price	76.9	84.6	80.2	70.2	74.3	84.1	77.9
Average % of premium price	9.75	13.11	14.41	13.25	11.92	12.97	12.87

Source: Sellers, 2016

In a wine context, Kallas et al. (2013) focused on elements involved in wine choices for a special occasion, such as origin, people's experience and knowledge of wine ("wine references"), grape type and price. In the survey, the respondents were asked to complete two separate wine CEs. The first being a so-called "forced choice task" (with no opt-out option), and the second being "non-forced choice task" (with an added opt-out alternative). Four hundred wine consumers participated in the study. The results, shown in Table A82, indicate that the most preferred origins were non-imported wines, particularly the regional Catalonian wine with WTP around 2.60-3.10 €/bottle (or around 30% of the base price). Also experience and type of wine influenced consumers' wine choices, as indicated by the relatively higher WTP estimates. The main differences between forced and non-forced choices involved the significantly higher premium for regional wine and Cabernet Sauvignon wine when allowing opting-out. However, the forced choices resulted in higher WTP for national wines as well as lower discount or compensation (negative WTP) for prestigious wines and imported wines. Overall, the results from the non-forced CE suggest an increasing tendency of statistically significantly higher WTP for most preferred type and origin levels (Kallas et al., 2013).

Table A82: Willingness-to-pay for wine attributes, Spain (N = 400*)

		Average WTP €/bottle (Premium %)**	
		"Forced choices"	*"Non-forced choices"*
Origin	Catalonia (regional) ***	2.65 (27%)	3.07 (31%)
	Spain (national) ***	0.50 (5%)	0.39 (4%)
	Imported (international) ***	-3.15 (-32%)	-3.46 (-35%)
Wine references	previously known/experienced	0.81 (8%)	0.73 (7%)
	Recommended wine	-0.17 (-2%)	0.04 (0.4%)
	Prestigious wine***	-0.64 (-6%)	-0.78 (-8%)
Grape variety	Cabernet Sauvignon (French variety) ***	1.77 (18%)	2.29 (23%)
	Grenache (Spanish variety)	-1.18 (-12%)	-1.33 (-13%)
	Merlot (French variety) ***	-0.60 (-6%)	-0.96 (-10%)

* Face-to-face interviews in supermarkets and streets (central city) of Barcelona.
** Compared to average of the applied price vector: 10 €/bottle
*** Statistically significant different between the forced and non-forced choices ($p < 0.01$ or $p < 0.10$)
Source: Kallas et al. (2013)

Pomarici et al. (2018) used an experimental auction method to assess younger Italian consumers' (n = 200) WTP for a range of water-related attributes of wine products. Specifically, this included three different wine products – a conventional wine product (i.e. no water saving), a water saving front-of-pack labelled product, and a water saving back-of-pack labelled product. The authors showed that participants bid a median price of €4.16 for the conventional wine product, and a median price of €4.51 (€0.35 premium) and €4.32 (€0.16 premium) for the front-of-pack and back-of-pack labelled wine products respectively (Pomarici et al., 2018).

A study in Portugal investigated the effect of region of origin on consumers WTP for wine. Ferreira et al (2020) conducted an experimental auction in three different Portuguese wine regions. Extrinsic cues tested were *region of origin, profile sensory, food pairing, grape variety, front label design, bottle form, wine history, winemaker, brand, and medals/awards*. An experimental auction methodology was used where participants were placed in two scenarios: a blind tasting with no information and; blind tasting with information. Results showed that participants placed more value on wine attributes when they had previous knowledge of the region of origin. This is likely due to the influence of wine acceptability and expected quality. Further, as the information available to consumers increased, so too did the WTP. Purchase frequency and less self-reported wine knowledge had a negative effect on WTP, while taste had a positive effect.

Asian studies

The current review includes two CE and other WTP studies examining the attributes of wine products in Asia (namely China). Attributes examined in these studies include country- and region-of-origin, vintage and brand.

Xu et al. (2014) used a mixed Logit model to examine Chinese consumers' WTP for country-of-origin, vintage and brand attributes in relation to red wine for personal consumption and gifting purposes. Table A83 shows that Chinese consumer WTP for red wine attributes differ depending on context (e.g. for personal consumption or gifting), with negative WTP shown for Chinese wines for gifting, as well as unanimously for non-branded wine products (Xu et al., 2014).

Table A83: Willingness-to-pay (Yuan) for red wine attributes for own consumption and gifting, China (N=540)

	Personal consumption	*Gift purchase*
USA to China	36.07	-63.3
USA to France	83.53	101.53
2- to 5-year old	57.42	36.81
2- to 10-year old	64.51	38.82
Branded to no brand	-91.32	-118.61

Source: Xu et al., 2014

Using the same dataset from the previous study, Xu and Zeng (2014) compared results using conditional logit and mixed logit models to examine Chinese consumers' WTP for red wine attributes. Table A84 shows differences in WTP estimates produced through the use of each method.

Table A84: Willingness-to-pay (Yuan) for red wine attributes for own consumption and gifting, China (N=540)

	Conditional logit	*Mixed logit*
California to China	-45.19	61.89
California to France	35.13	144.40
2- to 5-year old	35.77	39.36
2- to 10-year old	63.28	67.58
Branded to no brand	-115.36	-120.69

Source: Xu and Zeng, 2014

Other regions

The current review includes four CE and other WTP studies examining the attributes of wine products in other regions, including Australia and Russia. Attributes examined in these studies include country-of-origin and taste.

In another special occasion wine study by Mueller et al. (2010), the objective was to understand the importance of different wine label statements for regular wine consumers in Australia, not calculate WTP. The CE included a relatively large number of attributes, with ten different statements (history of the winery; local grape sources; production method; taste descriptor; elaborate taste descriptor; food pairing between wine and type of meal; consumption advice; environmental consciousness; website; and ingredients) either present or not on the label, plus price. Each alternative was represented with an undefined Australian wine with the same alcohol level to enhance the use of extrinsic cues in the choices. A

sociodemographic comparison indicates that the sample for this study is mostly aligned with the general Australian wine consumer population based on a wine consumer survey from Roy Morgan in 2007 (as cited in Mueller et al. 2010). The data was analysed with a consumer class segmentation approach which resulted in five distinct classes that varied in terms of preferences for certain label information and price, but not in terms of respondents' characteristics. Overall, the most influential label attributes associated with the wine choices were price, history, taste descriptors and food pairing. In contrast, environmental information, ingredients and website information on the labels had a relatively smaller, or negative, impact on choices. An additional analysis revealed that just over half of the participants, generally, read the wine labels and found them interesting as well as helpful.

In a Russian case study, Cicia et al. (2013) explored consumer preferences and WTP for red wine. Their CE included seven wine types varying by their geographical origin and quality-dependent price. Based on the estimated WTP (Table A85), three distinct segments were found: (1) high-quality-high-price Italian and French wines with WTP varying between €4.8-5.7/bottle, or 96-113 per cent of the base price; (2) a medium-quality wines (WTP of €2.96/bottle, or 54%); and (3) lower quality wines with WTP less than one Euro per bottle. Moreover, the non-CE results showed that wine consumption was generally described as occasional and that certification of origin was considered as a proxy for quality, which was also reflected in respondents' WTP (Cicia et al., 2013).

Table A85: Willingness-to-pay for wine attributes, Russia (N = 388*)

		WTP €/bottle	*Premium (%)***
Geographical origin (vs. Chile Cabernet)	Italy-Tuscany (Chianti)	5.66	(113%)
	France (Bordeaux)	4.81	(96%)
	Spain (Rioja)	2.69	(54%)
	Italy-Sicily (Cabernet)	0.97	(19%)
	Russia (Krasnodar Grenache dry)	0.92	(18%)
	Georgia (Saperavi dry)	0.06	(1%)

* Sample included Russian households located in Moscow, Saint Petersburg and Novosibirsk.
**Compared to the lowest value of the applied price vector including Chilean wine, approximately €5/bottle.
Source: Cicia et al. (2013)

Everett et al. (2018) investigated the WTP of consumers to pay for local muscadine wine (a variety of grape often used to make sweet red and white wines) (Everett et al., 2018). The authors used a choice experiment methodology of wine consumers residing in Tennessee, comparing North Carolina muscadine wine with Tennessee muscadine wine. Variables investigates were whether the consumer likes muscadine wine, a preference to drink red (over white), purchases from a winery, importance of purchasing local wine, and preparedness to pay a premium for local foods. The survey highlighted that while muscadines were a regionally important wine, many consumers had never tried them. Those that had were more likely to be older, live in rural areas, purchase from wineries, and prefer red wine. Overall there was a WTP a premium for locally produced wine, and weekly wine drinkers were more likely to have tried muscadine wine. Two consumer groups were identified: the first group viewed local wine as a 1, or "not important at all", and the second group viewed local wine as a 4, or "very important". The results showed that for each increase in the importance level of buying local wines, the WTP increased by USD 1.48. In contrast, each percentage point increase in premiums paid for local food held a WTP of USD 0.38 (see Table A87) (Everett et al., 2018).

Table A87: The WTP per bottle of local Muscadine wine in Tennessee (USD) (N=500)

	Willingness to pay per bottle*		
Variable	**Mean**	**Lower level**	**Upper level**
Sample mean	17.14	15.29	21.88
Group 1	13.46	11.75	16.23
Group 2	19.80	16.93	26.66
Effect on WTP of local wine	1.48	0.46	3.10
Effect on WTP of premium local foods	0.38	0.06	0.90

*95% confidence interval. All prices are in USD.
Source: Everett et al, 2018.

Cross-regional studies

Lastly, Mueller Loose and Remaud (2013) explored North American and European consumer preferences for wine choices which involve corporate social responsibility claims (an umbrella term for ethical and social attributes) alongside product price. Prior to the CE, participants were also asked about their awareness and trust of different claims in food and wine products. The survey targeting wine consumers resulted in between 982 and 2,027 respondents in different countries. The results show, firstly, that overall awareness, purchase penetration and trust with regards to social and environment claims were similar across for each claim but different across the markets. For example, compared to European markets, North American consumers seemed to have a higher level of trust and claim awareness. As shown in Table A88, WTP results support differences across markets, but also across the different label claims. Over all markets, the average WTP was highest for organic claims at around €1.20/bottle (or 14% premium) - twice as much than the WTP for the environmental claims. Across the markets, not all attributes were statistically significant in all countries, such as for social and environmental responsibility. In most of these markets, the organic attribute had the highest WTP, particularly in France and Germany. Negative WTP can interpreted as a consumer demand for a discount, or consumer dislike, if such labels exist for wine products, such as socially responsibility in French markets or the reduced glass weight of wine bottles. Overall, this cross-country study illustrates that differences might exist between different developed markets.

Table A88: Willingness-to-pay for wine attributes, USA, Canada, France, Germany and UK (N=11,322*: US n = 1,617 and n = 1,614, Canada n = 1,036 and n = 982, France n = 2,027, Germany n = 2,025, UK n = 2,021)

	Average all countries	By country	
	*Premium (%)***		*Premium (%)***
Social responsibility logo (vs. no logo)	2.3%	France	-3.4%
Environmental responsibility logo (vs. no logo)	6.6%	US East coast	10.4%
		US Midwest	7.3%
		CAN Anglo	8.8%
Organic logo (vs. no logo)	14.4%	UK	3.8%
		France	26.1%
		Germany	27%
		US East coast	17.6%
		US Midwest	10.7%
		CAN Anglo	12.8%
		CAN Franco	2.9%
Carbon zero logo (vs. no logo)	3.2%	UK	3.4%
		France	-3.1%
		Germany	-0.3%
		US East coast	9.6%
		US Midwest	5.2%
		CAN Anglo	4.0%
		CAN Franco	3.3%
10 per cent less glass logo (vs. no logo)	-2.9%	UK	-1.4%
		France	-4.3%
		Germany	-8.1%
		US East coast	1.2%
		US Midwest	1.7%
		CAN Anglo	-4.6%
		CAN Franco	-4.3%

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* Online survey, in 2009Samples in US included New York metropolitan area (Northeast) and Chicago metropolitan area (Midwest); samples in Canada included Anglophone and Francophone Canada
** reported in the study.
Source: Mueller Loose and Remaud, (2013)

A1.5 Other product categories

There has also been a number of CE and other WTP studies conducted for products that do not strictly fit in the previous categories (meat and seafood, dairy, fruit and vegetables, and wine) or include multiple types of food products. The current review includes 12 CE and other WTP studies examining the attributes of other types of food products in Europe and North America. Attributes examined in these studies include organic, local foods, GM production, country-of-origin, product quality, landscape of the place of origin, social responsibility, functional foods, environmental condition and carbon/GHG emissions associated with production.

European studies

The current review includes CE and other WTP studies examining the attributes of other types of food products (almonds, lamb, strawberries, olive oil, honey and chocolate) in Europe, including the markets of Belgium, Italy, Spain and the UK. Attributes examined in these studies

include organic, local foods, GM production, country-of-origin, product quality, landscape of the place of origin and social responsibility.

Bernabeu et al. (2022) explored Spanish consumers' WTP for a range of organic foods (as compared with conventionally produced foods) based on a typology of preference for organic foods. The authors identified three distinct consumer groups: 1) Consumers interested in buying organic food (*CIBOF*) (60.2 per cent of the sample); 2) consumers with no clear intention towards buying organic foods (*undecided*) (18.8 per cent of the sample), and; 3) Consumers not interested in buying organic foods (*CNIBOF*) (21 per cent of the sample). Table A89 below shows consumer WTP values (as a percentage of premium compared with conventional foods) for a range of organic food product types by the consumer segments identified above. This shows a range of positive premiums for organic food products across all identified consumer segments, with a spectrum of values shown based on interest in purchasing organic products. In addition, those in the CIBOF segment generally indicated the highest WTP for organic products in all categories (excluding *nuts and dried fruit, canned goods and juices*, and *red meat*) relative to other consumer segments (Bernabeu et al., 2022).

Table A89: Consumer WTP (% of premium compared with conventionally-produced food) for organic foods by food product type and consumer segment, Spain (n=415)

	CIBOF	Undecided	CNIBOF
Cereals and legumes	20.1	18.4	15.7
Vegetables and tubers	19.5	18.2	13.3
Nuts and dried fruit	19.4	19.8	17.3
Rice and pasta	19.3	17.0	15.4
Citric and other fruit	18.9	17.3	12.3
Wine	18.9	18.4	18.5
Olive oil	18.6	17.8	16.5
Jam	18.5	17.7	17.0
Medicinal and aromatic plants	17.9	16.7	15.9
Bread, biscuits and sweets	17.6	16.7	15.3
Honey	17.6	15.6	15.8
Canned goods and juices	15.9	17.3	14.1
Dairy products	15.9	13.0	11.6
Eggs	15.6	13.6	12.0
Red meat	15.2	15.9	11.6

Source: Bernabeu et al., 2022.

De-Magritis and Gracia (2016) examined Spanish consumers' WTP for almonds with organic and local attributes, including the inclusion of an EU organic label, as well as product labels indicating a series of distances between the production and consumption areas (i.e. food miles) (100km, 800km and 2,000km). Based on a series of preference questions, the authors placed participants in one of three segments: Segment 1 consisted of mostly male and younger participants who positively valued the organic and 100km labels and negatively valued the 2,000km label; Segment 2 consisted of mostly female and older participants who positively valued the organic and 100km labels and negatively valued both the 800km and 2,000km label; Segment 3 consisted of mostly female and older participants who positively valued both the organic and 100km label but negatively valued only the 2,000km label. Average WTP (€/package) for each of these attributes across the three segments are presented in Table A90 below. Results show participants in Segment 2 have the highest

negative WTP for higher food miles, while participants in Segment 3 have the highest positive WTP for organic and local foods (de-Magritis and Gracia, 2016).

Table A90: Willingness-to-pay for almonds with associated organic and local attributes, Spain (N=171), €/package

	Segment 1	Segment 2	Segment 3
Organic	0.27	0.85	1.22
100km label	0.21	1.18	1.40
800km label	-0.04	-1.01	0.23
2,000km label	-0.32	-1.68	-1.33

Source: de-Magritis and Gracia, 2016.

Arnoult et al. (2010) conducted a cross-product CE, focussing on UK consumers' WTP for COO and related attributes, including origin, season, type (GM or organic) alongside price. The sample size were just under 200 for both products. The WTP results reported in Table A91 indicate strong preferences for local products and an aversion to EU imports for both product types. WTP values were just under £1.94/kilo (or 37%-60% premium of the base price) and approximately -£1.10/kg (-22% and -34%). However, some seasonality differences were observed between product types as the WTP for lamb increased in spring whereas WTP for strawberries increased in summer. Another difference was observed was that while organic strawberries had higher WTP than GM-free berries, WTP was higher for GM-free lamb than organic lamb. Finally, a number of socio-demographic influences were tested, finding that the locality of product was valued higher by higher income people, higher weekly spending influenced WTP for lamb, whereas gender influenced WTP for strawberries over different seasons (Arnoult et al., 2010).

Table A91: Willingness-to-pay for lamb and strawberry attributes, UK (N = 185 lamb CE and N = 187 strawberry CE*)

		Lamb		Strawberries	
		WTP £/kg	*Premium (%)***	*WTP £/kg*	*Premium (%)***
Location (vs. Rest of the world)	Local	1.75	37%	1.94	60%
	National	-	-	-	-
	European Union	-1.06	-22%	-1.11	-34%
Seasonality (vs. winter season)	Summer			0.58	18%
	Autumn	-0.52	-11%	-0.49	-15%
	Spring	0.31	7%		
Type 1 (vs. nothing stated)	GM-free	0.59	12%	0.40	12%
Type 2 (vs. nothing stated)	Organic	0.29	6%	0.64	20%

* Face-to-face interviews in 2005.
** Compared to average of the applied price vectors (lamb: £4.74/kg and strawberries: £3.24/kg)
Source: Arnoult et al. (2010)

In a Spanish study, de-Magistris and Gracia (2014) used the "food miles" concept as part of the CE where alternatives vary across almonds produced between 100km and 2000km distances, versus no such labelling at all. The survey participants completed two sets of choice sets, where the second one was used for validity checking. In addition, at the end of this process each participant were offered €10 with a *hold-out set* including a purchase option. The estimated WTP values are described in Table A92, which shows positive preferences with WTP of €0.62-€0.68/100g, or a 30-33 per cent premium, towards an organic label and a 100km

label. WTP values towards longer distances were negative and increased according to total distance travelled, hence indicating preferences towards more local products (de-Magistris and Gracia, 2014).

Table A92: Willingness-to-pay for almond attributes, Spain (N = 171*)

		Average WTP €/100 g package (Premium %)**	
Production method (vs. No label: conventional)	EU organic label	0.62	(30%)
Origin of production (vs. no information of distance)	100-km label: almonds were produced within 100km (i.e., within province)	0.68	(33%)
	800-km label: almonds were produced around 800km (i.e., within Spanish or neighbour regions)	-0.25	(-12%)
	2000-km label: almonds were produced around 2000km (i.e., outside Spain but in Europe)	-1.03	(-49%)

* Random sample of respondents across the capital area of Spain.
** Compared to average of the applied price vector (€2.085/100g) based on the prices in supermarkets at the time.
Source: de-Magistris and Gracia (2014)

Aprile et al. (2012) assessed Italian consumer values for geographical and quality labels in olive oil products. These labels provide a tool to communicate sustainable production or products' value-added qualities. The labels included Protected Designation of Origin (PDO), Protected Geographical Indications (PGI) and organic farming (OF). The results suggested that all of these attributes affected consumer preferences with regards to olive oil product choices. Consumer WTP, as summarised in Table A93, ranged from €1.52 up to €5.60 per litre, being highest for the PDO label with an 86 per cent premium compared with the base price. The second highest WTP was found for the PF label. The authors commented higher WTP for the PDO label than the PGI label may be due to the fact that olive oil produced in the study location is typically PDO-certified (Aprile et al., 2012).

Table A93: Willingness-to-pay for olive oil attributes, Italy (N = 200*)

		WTP €/litre	*(Premium %)***
Type of olive oil/quality (vs. Virgin)	Extra virgin	4.44	(68%)
European OF label (vs. label absent)	Present	4.78	(74%)
European geographical indication (vs. label absent)	PDO label	5.60	(86%)
	PGI label	1.52	(23%)

* In-store interviews in grocery stores, 2010 in Naples.
** Compared to average of the applied price vector (€6.5/litre).
Source: Aprile et al. (2012)

In another Italian study, Cosmina et al. (2015) assessed consumer preference for honey attributes including product origin, product type, landscape of the place of origin and price. Most respondents (over 90% of the sample) were honey consumers – however, they typically consumed honey products only occasionally. The place of purchase varies between "buying directly from producer" and supermarkets. The result presented in Table A74 are based on the use of a consumer segmentation approach resulting in four consumer classes with similar choice patterns. People in the first class considered only the origin attribute in their choices. The other three classes were labelled as *'environmentally friendly'* consumers (35% of the

sample), *'pro-intensive production'* consumers and *'organic'* consumers. As Table A94 shows, *environmentally friendly* consumers had a WTP of between €4.76 and €3.99 (84 and 70 per cent) for organic and local honey respectively while indicating negative WTP for other attributes, whereas *pro-intensive production* and *organic* consumers were willing to pay between €2.54 and €8.30 (45 and 146 per cent respectively) for most attributes, with the type of honey valued the highest in both classes. Overall these WTP values indicate strong preferences towards local and organic attributes in honey with some differences in WTP between consumer segments. Only a small section of respondents (in Class 1) were not willing to pay any premium for any product other than the local product (Cosmina et al., 2015).

Table A94: Willingness-to-pay for honey attributes, Italy (N = 427*)

		Class 1 N/A	**Class 2 Environmentally friendly**	**Class 3 Pro-intensive production**	**Class 4 Organic**
Class probability		19%	35%	19%	27%
		WTP €/jar (premium %) **			
Geographic origin (vs. other Italian regions)	Friuli Venezia Giulia (local) Region	2.88 (51%)	3.99 (70%)	4.53 (80%)	5.41 (95%)
	Other countries	-	-6.45 (-114%)	-	-2.54 (-45%)
Honey crystallisation (vs. semi-solid state)	Liquid (runny) state	-	-4.84 (-85%)	8.30 (146%)	6.70 (118%)
Organic (vs. no)	Yes	-	4.76 (84%)	6.57 (116%)	6.33 (112%)
Landscape (vs. Skyscraper hives)	Evocative landscape	-	-	3.69 (65%)	2.54 (45%)
	Beehives near industrial buildings	-	-1.59 (-28%)	6.74 (119%)	5.23 (92%)

***** Face-to-face interviews, in 2014
** Compared to average of the applied price vector (€5.67/jar).
Source: Cosmina et al. (2015)

Migliore et al. (2022) examined Italian consumers' WTP for the functional food properties of organic eggs, including those enriched with Omega-3 using an experimental auction approach. The authors found that approximately 74 per cent of participants indicated that they would be willing to pay a premium for Omega-3 enriched organic eggs. In particular, participants indicated an average WTP for organic eggs of €1.64, and an average WTP for organic eggs enriched with Omega-3 of €1.80 (an additional €0.16) (Migliore et al., 2022).

Social responsibility attributes have been included in some, but not many, food and beverage choice studies. Vlaeminck et al. (2016) assessed consumer WTP for a Fair Trade (FT) chocolate product in Belgium. This was done using a within-sample test with two separate CEs: a "*FT-label* experiment" including the label (FT and Bio-FT), quality & taste, origin of cocoa and price attributes; and a "*FT-characteristics* experiment" with sub-attributes of FT covering environmental standards, price paid to producers, community investment, working conditions and product price. Half of the sample saw the FT-label CE first, with the other half seeing a reversed order. In this sample, the general purchase habits of FT products in general, if available, was split across (almost) never (approximately 50% of sample), regularly (42%) and always (5%); and only quarter of respondents defined a FT-product correctly. These general results also show that while most people (70%) believed the FT-statement, not everyone care

about these issues personally. A summary of the WTP results from the CE analysis is provided in Tables A95 and A96. As shown in Table A95, the results of the FT-label experiment show that consumers valued the FT-label with a positive WTP of €0.84/100g for the standard FT label and $1.22 for the Bio-FT label. This equates to 207 per cent and 301 per cent premiums, respectively, relative to the standard supermarket price. Average WTP for the FT-label was then compared with different combinations of the FT-characteristics (FT-high, FT-low, BioFT-high and BioFT-low). As shown in Table A96, WTP values for different FT-sub-attributes were between €2.25 and €3.76 (up to 928% premium); hence consumers valued the bundle of FT attributes more than the plain FT labels. The results of the plain FT-label valuation are comparable to the price premium operated in supermarkets indicating that consumer surplus is effectively captured.

Table A95: Willingness-to-pay for chocolate attributes, Belgium (N= 144*)

		CE with a Fair Trade label	
		WTP €/100g	Premium (%)**
Label presence (vs. no label)	Fair trade label	0.84	(207%)
	Bio-Fair trade label	1.22	(301%)

* Face-to-face intercept survey, in 2013.
** Compared to supermarket price of FT chocolate (€0.81/200g or €0.45/100g)
Source: Vlaeminck et al. (2016)

Table A96: Willingness-to-pay for chocolate attributes, Belgium (N= 144*)

Attribute bundles	CE with Fair Trade characteristics	
	WTP (€/200g)	Premium (%)**
FT highest outcomes: EU Environmental standard, price paid to producer, high community investment and frequent controls in working conditions	3.76	(928%)
FT lowest outcomes: EU Environmental standard, average price paid to producer, average community investment and infrequent controls in working conditions	2.54	(627%)
Bio-FT highest outcomes: Organic Environmental standard, fair price paid to producer, high community investment and frequent controls in working conditions	3.47	(857%)
Bio-FT lowest outcomes: Organic Environmental standard, average price paid to producer, average community investment and infrequent controls in working conditions	2.25	(556%)

* Face-to-face intercept survey, in 2013.
** Compared to supermarket price of FT chocolate (€0.81/200g or €0.45/100g)
Source: Vlaeminck et al. (2016)

Boccia et al. (2019) conducted a number of choice experiments to examine Italian consumer preferences and WTP for brand, corporate environmental and social responsibility programme participation in relation to ready-meal products. Results indicated approximate WTP for the inclusion of these attributes, with participants willing to pay a €2.46 premium for products with recognisable brand names that also participate in the above programmes. In addition, participants were willing to pay a €1.53 premium for products participating in environmentally friendly social responsibility programmes, while they were only willing to pay a €0.19 premium for only social responsibility programme participation (Boccia et al., 2019). A summary of these results is shown in Table A97 below.

Table A97: Willingness-to-pay for ready meal attributes, Italy (N = 1,083)

Attribute bundles	WTP (€/product)
Brand (well-known/recognised vs unknown); environmental programme participation; social responsibility participation programme	2.45895
Environmental programme participation; social responsibility participation programme	1.52860
Social responsibility participation programme	0.19325

Source: Boccia et al., 2019

Guney and Giraldo (2020) conducted a discrete choice experiment to understand consumer attitudes and WTP for organic eggs in Turkey. Aside socio-demographic characteristics, the authors investigated the egg attributes of *production method, brand, colour, and price.* Conducting a survey across seven regions of turkey, the researchers gathered a total of 552 responses by the household member responsible for purchases. The results showed that consumers perceive organic eggs to be healthier, more nutritious, and better tasting than conventional methods. Also, organic egg production was seen as being more sensitive to animal welfare and ethical issues. Table A98 below shows the results for the WTP of egg attributes (Gurney and Giraldo, 2020).

Table A98: WTP (₺) of Turkish consumers' for egg attributes

Attribute	WTP (Turkish Lira ₺)
Price	-
Egg type: Conventional	-
Egg type: enriched	0.04
Egg type: free-range	0.76
Egg type: organic	0.76
Brand: unbranded	-
Brand: local	1.02
Brand: big	0.81
Colour: white	-
Colour: brown	0.04

Source: Guney and Giraldo (2020)

North American studies

The current review includes CE and other WTP studies examining the attributes of other types of food products (canola oil and coffee) in North America (US and Canada). Attributes examined in these studies include organic, GM production, country-of-origin, social responsibility, functional foods, environmental condition and carbon/GHG emissions associated with production.

A comparison of GM (or genetically engineered (GE)) products and associated health-enhancing (or functional food) benefits were explored by Ding et al. (2015) in Canada. In this study, consumer preferences for GM-food were linked with consumer trust (generalized trust and trust in the food system) and health-related beliefs. In the context of canola oil products, the selected attributes covered GM or GE information, omega-3 content, COO and price. Consumer trust and health beliefs (i.e. health locus of control (HLC)) were measured in Likert-scale statements. The results in Table A99 show that consumers were willing to pay a premium

of between 12 and 29 per cent of the base price for domestic and/or regular/enhanced omega-3 levels over no label. However, this WTP was relatively lower compared to the perceived disutility, or required compensation, from the negative WTP associated with GM products. A further analysis with the interactions show (WTP not reported here) that stronger health concerns will increase WTP for enhanced omega-3, and that negative preferences of GM food can be offset or linked to trust. Some additional findings included that men valued GM products more than women, older people and those with higher education were less likely to prefer GM products, and that people with higher income valued health benefits more (Ding et al., 2015).

Table A99: Willingness-to-pay for canola oil attributes, Canada (N = 1,009*)

		WTP CAN $/1 litre	Premium (%)**
Omega-3 content (vs. no label)	Contains omega-3	0.95	19%
	Enhanced omega-3	0.86	17%
Country of origin (vs. USA)	Canada	1.45	29%
GM (vs. no label information)	Non-GM	0.60	12%
	Contains GM/GE	-1.82	-36%

***** Nationwide online survey

** Compared to average of the applied price vector ($5 per 1 liter)

Source: Ding et al. (2015)

Van Loo et al. (2015) focused on consumer preferences for sustainability certification of coffee products. The sustainability labels considered were Fair Trade (FT), Rainforest Alliance, USDA Organic and carbon footprint, the latter of which is less common in the US coffee market. A novelty in the study was a focus on visual attention on the choice sets (coffee packages) by respondents. This was done by an eye-tracking exercise on areas of interest (AOI) using a tracking device connected to the computer used to complete the surveys. From this, two measures were calculated - time and count of total fixation. In addition, Likert-scales were used to explore participants' attitudes to and perceived importance of the sustainability concepts. Three consumer segments were discovered based on the cluster analysis[3]: '*indifferent', 'sustainability and price conscious'* and "*price-oriented"* consumers. Relative WTP values presented in Table A100 show that respondents, on average, were willing to pay the most ($1.16/12oz, or 16% premium) for USDA certified coffee, and up to a 19 per cent premium for *'sustainability and price conscious'* consumers, which included most of the sample. The results also showed that visual attention to attributes is related to preferences for attributes whereby taking more time and fixating more attention on a particular attribute related to higher WTP. Significant interactions with participants' attention included USDA organic, Fair Trade and price attributes. Hence this study illustrated that *sustainability-motivated* consumers are also likely to seek information about sustainability credentials (Van Loo et al., 2015).

[3] Using the variables from the Likert scale questions and eye-tracking attention scores.

Table A100: Willingness-to-pay for coffee attributes, USA (N = 81*)

	Full sample		By consumer segments***		
			Sustainability and price conscious (n = 47)		Price-oriented (n = 26)
	WTP $/12 oz	Premium (%)**	WTP $/12 oz	Premium (%)**	
Fair Trade – label (vs. label not present)	0.68	(9%)	0.71	(10%)	-
Rainforest Alliance – label (vs. label not present)	0.84	(12%)	0.99	(14%)	-
USDA Organic – label (vs. label not present)	1.16	(16%)	1.41	(19%)	-
Carbon Footprint – label (vs. label not present)	-		0.51	(7%)	-

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* Participants were recruited from a University database, in 2013.
** Compared to average of the applied price vector ($7.30/12 oz)
*** Since the "Indifferent consumer" segment consisted of only 8 participants, no WTP was calculated.
Source: Van Loo et al. (2015)

A1.6 Products adopting new technology

Finally, some studies have considered the opportunities provided by technological advancements in relation to food choices. The current review includes CE and other WTP studies examining the attributes of food products adopting new technology in Europe (UK) and North America (US and Canada). Attributes examined in these studies include nanotechnology, animal welfare, food safety, traceability, country-of-origin, GM production, functional foods, RNAi, environmental condition and taste.

European studies

Erdem (2015) explored UK consumers' preferences for reduced food safety risk in chicken products. The authors tested the impact of incorporating nanotechnology into food product packaging by including this attribute (as a symbol) in one CE and not in the other. Other attributes of consideration were risk of food poisoning and animal welfare level (based on the Welfare Quality index). Each subsample was further split into "welfare-improved" chicken consumers and "conventional" chicken consumers according to their reported purchasing behaviour[4]. Other than the nanotech attribute, the levels used in the status quo option varied according to purchasing behaviour. As Table A101 shows, consumers on average preferred chicken with a lower food safety risk and improved animal welfare, regardless of the presence of nanotechnology. WTP values were found to be higher for the "welfare-improved" consumers compared with "conventional" consumers. It also appeared that the presence of nanotechnology could increase WTP for food safety and chicken welfare. A choice debriefing question revealed that around half of the respondents considered the inclusion of such nanotechnology to be "a good idea", with the remaining responses varying from "not bothered" to "more than concerned" (Erdem, 2015).

[4] Approximately 30% of the respondents in both samples were welfare-improved chicken consumers.

Table A101: Willingness-to-pay for chicken attributes, UK (N = 449*)

	Consumer type	Nano treatment (n = 225)		Non-nano treatment (n = 224)	
		WTP (£/chicken)	Premium (%) **	WTP (£/chicken)	Premium (%) **
Food poisoning risk: Reduction from a baseline	Conventional	-0.30	(-10%)	-0.30	(-3%)
	Welfare-improved	-0.59	(-20%)	-0.52	(-5%)
Chicken welfare level (scale 0-100)	Conventional	0.09	(3%)	0.08	(1%)
	Welfare-improved	0.67	(22%)	0.51	(5%)

* Online survey, in 2010
** Compared to average price (around £3/chicken).
Source: Erdem (2015)

North American studies

Lilavanichakul and Boecker (2013) explored Canadian consumer acceptance of traceability technology in ginseng products. This was explored amongst trade-offs with the products origin and manufacturer attributes. As summarised in Table A102, estimated WTP values implied a 16 per cent premium of the base price ($2.78/bottle) for having an internal tag for traceability/quality assurance. However, this WTP was relatively lower than for the inclusion of a Guarantee label or Canadian Ginseng product. The negative interaction term with a WTP of -$1.67/bottle for the simultaneous use of the 'Canadian Guaranteed' and 'Product of Canada' labels suggest that these attributes could be seen as substitutes (Lilavanichakul and Boecker, 2013).

Table A102: Willingness-to-pay for ginseng product attributes, Canada (N = 1,647*)

		WTP ($/bottle with 60 capsules)	Premium (%)**
Internal tag (vs. no)	Yes	2.78	(16%)
Manufacturer (vs. *Ontario Association of Ginseng Producers)*	National Manufacturer Brand	-2.34	(-14%)
Canadian Ginseng Guaranteed (vs. no)	Yes	9.52	(56%)
Product of Canada (vs. no)	Yes	5.74	(34%)
Canadian Ginseng Guaranteed* Product of Canada		-1.67	(-10%)

* Nationwide online survey
** Compared to average of the applied price vector ($16.99/bottle)
Source: Lilavanichakul and Boecker (2013)

In the third new-technology orientated CE, Yue et al. (2015) explored US consumer preferences for nano- and GM-food in the context of a rice product. The CE considered the possible benefits (e.g. better food safety) that these technologies could provide. The data was analysed using a class-based approach from which four distinct consumer groups, based on their choices and characteristics (gender, income, education, race/ethnicity, and political and religious associations), were identified (see Table A103). Most respondents were in the *'benefit orientated group'* with a likelihood of 40 per cent for participants to belong to this group. Across all groups, new technologies had a negative WTP, varying between -2 and -89 percent of the base price, thus the conventional production method was preferred. The most valued benefits varies across consumer groups. *'Price oriented'* consumers were willing to pay the most for the enhanced nutritional elements (an approximate 10 per cent premium) and no extra for improved taste or environmental impacts when compared to the provision of no

additional benefits. The remaining three groups were willing to pay most for improved food safety, (premiums of between 9 and 136 per cent), with the *'benefit oriented'* group indicating the highest WTP. These results imply that consumers express highly heterogeneous preferences when distinguished by their choices and consumer characteristics. While new technologies had negative WTP values, the attached benefits were valued differently across the groups. Thus, consumer preferences towards nanotechnology can include a complex set of trade-offs (Yue et al., 2015).

Table A103: Willingness-to-pay for (a bag of) white rice attributes: The latent class approach, USA (N = 1,117*)

		Class 1*** Price oriented	Class 2*** Technology averse	Class 3*** Benefit oriented	Class 4*** New technology rejecters
Class probability		18%	17%	40%	25%
		WTP ($/lb)			
		premium (%)**			
Production technology (vs. conventional)	Nanotechnology	-0.09 (-2%)	-0.70 (-16%)	-0.94 (-21%)	-3.39 (-77%)
	GM	-0.1 (-2%)	-0.78 (-18%)	-1.06 (-24%)	-3.9 (-89%)
Benefit from using the given technology (vs. no additional benefit)	Enhanced nutrition	0.42 (10%)	0.21 (5%)	5.16 (118%)	0.56 (13%)
	Improved taste	-	0.33 (8%)	2.99 (68%)	0.56 (13%)
	Improved food safety	0.22 (5%)	0.39 (9%)	5.96 (136%)	1.10 (25%)
	Less harmful environmental impact during production	-	-	4.08 (93%)	0.37 (8%)

Note: In this adapted Table, WTP was included only if the attribute was statistically significant.
* Online survey, in 2013
** Compared to average of the applied price vector ($$4.375/lb)
***Statistically significant class determinants: Class 1 reference group; Class 2 Gender; Class 3 Education, Gender, Income, Religion, Politics; Class 4 Gender, Religion
Source: Yue et al. (2015)

Britton and Tonsor (2019) investigated consumers' WTP to pay for beef products derived from RNA interference technology. This is a new technology that is not currently used in the meat sector, but has been successfully used in fruits and vegetables. Ribonucleic acid interference (RNAi) is a process in which small interfering RNA is introduced into an organism's cells and disrupts protein synthesis to alter traits such as muscle development, sex ratios and physiological changes in livestock. This technology has the potential to reduce the level of hormones and antibiotics used in the industry – something that consumers have been demanding. To investigate this further, the researchers adopted a choice experiment methodology and collected responses from an online survey of 3000 U.S. individuals. There were four choice experiment designs and respondents received one of these with an even spread across the sample (n=750). The three non-price beef steak attributes used in the study were *antibiotic use* (used, free, no claim), *RNAi use* (used, free, no claim), and *USDA grade* (choice and select). The results showed a negative association between price and the use of RNAi technology in beef steaks. This suggests that consumers will require a discount for beef products produced using RNAi, with specific magnitudes varying substantially based on the

label wording faced by consumers. Further, when other controversial attributes are present on the labelling of these products, such as antibiotic or hormone use, there is a potential market share to be gained for products using RNAi technology as an alternative. as opposed to antibiotics. This is important for the future use of the technology and its potential market viability (Britton and Tonsor, 2019).

A1.7 Summary

In conclusion, this review included 106 international CE and other WTP studies regarding food and beverage choices and associated credence attributes from 2010 to 2021. This complements and updates previous reviews (Driver et al., 2019; 2022; Miller et al., 2014; Saunders et al., 2016; 2018) with the inclusion of more recent studies. Most of the studies reviewed pertained to meat and seafood products (50), following by wine (15), fruit and vegetable (14) and dairy products (11). Another 16 studies were reviewed in other product contexts (e.g. coffee and chocolate) or food products adopting new technology to communicate food safety or traceability. Most studies examined consumer preferences, typically targeting regular purchasers of the type of product examined.

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Appendix B: Survey Instrument

Our Land and Water Science Challenge - Survey

Our Land and Water Science Challenge

The Drivers Project

Welcome to Our Land and Water Science Challenge survey.

We welcome your opinion on the international and domestic issues that have the potential to influence land use change/practice in New Zealand. The results will help Our Land and Water understand how New Zealanders prioritise the issues facing the primary sector, and provide market intelligence and foresight into consumer trends.

This survey takes about 10 minutes to complete. You have the right to decline answering any question or stop the survey at any time. If you do stop the survey before the end, the information you have provided will not be used. This survey is being conducted by the Agribusiness and Economics Research Unit (AERU) at Lincoln University in New Zealand.

The lead researcher is Professor Caroline Saunders. If you have any questions or concerns about the research, you may contact her at Caroline.Saunders@lincoln.ac.nz

To begin the survey, click on the >> button below.

Kind regards,

Caroline Saunders

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Q1 **Key Issues**: What do you see as the three most critical ***international*** issues that have the potential to influence **New Zealand land use change/practice**?

- 1 (Most critical) _____
- 2 _____
- 3 _____

Q2: **Key Issues:** What do you see as the three most critical ***domestic*** issues that have the potential to influence **New Zealand land use change/practice**?

- 1 (Most critical) _____
- 2 _____
- 3 _____

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Q3: **International Issues**

Below are some key issues that stakeholders and the team have previously identified.

Please indicate whether you think the following **international** issues/drivers will have a *high*, *medium* or *low* impact on New Zealand land use change/practice over the coming decade:

	High (1)	Medium (2)	Low (3)	Don't know (4)
Agricultural policy (1)	❍	❍	❍	❍
Air quality (2)	❍	❍	❍	❍
Animal health and welfare (3)	❍	❍	❍	❍
Authentication/traceability (4)	❍	❍	❍	❍
Biodiversity (5)	❍	❍	❍	❍
Biosecurity (6)	❍	❍	❍	❍
Brand (7)	❍	❍	❍	❍
Chemical residues (8)	❍	❍	❍	❍
Climate change (9)	❍	❍	❍	❍
Condition of the environment (10)	❍	❍	❍	❍
Country of origin (11)	❍	❍	❍	❍
Cultural values (12)	❍	❍	❍	❍
Demographics (13)	❍	❍	❍	❍
Digital communications systems (13)	❍	❍	❍	❍

	High (1)	Medium (2)	Low (3)	Don't know (4)
Emissions trading (14)	❍	❍	❍	❍
Extreme weather events (15)	❍	❍	❍	❍
Fair trade (16)	❍	❍	❍	❍
Family and community values (17)	❍	❍	❍	❍
Food safety (18)	❍	❍	❍	❍
Functional foods (19)	❍	❍	❍	❍
GM and nanotechnology (20)	❍	❍	❍	❍
Greenhouse gas emissions (21)	❍	❍	❍	❍
Health and safety (22)	❍	❍	❍	❍
Innovative products and services (23)	❍	❍	❍	❍
Local foods/food miles (24)	❍	❍	❍	❍

	High (1)	Medium (2)	Low (3)	Don't know (4)
Māori values (25)	❍	❍	❍	❍
Organic production (26)	❍	❍	❍	❍
Pasture-based production (27)	❍	❍	❍	❍
Product quality (28)	❍	❍	❍	❍
Public health (29)	❍	❍	❍	❍
Religion (30)	❍	❍	❍	❍
Social responsibility (31)	❍	❍	❍	❍
Soil quality (32)	❍	❍	❍	❍
Sustainable supply (33)	❍	❍	❍	❍
Trade agreements (34)	❍	❍	❍	❍
Trade policy (35)	❍	❍	❍	❍
Waste and recycling (36)	❍	❍	❍	❍
Water footprinting and use (37)	❍	❍	❍	❍
Water quality (38)	❍	❍	❍	❍

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Q7: **Domestic Issues**

Please indicate whether you think the following **domestic** issues and drivers will have a high, medium or low impact on **New Zealand land use change/practice** over the coming decade:

	High (1)	Medium (2)	Low (3)	Don't know (4)
Agricultural policy (1)	❍	❍	❍	❍
Air quality (2)	❍	❍	❍	❍
Animal health and welfare (3)	❍	❍	❍	❍
Authentication/traceability (4)	❍	❍	❍	❍
Biodiversity (5)	❍	❍	❍	❍
Biosecurity (6)	❍	❍	❍	❍
Brand (7)	❍	❍	❍	❍
Chemical residues (8)	❍	❍	❍	❍
Climate change (9)	❍	❍	❍	❍
Condition of the environment (10)	❍	❍	❍	❍
Cultural values (11)	❍	❍	❍	❍
Demographics (12)	❍	❍	❍	❍
Digital communications systems (13)	❍	❍	❍	❍
Emissions trading (14)	❍	❍	❍	❍
Extreme weather events (15)	❍	❍	❍	❍
Family and community values (16)	❍	❍	❍	❍

Food safety (17)	❍	❍	❍	❍
Functional food (18)	❍	❍	❍	❍
GM and nanotechnology (19)	❍	❍	❍	❍
Greenhouse gas emissions (20)	❍	❍	❍	❍
Health and safety (21)	❍	❍	❍	❍
Innovative products and services (22)	❍	❍	❍	❍
Local foods/food miles (23)	❍	❍	❍	❍
Māori values (24)	❍	❍	❍	❍
Organic production (25)	❍	❍	❍	❍
Product quality (26)	❍	❍	❍	❍
Public health (27)	❍	❍	❍	❍
Religion (28)	❍	❍	❍	❍
Social responsibility (29)	❍	❍	❍	❍
Soil quality (30)	❍	❍	❍	❍
Sustainable supply (31)	❍	❍	❍	❍
Waste and recycling (32)	❍	❍	❍	❍
Water footprinting and use (33)	❍	❍	❍	❍
Water quality (34)	❍	❍	❍	❍

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Q5: Which sector are you most aligned with?

- ❍ Meat (1)
- ❍ Dairy (2)
- ❍ Wool (3)
- ❍ Viticulture/Wine (4)
- ❍ Horticulture (5)
- ❍ Forestry (6)
- ❍ Aquaculture (7)
- ❍ Government (8)
- ❍ Māori enterprise (9)
- ❍ Science/Research (10)
- ❍ Extension work (11)
- ❍ Smart agriculture (12)
- ❍ Other (please specify) (13)

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Q6: How **important** do you consider the following product attributes in achieving **higher product value** from lower volume for New Zealand agricultural products?

	Very important (1)	Important (2)	Neutral (3)	Unimportant (4)	Very unimportant (5)	Don't know (6)
Animal welfare credentials (1)	❍	❍	❍	❍	❍	❍
Low carbon footprint (2)	❍	❍	❍	❍	❍	❍
Lower environmental impact of production (3)	❍	❍	❍	❍	❍	❍
Food safety (4)	❍	❍	❍	❍	❍	❍
Free range (5)	❍	❍	❍	❍	❍	❍
GM-free (6)	❍	❍	❍	❍	❍	❍
High quality (7)	❍	❍	❍	❍	❍	❍
Low level of processing (8)	❍	❍	❍	❍	❍	❍
Low price (9)	❍	❍	❍	❍	❍	❍
Made in New Zealand (10)	❍	❍	❍	❍	❍	❍

	Very important (1)	Important (2)	Neutral (3)	Unimportant (4)	Very unimportant (5)	Don't know (6)
No additives (11)	❍	❍	❍	❍	❍	❍
Organic production (12)	❍	❍	❍	❍	❍	❍
Personal health-enhancing (13)	❍	❍	❍	❍	❍	❍
Reduced water use (14)	❍	❍	❍	❍	❍	❍
Reduced energy use (15)	❍	❍	❍	❍	❍	❍
Regenerative farming (16)	❍	❍	❍	❍	❍	❍
Glysophate-free (17)	❍	❍	❍	❍	❍	❍
Freshness (18)	❍	❍	❍	❍	❍	❍
Good reputation of producer/grower (19)	❍	❍	❍	❍	❍	❍
Produced by kind, generous people (20)	❍	❍	❍	❍	❍	❍
Produced by a family enterprise (21)	❍	❍	❍	❍	❍	❍
Produced by a Māori enterprise (22)	❍	❍	❍	❍	❍	❍
Reduced chemical residues (23)	❍	❍	❍	❍	❍	❍
Socially responsible production (24)	❍	❍	❍	❍	❍	❍
Taste (25)	❍	❍	❍	❍	❍	❍
Traceability to farm (26)	❍	❍	❍	❍	❍	❍
Seasonal availability (27)	❍	❍	❍	❍	❍	❍
Care for workers (28)	❍	❍	❍	❍	❍	❍
Care for traditional cultures (29)	❍	❍	❍	❍	❍	❍

	Very important (1)	Important (2)	Neutral (3)	Unimportant (4)	Very unimportant (5)	Don't know (6)
Brand (30)	❍	❍	❍	❍	❍	❍
Nutritional content (31)	❍	❍	❍	❍	❍	❍
Pasture-raised rather than housed indoors (32)	❍	❍	❍	❍	❍	❍
100% grass fed (33)	❍	❍	❍	❍	❍	❍
Other, please specify: (34)	❍	❍	❍	❍	❍	❍

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Q7: Agribusinesses can belong to or participate in many schemes for quality assurance, marketing, certification or other purposes. For the next few questions, we are calling all of these ***'agribusiness schemes'***. Examples of agribusiness schemes include programmes such as New Zealand Farm Assurance Programme (NZFAP) and GlobalGAP.

Are you currently participating in an ***agribusiness scheme***?

- ○ Yes
- ○ No

[If 'No' selected, skip to Q11]

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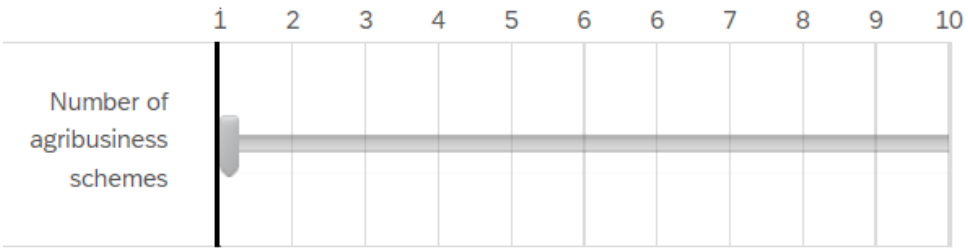
Q8: **How many** agribusiness schemes are you currently participating in?



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Q9: Does the agribusiness scheme(s) that you are participating in account for **environmental**, **social**, **economic**, and/or **cultural** dimension(s)?

	Is this dimension included in the evaluation criteria for the agribusiness scheme(s) that you participate in?		How many criteria are used to assess this dimension under the agribusiness scheme(s) that you participate in?	How often are you audited/assessed for your compliance with your agribusiness scheme(s) requirements for this dimension?			
	Yes	*No*	*Number of criteria*	*Monthly*	*Quarterly*	*Annually*	*Less than annually*
Environmental	○	○		○	○	○	○
Social	○	○		○	○	○	○
Economic	○	○		○	○	○	○
Cultural	○	○		○	○	○	○

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Q10: How much does your agribusiness scheme(s) affect the **prices** that you get for what you sell?

- ○ Large increase in prices received
- ○ Moderate increase in prices received
- ○ Small increase in prices received
- ○ No increase or decrease in prices
- ○ Small decrease in prices received
- ○ Moderate decrease in prices received
- ○ Large decrease in prices received

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Q11: What level of knowledge do you have concerning the following markets/regions:

	Very knowledgeable (1)	Knowledgeable (2)	Some knowledge (3)	Little knowledge (4)	No knowledge (5)
North America (Canada, USA, Mexico) (1)	❍	❍	❍	❍	❍
China (2)	❍	❍	❍	❍	❍
South East Asia (Vietnam, Thailand, Cambodia, Indonesia, Malaysia, Myanmar) (3)	❍	❍	❍	❍	❍
Japan (4)	❍	❍	❍	❍	❍
South Korea (5)	❍	❍	❍	❍	❍
European Union (6)	❍	❍	❍	❍	❍
Other European countries (7)	❍	❍	❍	❍	❍
United Kingdom (8)	❍	❍	❍	❍	❍
Other (Please specify): (9)	❍	❍	❍	❍	❍

Q12: Please indicate the extent of your experience in the following areas:

	Extensive (1)	High (2)	Moderate (3)	Some (4)	None (5)
International markets (1)	❍	❍	❍	❍	❍
Environmental policy (2)	❍	❍	❍	❍	❍
R&D/innovation (3)	❍	❍	❍	❍	❍
Trade policy (4)	❍	❍	❍	❍	❍
Other domestic (5)	❍	❍	❍	❍	❍

Q13:

Thank you!

Thank you for your contribution to our research.

We value the time and contribution you have made to setting the direction of this National Science Challenge. If you have any queries, please contact:

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