Factsheet 3: Projected Climate-related Impacts on Food Safety/Systems in the Arable Sector

The risk matrix represents a sector specific overview of the climate change impacts to food safety and systems, their risk now, in the future under a high emission scenario, and following suggested adaptation options. The risks are defined as low = green, medium = yellow, high = orange, high = red. Information used to develop the risk matrices was sourced from scientific publications and industry feedback from Workshop 1 and based on the high emission scenario. The purpose of the risk matrix is to provide a summary of potential impacts for discussion with representatives from the NZ food sectors, research providers and government agencies.

Issues have been categorised as follows:

Category 1: Existing hazards affected by climate change

- Those arising from infectious agents
- Those arising from naturally occurring chemicals and biotoxins

Category 2: From risk management to address climate change issues

- Chemical interventions (pesticides, antibiotics etc.)
- Other changes in production processes

We have based our indications of climate change expected over the next 100 years on the highest representative concentration pathway (RCP) 8.5, because this enables us to more clearly assess future change.

Additional commentary is provided below the table.

CLIMATE CHANGE AND FUTURE IMPACTS

Extreme events are likely to increase and include:

- Frequency, duration and intensity of hot spells, mostly in the north of the NI and Eastern SI, however, towards the end of the Century this could affect All of the NI and Eastern SN
- Frequency of heavy precipitation events and the potential for associated flooding will affect all off NZ,
- Incidence of extremely high sea levels during storm surges,
- Longer dry spells in some areas (especially in the north of the North Island and east of both islands), and the areas affected by drought each year, are likely to increase.
- Cold spells and frosts will decrease in frequency, duration and intensity (Solomon et al 2007).

Changes to the average climate will include:

- Increases in warmer and wetter weather in Western NZ and Southern SI
- Most areas of New Zealand will experience increased average crop and pasture yields associated with increased CO_2 generating a 'fertilisation effect', and anticipated mean temperature rises of 1–3°C. This will compensate for negative yield impacts of climate change with the exception of area expected to increase in frequent drought.
- Average annual rainfall in New Zealand will generally increase in the south and west and generally decrease in the north and east of the country, with seasonal variations.
- The winter season is projected to have the greatest rainfall changes (an exacerbation of the annual changes), as westerly winds (particularly across the South Island) are likely to strengthen. Together with warmer temperatures, this is likely to have a significant effect on winter cropping and pasture production.
- Average relative humidity is likely to increase for most areas of New Zealand.
- All regions will be susceptible to yield losses, but impacts on global food availability would be small owing to compensatory institutional factors, such as enhanced global markets.
- By the end of the 21st century, mean growing season temperatures are highly likely to equal current extremes in temperate areas (including New Zealand) and to exceed them in the tropics and subtropics, resulting in major impacts on global food production (Battisti and Naylor 2009).
- Northern regions of New Zealand show greater risk of negative silage maize yield impacts than southern regions, where climatic suitability for maize is potentially improved.
- With projected warmer temperatures, some regions in New Zealand currently too cool may become suitable and some regions where crops are currently grown successfully may become less suitable over time.

FOOD SAFETY SYSTEM ISSUES

The impacts of global climate change on food systems will be widespread and complex –

- Scientific consensus says that individual pathogens will differ widely in epidemiological responses, the net impact of climate change will lead to a large increase in the burden of infectious diseases (Costello et al 2009)
- For plant-derived foods including stock feed, mycotoxins are considered the key issue for food safety under climate change (Miraglia et al 2009).
- Rising incidence of disease will lead to overuse or misuse of pesticides and veterinary medicines, particularly in fisheries (Gerard et al 2010; Kean et al 2015; Lennon et al 2015; Miraglia et al 2009; Shalaby et al 2013; Solomon et al 2007).

- Many adaptation solutions include the use of GMO – how these are regulated and accepted by society may impact food systems.

Increase in hot days (maximum temperature of 25°C or higher)

- Increased demand for water and declining water quality could all lead to increases in the levels of pathogens and chemicals in food.
- Extreme drought may promote use of contaminated water supplies (algal toxins, chemicals and pathogens). Water stress also increases the need for fertiliser.
- Increases in hot/dry days will favour the growth of some fungal metabolites on crops.

Increased winter rainfall coupled with milder winter temperatures

- Contamination of pasture and silage by emission, soil, manure and water
- Increased pesticide and veterinary drug residues in the environment, leading to new or higher residues in food, some from new approvals.
- Changes in pesticide activity of some pesticides.
- Control responses may generate food safety problems due to the novelty of the pests in question as well as the unfamiliarity of farmers using the controls

Increased average temperature

- Increase in pathogen loads
- Increase in insect vectors
- Increased energy requirements
- Changes in soil nutrients and bioavailability of elements in soils

Increased temperature/CO_2

- Change to nutrient content of foods, potential for allergenic foods
- Change in crop suitability

Sea level rise

- Changes in land use and availability of land

Establishment of new exotic pests, weeds and diseases resulting in outbreaks

- Increased risk of antibiotic-resistant pathogens developing.
- Mycotoxins, including aflatoxins will increase in range, type and amount.

Meeting stringent climate change targets

- Refrigerant management ranked as the No. 1 global solution in terms of estimated atmospheric CO_2-equivalent reductions between 2020 and 2050. About 20% of the global-warming impact of refrigeration plants is due to refrigerant leakage.
- Reduced meat and dairy consumption – ethical food choices, increased demand for arable crops?

- Land use changes

ADAPTATION OPTIONS

At the farm level

- better use of seasonal climate forecasting (Jarvis et al 2011),
- greater deployment of water conservation technologies ,
- diversification of on-farm activities (Hansen et al 2007),
- development and adoption of different varieties and species more suited to emerging climatic conditions,
- improved management of pests and diseases,
- Promotion of integrated pest management and non-synthetic methods of pest control
- adjustments in cropping and management practices (Easterling et al 2007;Jarvis et al 2011),
- Shift in land use or crop varieties that are more suitable for new conditions
- At a national scale, considering logistic and economic constraints, expansion of cropping areas to regions with improved climatic suitability is an adaptation option to minimise negative impacts on silage maize yields. At a local scale, adaptation of agronomic practices, such as the use of earlier sowing dates and long-cycle genotypes for maize, may minimise negative impacts on silage maize yields.

At post-harvest/off-farm level

- improving energy efficiency,
- switching to cleaner and renewable fuels,
- improved processing technologies,
- strengthening food safety systems, including hazard intervention and control
- improving non energy resource efficiency, such as through recycling and reuse.
- CH_4 from wastewater treatment could potentially be recaptured for energy generation, minimize food waste

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