A scoping of climate change implications for the New Zealand summerfruit industry

A REPORT FOR

Summerfruit New Zealand

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1. Summary

This report scopes the implications of climate change for the summerfruit industry based on currently available data, and presents the issues and opportunities for the industry to develop appropriate strategies. As both a primary industry and an exporter, the implications of climate change for the industry are of major significance, although the time frame for them is long.

Despite remaining uncertainties about the *magnitude* of regional climate changes, certainty is growing as to the *direction* of expected changes over the coming century.

Many of the general trends identified for New Zealand apply to Hawke's Bay and Central Otago. These include:

- Mean temperature increases of around 1°C by 2040 and 2°C by 2090 apply fairly consistently to all seasons in Hawke's Bay and Central Otago. However, the range of projected warming ranges from negligible up to 2.5°C by 2040 and 5°C by 2090.
- The projected future changes in precipitation show a marked difference between Central Otago and Hawke's Bay.
    - The annual averages are anticipated to decline slightly (-3 to -4%) in Hawke's Bay, but the seasonal averages show much greater variation.
    - Annual average precipitation is anticipated to rise by 7 - 12% in Central Otago, with the most change in winter rainfall with average increases of around 16% by 2040.
- Local impacts of climate are likely to depend more on changes in the frequency of extreme events (such as heavy rainfall, drought or very high temperatures) than on changes in average conditions. However, these two aspects of climate – averages and extremes – are closely connected. A small change in average conditions can lead to a large change in the frequency with which extremes occur.
- There is significant variability in the seasonal ranges that are projected. At the high and low end of the range these generally represent significant changes in precipitation and temperature for both Hawke's Bay and Central Otago.
- Based on the latest Intergovernmental Panel on Climate Change (IPCC) and other reports increasing global emissions are already resulting in the "worst case" scenarios. If this is so, the resultant changes are likely to be more extreme and occur faster than projected.
- For both regions such changes will impact on fruit physiology and production e.g. through water shortage and a reduction in winter chill

Climate change may offer advantages and disadvantages for both regions and to some extent these may balance each other. These impacts are difficult to assess precisely as there is a wide range of possible interactions between growing practices, region and climate. However, overall, the potential negative impact may be greater for Hawkes Bay than for Central Otago, depending on access to water.

2. Introduction

SummerfruitNZ has secured funding from the Sustainable Farming Fund to scope the implications of climate change for the summerfruit industry. It is not within the scope of the report to identify solutions but rather present the issues/opportunities as guidance to inform the industry that may then develop appropriate mitigation and adaptation strategies e.g. research and development options.

The New Zealand summerfruit industry comprises 335 growers on approximately 2,300 hectares and is centred on two main production regions: Hawkes Bay and Central Otago. Hawkes Bay growers mainly supply fresh summerfruit to the domestic market and processing fruit to Heinz Wattie's Ltd. Central Otago is more export-oriented and grows a wider variety of summerfruit, with a larger proportion of cherries and apricots.

Seventy percent of all summerfruit produced in New Zealand is consumed on the domestic market (see Table 1). The export market takes a about a further 25% ($21.5m) with the remaining 5% being processed. The key export markets for New Zealand are Australia for apricots, and Taiwan, Korea and Thailand for cherries. The UK/EU and the USA are currently less than 5% but are growing markets for both crops.

Table 1. Summerfruit sales 2007/08 (tonnes)

	NZ Domestic total	Export total	Export & NZ Market total	% Export	% NZ Market
Apricots	2,281	953	3,234	30.0	70.0
Cherries	797	1,307	2,104	62.0	38.0
Nectarines	3,971	19	3,990	0.5	99.5
Peaches	3,290	24	3,314	0.7	99.3
Plums	1,885	42	1,927	2.2	97.8

This report outlines the:
- Summerfruit production in New Zealand
- climate change projections (for New Zealand, Hawke's Bay and Central Otago)
- climate change impacts on summerfruit production
- climate policy impacts and implications for markets.

It also scopes areas that growers can address, both in the short and medium term, including
- gaps in knowledge in industry resources to deal with climate change, and
- mitigation and adaptation responses.

3. Summerfruit Production in New Zealand

Before addressing climate change projections, this section outlines the activities within the production system that are likely to be impacted by climate change, and the climate requirements of the crops.

3.1. Summerfruit minimum physiological requirements

Summerfruit crops have certain climatic requirements for their physiology and development; they require the following as a minimum:

- A period of winter chill
- Winter hardiness to extreme cold (this is not usually an issue for New Zealand)
- Sufficient heat units to flowering
- Frost tolerance or avoidance at flowering and early fruit development
- Sufficient growing degree days between the incidences of frost and ripening
- Absence of rainfall at fruit maturity for cherries
- Adequate soil moisture.

The climate requirements that are likely to limit the production of summerfruit, either by their absence, or through their disruptive effects, are described in Table 2.

Table 2. Climate requirements for summerfruit likely to limit production

Climate requirement	Definition	Comment
Winter chill	The number of hours below a specified base temperature (often 7°C).	Winter chill is accumulated after about May 1. Plants need to be physiologically dormant to be receptive to winter chilling. A warm autumn and winter may not provide sufficient winter chill.
Winter hardiness	The number of days below a very low temperature.	Trees must be able to withstand periods of intense cold.
Frost tolerance	The degrees of frost and the length of time that a susceptible plant part can tolerate freezing.	Overhead sprinklers provide frost protection, where present.
Even transition between late winter and spring	Absence of extremes of temperature.	After winter chill is received, warm periods in winter can promote early flowering. Subsequent cold periods can result in abortion of flowers and small fruit.
Sufficient Heat Units	Growing degree days (GDD) above a base temperature, often 7°C.	Sufficient growing degree days are required for the fruit to ripen.
Soil water availability	Water available for extraction by the roots.	Provided by either rainfall or irrigation.

From the above table it can be seen that summerfruit, as flowering perennials, have quite specific and sequential climate requirements compared to annual crops and other perennial crops such as timber trees and grasslands.

4. Climate change projections

Climate change is anticipated to change the frequency and intensity of climate-related risks as well as introducing some long-term shifts in climate regimes across the country. Projections of future climate are derived from scenarios and climate models and hence are not predictions.

4.1. New Zealand

There are a number of reports identifying climate change impacts for New Zealand. This section is largely based on a recent report by Ministry for the Environment (MfE) [1]. This report bases its projections of climate change on a specific scenario developed by the IPCC. The scenario (A1B) used describes a future world of very rapid economic growth, global population that peaks mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. The A1 family is split into three groups that describe alternative directions of technological change in the energy system: fossil intensive (A1FI), non-fossil energy sources (A1T) or a balance across all sources (A1B). The model used in the MfE report and here is the A1B model: a balance across all sources. This is a middle range projection.

Despite remaining uncertainties about the *magnitude* of regional climate changes, certainty is growing as to the *direction* of expected changes over the coming century. This direction of projections for New Zealand is shown in Table 3.

Table 3. Direction of projections for climate change.

Climate variable	Direction of change
Mean temperature	Average temperatures expected to increase by about 1°C by 2040, and 2°C by 2090.
Daily temperature extremes (frosts, hot days)	Fewer cold temperatures and frosts, more high temperature episodes.
Mean rainfall	Varies around country, and with season. • Increases in annual mean expected for Tasman, West Coast, Otago, and Southland; • Decreases in annual mean in Northland, Auckland, Gisborne and Hawke's Bay Substantial variation around the country and with season.
Extreme rainfall	Heavier and/or more frequent extreme rainfalls, especially where mean rainfall increase predicted.
Wind (average)	Increase in the annual mean westerly component of wind flow across New Zealand.
Strong winds	Increase in severe wind risk possible.
Snow	Shortened duration of seasonal snow lying, rise in snowline and a decrease in snowfall events.
Sea level	Increase of at least 18–59 cm rise (New Zealand average) between 1990 and 2100.

It is important to note that recent reports [2] suggest increasing global emissions are already resulting in the "worst case" scenarios that were projected in the last international assessment report [3]. This indicates that the climate system is now moving beyond natural variation, and there is a significant likelihood that these trends will accelerate. If this is so the above projections may be conservative and changes may also happen significantly faster.

4.2. Climate projections for Hawke's Bay and Central Otago

In this section we go from the general projections for New Zealand to those projections applicable to Hawke's Bay and Central Otago.

The MfE (2008) report [1] includes climate projections and identifies changes anticipated by around 2040 and 2090 for regional council areas in New Zealand. This report provides data on what the average change is projected to be as well as possible range of outcomes. Many of the general trends identified for New Zealand apply to Hawke's Bay and Central Otago. The relevant temperature, rainfall and wind data for these regions are provided in Annex 2 and a summary of key features is provided in Table 4.

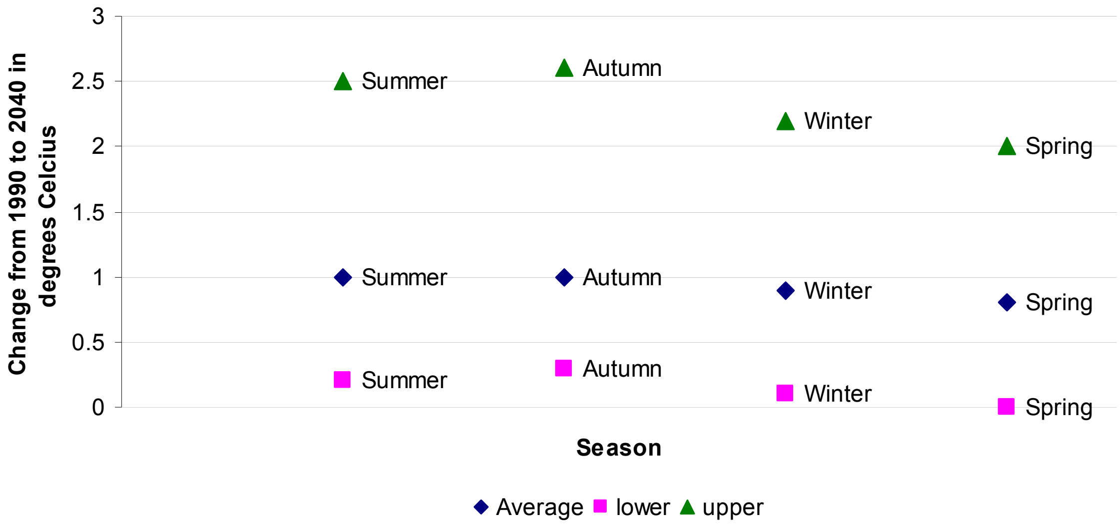
4.2.1. Temperature

The projections show that mean temperature increases of around 1°C by 2040 and 2°C by 2090 apply fairly consistently to all seasons in Hawke's Bay and Central Otago. However, the range of projected warming ranges from negligible up to 2.5°C by 2040 and 5°C by 2090.

Hawkes Bay

Figure 1 shows the projections for the Hawke's Bay until 2040. For example the average temperature in summer is projected to be about 1 °C warmer in 2040 but with a possible range from about 0.3 °C to 2.5°C warmer. Thus while on average a 1 °C is projected, the potential range is significant.

Figure 1. Three projections for potential temperature increases in Hawke's Bay 1990 - 2040

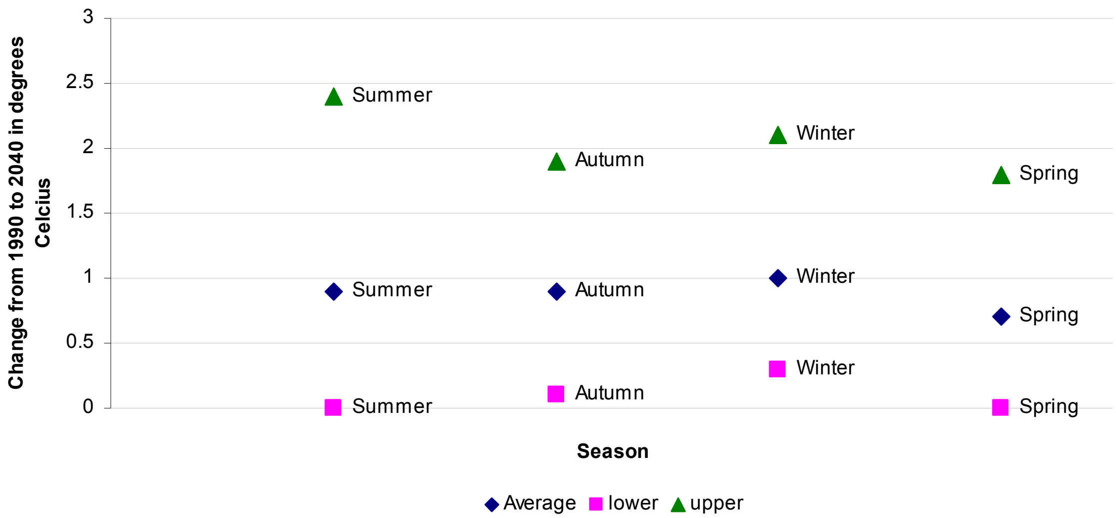


While a 1°C change from 1990 may not seem significant to put it in perspective the 1997/98 summers which many New Zealanders remember as particularly long, hot and dry was only about 0.9°C above New Zealand's long term average for the 1990s.

Central Otago

Figure 2 shows projections for Central Otago. The average shows between 0.5°C and 1 °C increase. However, there is also a significant range in the projections albeit not as great as for Hawke's Bay.

Figure 2. Three projections for potential seasonal temperature increase in Central Otago 1990 – 2040



4.2.2. Precipitation

The projected future changes in precipitation show a marked difference between Central Otago and Hawke's Bay.

Hawke's Bay

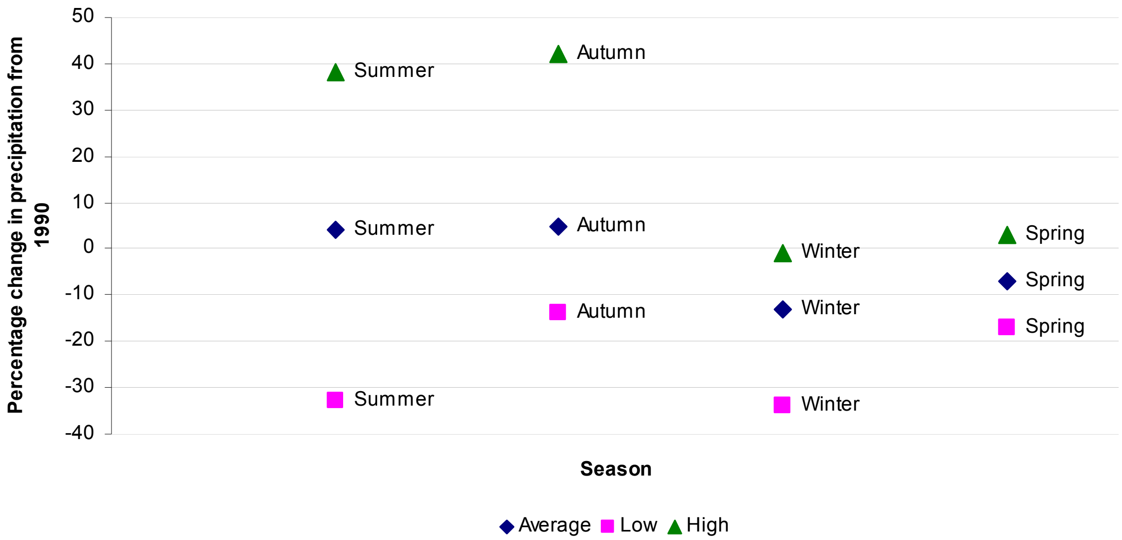
The annual averages are anticipated to decline slightly (-3 to -4%) in Hawke's Bay but the seasonal averages show much greater variation. These are outlined in Figure 3 for 2040. For example the region could see a 13% decrease in average winter precipitation by 2040 but with a potential range from a 1% decrease to a 34% decrease.

To put this in context 2008 rainfall for the Hawkes Bay region was 15% less than the 30 year average[1].

Conversely projections are for a small increase in precipitation in summer by 2040 (4%) and 9% by 2090. The projections out to 2090 show further decreasing winter and spring precipitation also with wide variation between the high and low estimates. At the low end of the range Summer precipitation will be 46% less than 1990 in 2090.

[1] http://www.hbrc.govt.nz/WhatWeDo/Water/Rainfall/2008RainfallSummary/tabid/970/Default.aspx

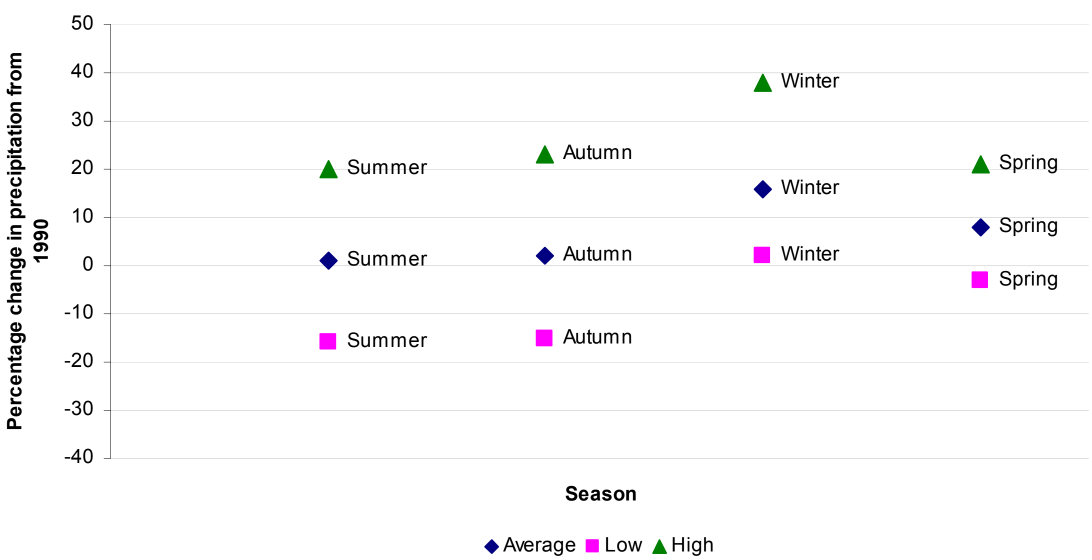
Figure 3. Three projections for percent change in precipitation in Hawke's Bay from 1990 - 2040



Central Otago

Annual average precipitation is anticipated to rise by 7 - 12% in Central Otago with the most change in winter rainfall with average increases of around 16% by 2040 and 29% by 2090. Summer precipitation may be little affected.

Figure 4. Three projections for percent change in precipitation in Central Otago from 1990 – 2040.



4.2.3. Wind

The most prominent changes in wind patterns across the country are projected to be a marked increase in westerly winds during winter, with a slightly less pronounced increase in spring. No specific guidance is available at a regional level that would be appropriate for summerfruit.

4.2.4. Summary

In line with the overall projections for New Zealand average temperatures are projected to rise as shown in Table 5.

Table 4. Summary of projected climate impacts on Hawke's Bay and Central Otago

Projected average change	Time period	Central Otago	Hawke's Bay
Temperature change (°C) Summer	1990-2040	+ 0.9	+ 1.0
	2040-2090	+ 2.0	+ 2.1
Temperature change (°C) Winter	1990-2040	+ 1.0	+ 1.0
	2040- 2090	+ 2.2	+ 2.1
Rainfall change (%) Summer	1990-2040	+ 1	+ 4
	2040-2090	+ 1	+ 9
Rainfall change (%) Winter	1990-2040	+ 16	- 13
	2040- 2090	+ 29	- 16

Note: Wind data is not region-specific so has not been added in the table above.

It is important to put these projected average changes in some context. This includes:

1. Local impacts of climate are likely to depend more on changes in the frequency of extreme events (such as heavy rainfall, drought or very high temperatures) than on changes in average conditions. However, these two aspects of climate – averages and extremes – are closely connected. A small change in average conditions can lead to a large change in the frequency with which extremes occur. The MfE website has further explanation of this[2].

2. There is significant variability in the seasonal ranges that are projected. At the high and low end of the range these generally represent significant changes in precipitation and temperature for both Hawkes Bay and Otago.

3. Based on the latest IPCC and other reports increasing global emissions are already resulting in the "worst case" scenarios. If this is so, the resultant changes are likely to be more extreme and occur faster than projected.

4. For both regions such changes would impact on fruit physiology. For example:
   - For Hawke's Bay water is likely to be the key concern and will impact on production systems.
   - For Central Otago there may be increased winter rainfall, but a decrease in average snow cover. This may impact on summer river flow in the Clutha river. Summer rainfall will not be less, and may increase.

5. Climate change impacts on Summerfruit production

A comparison of projected climate change with the summerfruit production system provides an understanding of both positive and negative impacts on summerfruit production. These are outlined in Table 5.

[2] http://www.mfe.govt.nz/publications/climate/climate-change-effect-impacts-assessments-may08/html/page4.html

Table 5. Projected climate change and impacts on summerfruit production

Climate factors	Possible impacts	Possible outcome for production	Is outcome positive or negative for summerfrut production?
Increase in mean annual temperature	Insufficient winter chill	Reduced flowering, decreased yield.	Negative
	Fewer early frosts	Reduced crop losses	Positive
	Early spring	Advance crop	Positive
	Early spring followed by cold weather	Advance crop, and then cause flower/fruit abortion	Negative
	Warm spring	Potential set up for good fruit size	Positive
		However too hot can lead to non-viable pollen	Negative
	Warm summer	Good fruit size/finish high sugars advance harvest	Positive
	Late onset of winter	Delay dormancy/leafdrop/bud set?	Negative
Increased westerly winds (winter/spring)	Possible reduced bee activity	Reduce flowering and/or pollination and fruit set?	Negative
Decreasing winter/spring rainfall (East)	Less spring rain	Reduce bacterial leaf spot and brown rot incidence	Positive
Decreasing annual average rainfall		Decreased yield, lost crop	Irrigation may compensate.
Increasing summer/autumn rainfall (Hawke's Bay)	Heavy summer rain	Splitting fruit and disease reduces marketable yields.	Negative
Increasing /autumn rainfall (Central Otago)	Heavy autumn rain	Good autumn root growth and increase fruit size following year	Positive
		less able to harden off tree for winter frosts	Negative
Increasing risk of dry periods or droughts (Hawke's Bay)	Water restrictions	Lower fruit size and yield	Negative

In addition there is an increased risk of extreme events whether this is rainfall, temperature or wind or a combination thereof. Depending on timing these have the potential to have a significant impact on production by exacerbating many of the above negatives.

In addition to the direct effects of climate on fruit production, climate may have an indirect effect on factors such as pests and diseases. For example:

- Stressed trees may be more susceptible to pests and diseases otherwise kept under control.

- New climates may alter the prevalence of existing pest and diseases, or provide environments for new pests and diseases. For example, for all rootstocks in peaches in Chile, Phytophthora root and crown rot severity increased considerably after repeated soil saturation episodes [4].

In summary:

There are advantages and disadvantages for both regions and to some extent these may balance each other. These impacts are difficult to assess precisely as there is a wide range of possible interactions between growing practices, region and climate. However, overall, the potential negative impact may be greater for Hawke's Bay than for Central Otago depending on access to water.

6. Climate change projections for other countries

Climate changes may have a direct effect on summerfruit production, and an indirect effect via impacts, on competitor's production in other climatic regions.

In general the following impacts have been noted on global regions [5]:

- Food production, at the global scale, might be slightly down overall in the first half of the 21st century, but will be significantly reduced after that.
- Importantly, crop production in (mainly low latitude) developing countries would suffer more, and earlier, than in (mainly mid- to high-latitude) developed countries, due to a combination of adverse agro-climatic, socio-economic and technological conditions.

The IPCC Fourth Assessment Report [3] adds to the previous assessment findings. It includes discussion of a range of impacts on global food, fibre and forests [6].

- The models suggest that climate change associated with warming of 1-3^{O}C may bring small increases in crop yields to mid- to high-latitude regions, but even slight warming decreases yields in seasonally dry and low-latitude regions. However, they also caution that the projected frequency and severity of extreme climate events have significant consequences for food and forestry production, and food security, in addition to impacts of projected mean climate. Climate variability and change also modify the risks of fires, and pest and pathogen outbreaks.

- Food and forestry trade is projected to increase in response to climate change, with increased dependence on food imports for most developing countries. Exports of temperate zone food products to tropical countries will rise.

At a level more specific to the summerfruit industry the following are some examples of the impacts of climate change on summerfruit or horticultural production internationally:

- Australia has been dealing with restricted water availability for many years and recognises the increased risks from climate change. The Victoria horticulture industry has guidelines for using recycled water [7].

- One of the most spectacular effects of the warmer climate in Hungarian orchards is the faster bud development and earlier blooming of fruit trees, including apricots with a 49-day difference between the blooming time of apricot varieties in two years [8].

- In Oman long-term temperature records indicated that the number of chill hours decreased markedly over the past 23 years [9]. This decline is the most likely cause for the almost complete crop failure of pomegranate, peach and apricot at intermediate altitude and very low yields of peach and apricot during the season of 2005/06. The rate of decline in chill hours was noted as "alarming".

- On the "positive side" a comprehensive modeling exercise in British Colombia found that the anticipated climate change appears to favour *Prunus* production in the Okanagan Valley, except for increased rainfall on sweet cherry production [10].

It is outside of the scope of this report to provide a detailed analysis of the impact of climate change projections on New Zealand's summerfruit competitors. However, it appears that other summerfruit sectors internationally are being impacted by climate change and are to varying degrees undertaking analysis to enable them to understand the impacts on their sector.

7. Climate policy impacts

7.1. New Zealand's international obligations

There are a number of international obligations of direct relevance to summerfruit.

7.1.1. National Greehouse gas (GHG) inventory

The New Zealand Greenhouse Gas Inventory is required under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. It is an inventory of New Zealand's greenhouse gas emissions and removals from six sectors: energy; industrial processes; solvents; agriculture; land use, land-use change and forestry; and waste.

New Zealand GHG emissions in 1990 (excluding the land use, land-use change and forestry sector) were around 62 million tonnes carbon dioxide equivalent (Mt CO_2e). In 2006, total greenhouse gas emissions were 78 Mt CO_2e which was 26% higher than in 1990. Net removals of CO_2 through forest sinks is reported to have increased from 21 Mt CO_2 in 1990 to 23 Mt CO_2 in 2006.

As at May 2008, the net position is projected to be a deficit of 21.7 million units during the first commitment period up to 2012. Around half of all NZ GHG emissions are non-CO_2 emissions from agriculture (methane and nitrous oxide). Growth in emissions is mainly in the energy and agriculture sectors.

The GHG impacts of the summerfruit industry are mostly reported within the land use change and forestry sector of the national GHG inventory. The main features relating to summerfruit operations are:

- Significant emissions arise from the use of transport fuels and other energy sources that are included in the energy sector of the inventory.
- Emissions of nitrous oxide resulting from the application of nitrogenous fertilizers is the main component of reporting in the agriculture sector.
- As a general rule, all carbon dioxide sequestered on the land and carried through agricultural products is excluded, because it is considered to be too short-lived and hence of little importance to the global climate system.

- Similarly the carbon transferred offsite in food, fibre, fuel or other products is rarely included and hence are considered carbon neutral.

Although the impact on the atmosphere of these elements may be limited, including sequestration and products transferred off site could provide important signals to producers and consumers wanting to reduce GHG emissions.

7.1.2. Kyoto Protocol (KP)

New Zealand joined KP and in doing so committed to reduce its average net emissions of greenhouse gases over commitment period 1 (CP1) to 1990 levels or to take responsibility for the difference. New Zealand expects to meet its commitment through:

- emissions reductions,
- offsetting emissions by forests,
- carbon trading and
- participation in projects under the KP flexibility mechanisms e.g. Joint Implementation and the Clean Development Mechanism, which enable countries to jointly reduce emissions.

Depending on the type of system in place, orchards could be considered as forestry, permanent cropland, or grassland with woody vegetation. These land use categories and activities have little impact on reporting but can affect the accounting system to be applied. For example afforestation is a required activity for which stock changes in biomass and soils must be accounted for by New Zealand under the KP, whereas the changes resulting from the management of forests is not accounted by New Zealand. Similarly the GHG impacts of cropland management are not accounted by New Zealand.

It might be possible for orchard activities to be awarded voluntary carbon credits that are not related to the Kyoto Protocol.

7.2. Policy and regulatory issues within New Zealand

This section contains an overview of policy and regulatory issues within New Zealand that are directly relevant to summerfruit.

Summerfruit may be affected by climate policy and trading in different ways:

- direct impacts on costs e.g. fuel, energy, fertiliser
- regulations regarding land use (change)
- reporting requirements related to GHG sources/sinks
- market demands for ‘carbon-neutral’ products

7.2.1. Emissions trading legislation

The Climate Change Response (Emissions Trading) Amendment Act 2008 received the royal assent on 25 September 2008. However, with the change of Government in November 2008 this legislation has been sent to a Select Committee for review. Submissions are being received until 29 February and the Committee is expected to report back to Parliament in April.

While the Committee process has to run its course it appears that the National government is committed to an emissions trading scheme (ETS) with a “carbon tax’ being dismissed by National Members of Parliament.

The general consensus with regards the review currently can be summarised as:

- New Zealand will have an ETS
- Aspects may be changed to align with trading partners e.g. Australia
- Trade exposed sectors e.g. agriculture may obtain concessions e.g. later entry, more generous free-allocation of credits

NZ continues to push for land-use flexibility in international discussions, on the basis that NZ produces and delivers food (particularly dairy but also others) with lower emissions intensity than many other countries.

7.2.2. Voluntary Carbon Markets (VCM)

A commercial opportunity may exist to generate voluntary carbon offsets from certain carbon sequestration activities in New Zealand. The following is a brief description of the VCM:

- Article 3.4 of the Kyoto Protocol (KP) allows Annex B Countries (such as New Zealand) to elect to account for net carbon stock changes since 1990, arising from Article 3.4 activities (land use, land use change and forestry activities (LULUCF)).
- New Zealand did not elect to account for LULUCF activities during the first commitment period of the KP.
- As such, under the former New Zealand ETS legislation, landowners receive no benefit for the carbon sequestered through these activities.
- The voluntary carbon market provides a mechanism to monetize this carbon.
- Activities such as grazing land management practices or revegetation that increase the carbon sequestered in soil and vegetation on this land, should be eligible for the creation of voluntary carbon offsets.

7.2.3. International standards

A range of standards are in place or being developed internationally as the basis for organizations to undertake carbon “footprints” and Life Cycle Analysis (LCA) of products to agreed standards. The most significant of these are:

- International Standards Organization (ISO)
- World Resources Institute (WRI), and
- Publicly Available Specification (PAS) 2050

Currently ISO standards are being developed for life cycle analysis and New Zealand is actively participating in this development. These standards will form the basis on which transparent and consistent analysis of the GHG impact of products or organisations can be undertaken and compared. These standards will form a key part in the debate on whether products or systems are “carbon neutral” or what their carbon footprint is. Primary industries, in particular those in what are perceived to be “distant” markets, may need to address customer perceptions of having a large carbon footprint. It is worth noting that cherries have already been studied by several authors to determine their carbon footprint. As these analyses are typically based on cherries being air-freighted to Europe from the Southern Hemisphere cherries do not compare favourably.

In summary a national and international regulatory and policy framework is in place and developing rapidly. This framework is technically and politically complex and may be subject to change. However, it is only a matter of time before industries will be impacted, even though the exact nature of that impact cannot currently be accurately predicted. It would therefore be prudent to quantify emissions and thus identify opportunities to reduce these wherever practicable.

7.3. Activities in other horticultural sectors in New Zealand

The New Zealand Greenhouse Gas (GHG) Footprinting Strategy for the Land-Based Primary Sectors was developed in response to significant and increasing pressure by key export markets for information on the GHG-intensity for primary products.

The strategy includes the development of sector-specific approaches ('sector methodologies') to GHG footprinting and methodologies for estimating GHG emissions across the supply chain of a primary product. The first projects initiated were: dairy, lamb, kiwifruit, wine, forestry, onions, and berryfruit (Table 6).

Table 6: Sectors undertaking GHG footprinting

Sector	Project leader	Other project members
Berry-fruit	Landcare Research	Plant & Food Research
Dairy	Fonterra	AgResearch, University of New South Wales, Scion
Forestry	Scion	Landcare Research, Wood Processors Association; Nelson Forests, Tenon, Laminex, Earnslaw Bioenergy
Kiwifruit	Landcare Research	Zespri, Plant & Food Research, AgriLink NZ Ltd, Massey University
Lamb	AgResearch	Meat Industry Association, Balance AgriNutrients, Landcorp, Meat & Wool New Zealand, Institute of Environmental Science and Research Limited
Onions	AgriLink	Plant & Food Research
Wine	Landcare Research	New Zealand Winegrowers, Plant & Food Research
Venison	AgResearch	DeerResearch/DINZ, Landcorp

The results from these are just becoming available. Kiwifruit footprinting has revealed that around 30% of the total GHG emissions per tray of kiwifruit in the UK arises from orchard and packhouse operations, over 40% from shipping, and 20% from end-of-life disposal. The results are sensitive to variations in practices along the supply chain, for example higher yields and shorter storage times reduce emissions per tray.

The wine industry has also been very active with considerable interest in carbon footprinting and several New Zealand wine companies have responded to market demands and have already been certified (e.g. "CarboNZero"). International collaboration, including New Zealand, has resulted in an International Wine Carbon Calculator Protocol as well as broader strategic initiatives focused in the wine sector. The Global Wine Sector Environmental Sustainability Principles recognize that the continued health of the wine industry rests entirely on natural resources, namely: solar energy, an appropriate climate, clean water, healthy soils, and the successful integration of these elements within sound ecological tenets. The International Wine Carbon Calculator Protocol guide and associated spreadsheet tool is structured so that it can be used by different types of wine production companies conducting any combination of grape growing, winemaking and bottling operations themselves, as well as contract operations.

8. Discussion of implications for the New Zealand summerfruit industry

8.1. Issues and impacts

While there is a significant range of possible climate outcomes the following general trends are likely to impact on the summerfruit industry. As noted above the there is a likelihood that some of these will be more extreme and occur faster than current projections.

- **Winter chill requirements may not be met.** Both Hawke's Bay and Central Otago are likely to have warmer winters, with less winter chill. This will obviously impact on fruit production.
- **Divergence of climate between Hawke's Bay and Central Otago.** This divergence will lead to two different production systems, with different requirements for cultivars. For Hawke's Bay there is an increased risk of dry periods or droughts and water restrictions will impact on summerfruit production. Summer impacts are likely to be less severe for Central Otago, although any increase in the frequency of heavy rainfall events could have devastating effects on the cherry industry.
- **Greater frequency of severe events.** This will result in more production extremes of good and bad seasons. One off events such as very hot weather periods, and high rainfall events will have effects on fruit quality.

8.2. Adaptive responses

The world is already undergoing some degree of climate change, regardless of mitigation efforts. Adaptation is therefore a prudent response, incorporating building resilience, accepting some risks and some losses, as well as taking advantage of the opportunities.

Most of the risks and hazards are already present to some extent, hence adapting to climate change will also enhance resilience to other causes of fluctuations in climate, such as El Niño, which often leads to dry conditions particularly in northern and eastern parts of New Zealand.

The summerfruit industry may want to start considering adaptive responses to the issues outlined above i.e. lack of water is likely to be a major issue, particularly in Hawkes Bay, increased periods of high temperatures and drought. There needs to be forward planning that takes into account 'what-if' scenarios of climate change. Decisions need to be made on what proactive adaptations are needed. What are the priorities for protection and enhancement of the environment?

Guidance for adaptation appears to have generally focused on pastoral systems rather than horticultural systems. However, the generalized approach may still be appropriate. The following is based on guidance given for Eastern New Zealand by MfE and is focused on what farmers/growers can do to adapt their business to become a more resilient system. Areas to consider include:

1. Economy
   - Do what you can afford now but be mindful of the future.
   - "Don't have all your eggs in one basket"

2. Ecology
   - Match land use with the limitations and potential of the land.

3. Water

- Develop efficient water harvesting, storage and reticulation systems, ensure flood and erosion protection, improve water quality.

4. Diversification
   - There are many options for diversification but it needs to be in keeping with the land type and resource base of the farm.

5. Soil
   - Focus on smart fertility management, building up organic matter, and fence to land classes.

6. Infrastructure
   - A good infrastructure is critical both for effective management and to cope with climatic extremes such as extreme rainfall and flooding.

7. Energy
   - Aim for household and farm energy efficiency and self-sufficiency.

Some primary sectors have started some of these processes. For example:

- The kiwifruit industry has a detailed scenario analysis showing changes in the area suitable for kiwifruit in the Bay of Plenty, using a range of scenarios over a 100-year timeframe.
- Studies have been undertaken to quantify the potential change in agricultural water usage and availability due to climate change, and assess the implication of these changes on the potential pressures on water sources and water allocation issues. One of the rivers studied was the Tukituki in Hawke's Bay.
- Detailed farm level case studies of adaptation in Eastern New Zealand (http://www.earthlimited.org/accenzpubs.html)

8.3. Gaps and opportunities

Whether through direct effects or indirect e.g. market requirements and competitor behavior, climate change will impact on the summerfruit industry. The climate change projections do not appear to present many opportunities as such for the industry. However, addressing some of the apparent gaps may present opportunities to mitigate the effects of climate change on the industry:

To better prepare the industry, the following will need to be addressed:

- Does the genetic material within New Zealand currently have the range of variation that may be necessary for future projections. For example cultivars with a significantly lower winter chill, or with greater heat or rainfall tolerance?
- An analysis of the impact of climate change projections on New Zealand's competitors in the summerfruit market – while some may be disadvantaged others may develop a competitive advantage in specific niches.
- Better summerfruit specific climate data – much of the information available is generalized or focused on other larger sectors. Access to more specific information for summerfruit will enable better decision-making.
- The development of sector and region specific adaptive response based on robust data.
- Having the data on the footprint of the industry and its efficiency as a producer is likely to become critical as customers become better informed on the issue. Distance to export market and method of transport i.e. air-freight compared to sea-freight will be

important to perceptions of “food miles”. Depending on the market, mode of transport and sources of competing product for the customer closer destinations such as Australia, Taiwan, Korea, and Thailand may be preferable for development rather than more distant markets such as the EU/UK.

- Production efficiencies in every form will be important both in mitigating climate change effects, cost reduction and managing market perception e.g. reducing the industries footprint.

9. Conclusions and next steps

It is generally accepted that climate change is occurring. The significant debate is with regard to the degree and speed of change. As with other primary sectors in New Zealand summerfruit will be affected whether through the direct effects e.g. a reduction in winter chill or indirect effects e.g. market perceptions.

Given the variability in projections and the significant risks involved it is prudent for the industry to develop mitigation and adaptation strategies whether these be on farm efficiencies or investment in low chill genetic material.

There are a number of steps the industry can take to adapt to this change and these have been outlined above. The next steps would be developing a structured approach to incorporating these into the industries planning and where appropriate develop specific projects to address them.

10. References

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Annex I. Terms of reference

Stage 1
Scoping of climate change issues that are relevant to the summerfruit industry. This would include:

1. Provide to SummerfruitNZ a list of industry data that we will require to undertake the project.

Climate change impacts on production

2. Summary of anticipated changes in climate and impacts on summerfruit production systems in Hawke's Bay and Central Otago.

Climate policy impacts

3. An overview of New Zealand's international obligations. There are a number of international obligations and based on these we would develop an overview that was of extensive reviews of direct relevance to summerfruit.
4. An overview of policy and regulatory issues within New Zealand. Due to both the amount of information and the policy uncertainty e.g. the implementation of the ETS this would focus on areas that are directly relevant to summerfruit.
5. Develop a listing of climate change/ETS activities that have or are being conducted by other New Zealand industries that may be relevant to the summerfruit Industry. A significant amount of work has been commissioned by agencies such as MAF, and CATALYST® has direct experience with a number of land-based industries. We would list all work we identify based on a desk-top search and would focus on areas that are directly relevant to summerfruit.

At the conclusion of Stage 1 we would review the scope with the SummerfruitNZ team as the basis for identifying specific issues for the summerfruit industry in Stage 2.

Stage 2
Identification of issues, gaps and opportunities

1. Identify areas that growers and exporters can address both in the short and medium term.
   We would provide:
   - a table outlining possible actions
   - recommendations for prioritising the actions
   - a timeframe for the prioritised actions.
2. Where it is apparent we will identify and describe gaps in existing industry knowledge,
3. We will outline potential opportunities for the industry resulting from climate change. This will include opportunities for commercial responses to climate change e.g. market issues – certification, food miles, marketing

The results from Stages 1 and 2 would be presented to the SummerfruitNZ project management group in Wellington. A final report would be prepared that can be used as the basis of a detailed plan for the industry. Our estimated time to complete this is 2 months from time of approval. This assumes all industry data we require is readily available.

Annex 2. Projections from New Zealand climate scenarios

The following data have been sourced from the report by MfE (2008).

Table 1. Projected changes in seasonal and annual mean temperature (in °C) from 1990 to 2040 and 2090, by regional council area. The average change, and the lower and upper limits, over the six illustrative scenarios are given.

	Summer			Autumn			Winter			Spring			Annual		
	Average	lower	upper	Average	lower	upper	Average	lower	upper	Average	lower	upper	Average	lower	upper
Hawke's Bay															
2040	1.0	0.2	2.5	1.0	0.3	2.6	0.9	0.1	2.2	0.8	0.0	2.0	0.9	0.2	2.3
2090	2.1	0.8	6.0	2.1	0.6	5.3	2.1	0.5	5.1	1.9	0.3	5.1	2.1	0.6	5.4
???Central Otago															
2040	0.9	0.0	2.4	0.9	0.1	1.9	1.0	0.3	2.1	0.7	0.0	1.8	0.9	0.1	1.9
2090	2.0	0.7	4.8	2.0	0.8	4.6	2.2	0.8	4.8	1.7	0.5	4.3	2.0	0.8	4.6

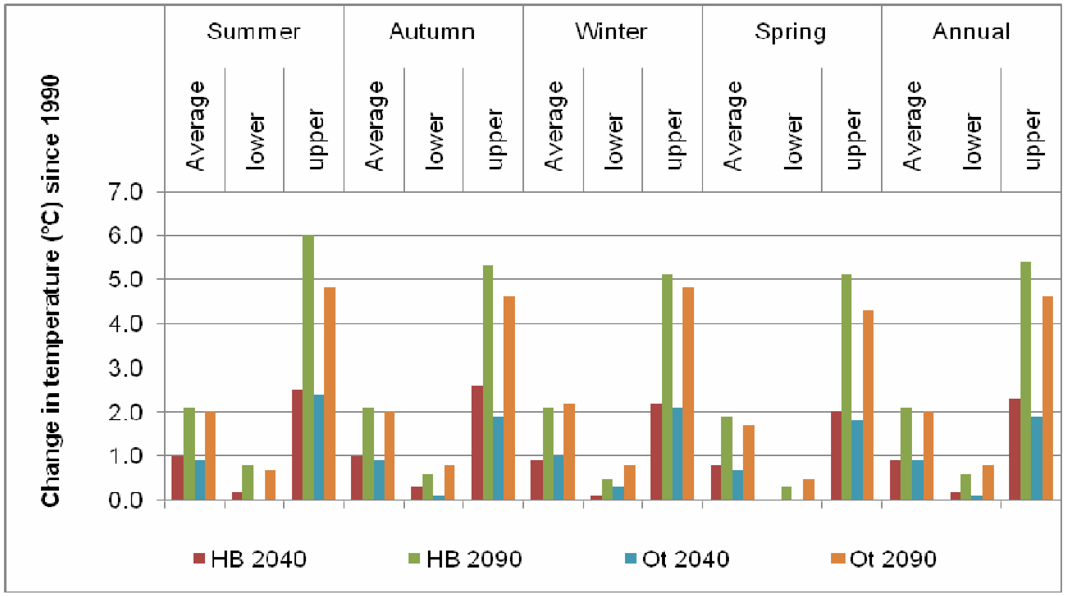

Table 2. Projected changes for selected stations within each regional council area in seasonal and annual precipitation (in %) from 1990 to 2040 and 2090. The average change, and the lower and upper limits, over the six illustrative scenarios are given.

	Summer			Autumn			Winter			Spring			Annual		
	Avg	Low	High	Avg	Low	High	Avg	Low	High	Avg	Low	High	Avg	Low	High
Hawke's Bay															
2040	4	-33	38	5	-14	42	-13	-34	-1	-7	-17	3	-3	-14	14
2090	9	-46	52	5	-14	25	-16	-45	-1	-13	-38	9	-4	-20	11
Central Otago (Queenstown)															
2040	1	-16	20	2	-15	23	16	2	38	8	-3	21	7	1	22
2090	1	-38	37	2	-32	20	29	7	76	15	-5	50	12	-2	34

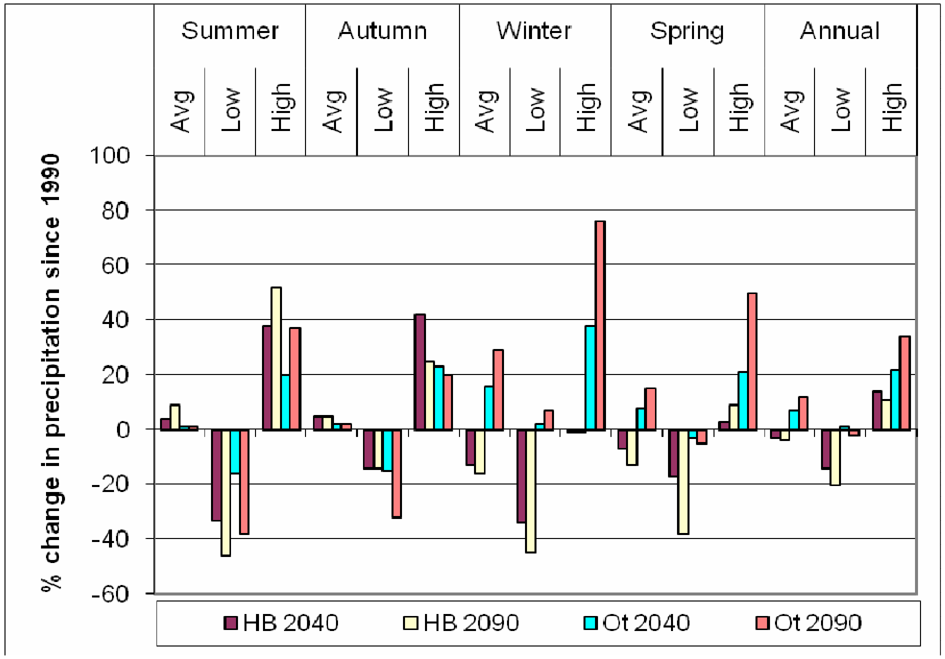

Table 3: Projected changes in seasonal and annual westerly and southerly wind speed components (m/s) 1990 to 2040 and 2090

	Summer			Autumn			Winter			Spring			Annual		
Wind component	Mean	Range		Mean	Range		Mean	Range		Mean	Range		Mean	Range	
Westerly															
1970-1999 climate	2.9			2.2			2.1			4.2			2.9		
Change by 2040	-0.3	-1.6	1.3	-0.1	-2.1	1.3	0.9	0.2	2.4	0.5	-0.6	1.4	0.3	-0.5	1.2
Change by 2090	-0.6	-2.5	1.4	-0.4	-2.3	1.0	1.4	0.0	3.6	0.8	-0.7	2.0	0.3	-0.6	1.5
Southerly															
1970-1999 climate	-0.3			0.6			0.9			0.2			0.4		
Change by 2040	-0.3	-0.8	0.5	-0.1	-0.6	0.3	0.0	-0.7	0.5	0.1	-0.4	0.6	0.0	-0.5	0.4
Change by 2090	-0.3	-1.2	0.6	-0.3	-0.6	0.2	-0.2	-1.3	0.5	0.0	-0.6	0.6	-0.2	-0.9	0.0

A positive value means more westerly or more southerly, as appropriate.