Factsheet 1: Projected Climate-related Impacts on Food Safety/Systems in the Dairy Sector

RISK MATRIX

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 21st Century this could affect all of the NI and Eastern SI.
- Frequency of heavy precipitation events and the potential for associated flooding will affect all of NZ.
- Intensity of ex-tropical cyclone events.
- 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.

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 'fertilization 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.

FOOD SAFETY SYSTEM ISSUES

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

- Individual pathogens will likely differ widely in epidemiological responses, but the net impact of climate change will lead to a large increase in the burden of infectious diseases.
- For plant-derived foods including stock feed, mycotoxins are considered the key issue for food safety under climate change.
- Rising incidence of disease will lead to overuse or misuse of pesticides and veterinary medicines, particularly in fisheries.

Specifically for the New Zealand Dairy Sector:

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

- Increased heat stress could affect dairy/milk production (reduced feed intake, fertility rates, lameness [claw horn]) through increased levels of mastitis

infection/increased somatic cell counts together with higher parasite loads including ticks and helminths.
- Increased heat stress could mean more sub-clinically affected animals exhibit signs of TABA
- Heat stress may result in more shedding of STEC (see case study).
- Changes to mitigate heat stress such as housing for shelter may increase food safety risks e.g. hide contamination, crowding conditions that enhance transmission of other infectious diseases, hygienic dressing more difficult.
- Increased demand for water and declining water quality could all lead to increases in the levels of pathogens and chemicals in food.
- Extreme drought can lead to boreholes contaminated with nitrates.
- Combined with increased rainfall tick abundance, competency and activity is favoured.
- Extreme drought will desiccate ticks.

Increased temperature and rainfall

- Combined with increased rainfall tick abundance, competency and activity is favoured.

Increased winter rainfall coupled with milder winter temperatures

- Contamination of pasture, drinking water and silage by emission, soil, manure and water leading to increased contamination of livestock.
- 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 appropriate controls.
- Increase spread of facial eczema resulting in increased use of zinc treatments.
- Muddy conditions can be created where cows are more fatigued and prone to lay down, with associated udder contamination, increasing contact with environmental pathogens.
- Reduced grazing, can also occur resulting in a lowered immune system

Increased rainfall and humidity

- Increased rainfall and humidity will also lead to more animal stress that increased shedding of pathogenic bacteria. This will also result in higher pathogen loads transferred to waterways.

Increased rainfall with milder winter temperatures

- Rainfall and muddy conditions can be created where cows are more fatigued and pastures are damaged. Resultant reduced grazing leads to more hide contamination, nutritional stress thus more sub-clinically affected animals' exhibit signs of TABA.

- An extension of the tick distribution and abundance may lead to extension of unstable TABA zones resulting in increased use of acaricides and other ACVMs (e.g. Buparvaquone, erythtomycin) with subsequent residue issues.
- Extended tick distribution may lead to extension of the stable endemic area.

Emergence of new exotic pests, weeds and diseases resulting in outbreaks:

- Increased intestinal/hide microbial burden associated with animal, especially in summer, leading to increased pathogen levels in raw milk.
- Increased risk of antibiotic-resistant pathogens developing.
- Mycotoxins, including aflatoxins will increase in range, type and amount. When cows consume aflatoxin-contaminated feeds and milk products can also serve as an indirect source of aflatoxins.

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 dairy consumption – ethical food choices
- Land use changes

At the farm level

- Better use of seasonal climate forecasting.
- Greater deployment of water conservation technologies
- Diversification of on-farm activities.
- Cooling of animals during milking. Infrastructural changes to the milking platform and farm landscape to reduce heat stress.
- Improved farm design, provide shelter through trees or housing systems
- 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 i.e. Once a day milking, good husbandry, biosecurity and pasture management.
- Shift in production to areas more suitable e.g. further south to avoid new pests and diseases or to areas with more reliable rainfall/water supply.
- Reduction of mingling during transport and lairage of calves.
- Changes in management of calf shed – e.g. number of animals, bedding turn-over.
- Decontamination of hides at lairage.
- Post dressing interventions: hot water acidified sodium chloride wash.

At post-harvest/off-farm level

- Improving energy efficiency.
- Switching to cleaner and renewable fuels.
- Improved processing and food safety 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.
- Enhanced transport truck hygiene measures.
- Vaccine development (similarities with human malaria).
- Identification and selection of genetically resistant animals.

CASE-STUDY #1: STEC (Shiga toxin-producing Escherichia coli)

STEC are bacteria primarily transmitted via the faecal-oral route. Ruminants, predominantly cattle, are important reservoirs. STEC has no known animal health or production effects and is considered normal gut flora. Due to the public health risk, STEC are a red meat trade concern and declared adulterants of beef and bobby veal in the USA. STEC are also a domestic public health risk, causing haemorrhagic diarrhoea and kidney failure, particularly in children. New Zealand has a high and increasing incidence of human cases of STEC compared to other countries, with 9.6 cases per 100,000 people reported in 2016. A 2011/2012 New Zealand case-control study of 113 cases and 506 controls identified the presence of cattle in the local area, contact with animal manure and contact with recreational waters, as significant risk factors for human STEC infection.

A nationwide 2014 cross-sectional study of 1508 young calves on 102 randomly selected dairy farms reported 20% of calves and 75% of farms had infection detected of STEC. Risk factors included region, with Northland most affected, and increased shed humidity and number of calves per shed.

CASE-STUDY #2: THEILERIOSIS

Theileriosis is a tick-borne protozoal disease of cattle in New Zealand that in naïve cattle can cause anaemia, jaundice and death. Theileria-associated bovine anaemia (TABA) is associated with the abundance, activity and competence of the brown cattle tick *Haemaphysalis longicornis* which thrives in warm, moist conditions.

TABA is more likely to be seen at time of stress, therefore the largest burden is seen in the dairy industry e.g. in cows when transitioning and at peak lactation, and in bulls during concentrated periods of mating. Beyond a concern of residues for treatment/support of affected animals there are no known public health effects of this infection in cattle and there are no current trade issues.

TABA is a recent introduction to New Zealand and at the time was concerned exotic. The first three notifications occurred in the spring of 2012 in Northland and Waikato. By March 2014 there were approximately 500 case herds (80% dairy). To date (September 2017) an estimated 65% of North Island versus 2% of South Island farms are infected. The infection is considered endemic (every animal becomes infected) from north Waikato north thus TABA is in equilibrium and serious clinical disease is unlikely except in calves. More concerning are current unstable areas of the mid north island and coastal east and west of the lower north islands, also the top of the south island. There is no equilibrium and new disease cases occur both in adults and calves.