

	Hazard	Number	Climate change impacts on food safety/systems	Risk Now/Location	Risk by 2050	Risk by 2100	Adaptation	Risk by 2100 post-adaptation
DIRECT FOOD SAFETY/SYSTEM IMPACT	Infectious Agent:	1	Increase in hot days (maximum temperature of 25°C or higher) may affect livestock production (e.g. heat stress, reproduction, feeding etc. leading to higher parasite loads including ticks and helminths.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	All of North Island, Eastern South Island	Improved farm design (trees) to provide shelter and paddock shade. Housing control systems, new feeding systems/crops. Could also mean better control of effluent.	All of North Island, Eastern South Island
		2	Increase in hot days (maximum temperature of 25°C or higher) may affect livestock production leading to increased microbial burden on carcasses and meat resulting in foodborne illness. Animals may carry more enteric pathogens in their guts or on body surfaces. In particular, for pigs, the upper intestinal tract can act as a reservoir for particular strains of antibiotic-resistant bacteria. In poultry, research has indicated that retail products are more likely to carry higher total viable bacteria counts in summer.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	All of North Island, Eastern South Island	Improved on farm management practices and meat processing techniques.	All of North Island, Eastern South Island
		3	Increase in rainfall may create muddy conditions where cows are more likely to feel tired and lay down, such that their udder will become coated with mud, increasing contact with environmental pathogens. Reduced grazing, can also occur resulting in a lowered immune system.	Western New Zealand, South of South Island	Western New Zealand, South of South Island	Western New Zealand, South of South Island (especially winter)	Improved farm design (trees) to provide shelter, paddock shade and reduce wind chill. Housing control systems, new feeding systems/crops. Could also mean better control of effluent.	Western New Zealand, South of South Island
		4	Increase in temperatures and rainfall may promotion the transmission of pathogens between animals, resulting in greater pathogen load in faeces.	Western New Zealand, South of South Island	Western New Zealand, South of South Island	Western New Zealand, South of South Island (especially winter)	Improved on farm management practices and better control of effluent.	Western New Zealand, South of South Island
		5	Increase in heavy rainfall events and flooding will favour contamination of feed or water for stock leading to greater pathogen load in faeces	All of New Zealand	All of New Zealand	All of New Zealand	Strengthening of on farm food safety management programmes	All of New Zealand
		6	Increases in temperature will have a substantial effect on the current and developing food cold-chain. A rise in temperature will increase the risk of food poisoning and food spoilage unless the cold-chain is extended and improved. Increasing the ambient temperatures from 17 to 25°C resulted in an 11% increase in average power consumed.	All of New Zealand	All of New Zealand	All of New Zealand	Temperatures in both retail display and domestic storage, need to be lowered if food safety is not to be compromised. Maintenance of food refrigeration systems. New/alternative refrigeration systems/cycles.	All of New Zealand
		7	Hot and drier conditions in some parts of the country may lead to increase in use of manure, irrigation or runoff. Contaminated irrigation water, the use of wastewater, increased demand for water and declining water quality could all lead to increases in the levels of pathogens and chemicals in food.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	Improved water management systems	North and East of the North Island, Eastern South Island
	Biotoxins:	8	Increase in hot and humid conditions may lead to increase in mycotoxins, including aflatoxins, particularly in stored grains and nuts.	All of North Island, Eastern South Island	All of North Island, Eastern South Island	All of New Zealand	Use of new resistant commercial crop types and/or new species. Avoid growing feedstock in warm and wet areas. Use of mycotoxin controls including improved drying of grain at harvest, good crop husbandry, storage and transport. Routine testing of supplemental feed to check for presence of aflatoxins.	All of New Zealand
		9	Increases in heavy rainfall and flooding will favour contamination leading increase fungal infections in silage making and increase the risk of mycotoxins. Increases in dry matter content may also pose a risk in terms of level of contaminants	All of New Zealand	All of New Zealand	All of New Zealand	Improvements to feed, handling and storage	All of New Zealand
		10	Harmful fungal metabolites under dry, hot conditions can also contaminate cereals and pulses during crop growth and post-harvest. When cows consume aflatoxin-contaminated feeds milk products can also serve as an indirect source of aflatoxins.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	Use of new resistant commercial crop types and/or new species.	North and East of the North Island, Eastern South Island
		11	Increase in humidity may result spread of facial eczema	All of New Zealand	All of New Zealand	All of New Zealand	Change in cattle breed or use of genetically resistant animals. Monitoring pasture spore count during danger periods (minimum temperatures are above 12°C for two or three nights and humidity is high (usually January to May) and either dosing animals with zinc or spraying pastures with a fungicide	All of New Zealand
INDIRECT FOOD SAFETY/SYSTEM IMPACT	Residues:	12	Increase in hot days (maximum temperature of 25°C or higher) could affect livestock production leading to increase in pests affecting feed quality and use of pesticide and veterinary drug residues in the environment. New or higher residues in food may occur. Climate change may affect the pesticide activity of some pesticides.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	All of North Island, Eastern South Island	Use of new bio control agents and new approvals (prevention). Shift in production to areas further south to avoid new pests and diseases. Use crops to break pest cycles. Introduction of new bio control agents. Pesticide safety training programs for farmers with stringent enforcement of pesticide laws.	All of North Island, Eastern South Island
		13	Increase in hot days (maximum temperature of 25°C or higher) could affect livestock production leading to increased risk of antibiotic-resistant pathogens developing.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	All of North Island, Eastern South Island	Need for newer treatments. Unknown human health effects of new pesticides or veterinary medicines. Withholding periods affected. Pesticide residues may be higher than approved levels. Use of technologically-advanced foods (GMO), functional foods and nanotechnology in preference to the use of pesticides. Strengthening of food safety systems	All of North Island, Eastern South Island
		14	Increase in hot days (maximum temperature of 25°C or higher) could affect livestock production leading to increase in anthelmintic residues in meat	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	All of North Island, Eastern South Island	Parasite resistant breeds, nutrition, pasture management, nematode-trapping fungi, antiparasitic vaccines and botanical dewormers.	All of North Island, Eastern South Island
		15	Increased winter rainfall coupled with milder winter temperatures in some areas may require greater use of anti-helminthics as snail vectors multiply leading to increase in use of zinc treatments	Western New Zealand, South of South Island	Western New Zealand, South of South Island	Western New Zealand, South of South Island	Movement of animals to areas with lower temperatures and humidity.	Western New Zealand, South of South Island
		16	Hot weather and drier conditions in some parts of the country increased use of parasite and veterinary treatment leading to residues.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	Increased use of more genetically resistant animals.	North and East of the North Island, Eastern South Island
	17	Extreme drought can lead to boreholes contaminated with nitrates.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	Drought-resistant forage plants. Water security measures or movement to areas with more reliable rainfall/water supply	North and East of the North Island, Eastern South Island	
	Management:	18	Increase in hot days (maximum temperature of 25°C or higher) could affect livestock production (e.g. heat stress, reproduction, feeding etc. Changes to mitigate heat stress could affect food safety e.g. greater use of housing for shelter and other livestock may lead to crowding conditions.	North and East of the North Island, Eastern South Island	North and East of the North Island, Eastern South Island	All of North Island, Eastern South Island	Use of more genetically resistant animals. Refrigeration to cool drinking water. Improved energy efficient cooling. Use of sustainable energy sources.	All of North Island, Eastern South Island
		19	Intermingling, crowding of food animals in response to natural disasters or climate may lead to food safety issues, in particular mycotoxins. New raw materials and fewer varieties may increase food safety risks	All of New Zealand	All of New Zealand	All of New Zealand	Intensification of food safety management including all sector (farm to fork) co-ordination, surveillance and monitoring, risk assessment, predictive modelling. Small reduction in stock	All of New Zealand
		20	The cold-chain accounts for approximately 1% of CO2 production in the world, however this is likely to increase if global temperatures increase significantly. About 20% of the global-warming impact of refrigeration plants is due to refrigerant leakage.	All of New Zealand	All of New Zealand	All of New Zealand	Using the most energy efficient refrigeration technologies it would be possible to substantially extend and improve the cold-chain without any increase in CO2, and possibly even a decrease.	All of New Zealand