FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

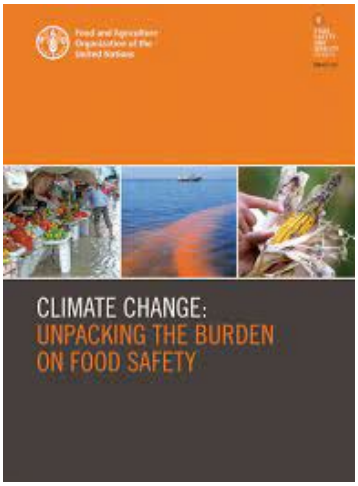
FAO REPORT SUMMARY

CLIMATE CHANGE: UNPACKING THE BURDEN ON FOOD SAFETY

FEED THE FUTURE INNOVATION LAB FOR FOOD SAFETY

Climate change poses a risk to food production and food security, and planning for its potential impacts on food safety can better position current research to meet future needs. In 2020, the Food and Agriculture Organization of the United Nations (FAO) published "Climate Change: Unpacking the Burden on Food Safety" to identify risks and recommend approaches for addressing hazards including pathogenic microbes, algal blooms, heavy metals, methylmercury, pesticides, and mycotoxins. The Feed the Future Innovation Lab for Food Safety prepared this brief synopsis of the report to provide an introduction to the potential effects of climate change on food safety and encourage food safety researchers to consider predicted climate impacts on foodborne illness.

CLIMATE DRIVERS OF FOODBORNE ILLNESS



The extreme weather conditions, elevated temperatures, rising sea levels, and variability in precipitation associated with climate change can reduce yields and disrupt food systems. Climate change is also predicted to directly and indirectly increase the risk of foodborne illness from both microorganisms and toxins. For example, warming ocean temperatures are predicted to lead to an increase in the geographic distribution of aquatic pathogens such as *Vibrio*. More indirectly, heavy rainfall can increase relative humidity, which can promote the growth of mycotoxin-producing fungi, and heavy rains near mining areas can trigger the release of heavy metals into nearby agricultural fields for uptake into food chains. Forward-thinking approaches and surveillance are keys to implementing a proactive, rather than reactionary, response to food safety challenges in a changing climate.

PREDICTED IMPACTS OF CLIMATE CHANGE ON FOOD SAFETY HAZARDS

Foodborne pathogens: Climate change is predicted to increase the net burden of food and water-borne diseases. Emerging evidence suggests that higher temperatures are linked to increased incidences of infections with foodborne pathogens, including *Salmonella*, *Campylobacter*, *Vibrio*, and parasites. In addition, rising temperatures and increased precipitation are also predicted to shift the geographic distribution of pathogens and seasonal patterns of outbreaks. Specific examples include a 50% morbidity increase from salmonellosis by 2030 in Australia; a 23% increase in campylobacteriosis cases in Canada by 2055; an overall expansion of *Vibrio's* geographic range due to warming sea waters; and an increase in antimicrobial resistance.

Algal Blooms: Harmful algal blooms (HABs) cause marine animal deaths, human sickness, substantial economic losses, and the destruction of coastal regions. HAB phycotoxins can bioaccumulate in fish and shellfish and cause toxic syndromes in humans who consume them. The frequency, intensity, and geographic

distribution of algal blooms are likely to increase due to factors including higher temperatures, rising sea levels, ocean acidification, changing currents, and zooplankton grazing. For example, over the next century, a 2.5-3.5°C increase in Caribbean water temperatures is expected to lead to a 200-400% increase in ciguatera food poisoning cases in the Caribbean and the expansion of dead zones.

Heavy Metals: Metals such as Pb, Cr, Hg, Cd, and As are systemic toxicants with detrimental effects on human health, marine ecosystems, and plant growth. Acid rain and overuse of nitrogen fertilizers can increase the leaching of heavy metals from soils into runoff, and drought can concentrate metals in aquatic ecosystems. Heavy metals bioaccumulate as the result of dietary intake, and their use in agricultural and aquatic production systems can, through a co-selection process, promote the spread of antimicrobial resistance.

Methylmercury: A top ten chemical contaminant according to the World Health Organization, methylmercury (MeHg) is a developmental neurotoxicant. The presence of mercury in aquatic ecosystems comes from natural sources, anthropogenic sources, and re-emissions, and it bioaccumulates in both ocean and freshwater aquatic food chains. Because methylation of mercury is temperature sensitive, warming ocean temperatures are predicted to increase levels of MeHg in fish. It is estimated that for every 1°C rise in ocean temperature, MeHg concentrations in fish could increase 3-5%. Also, due to oversaturation of MeHg in colder, deeper waters, the MeHg content in tuna off the coast of Maine is predicted to increase up to 30% by 2030.

Pesticides: Several health issues are linked to pesticides, including Parkinson's disease, cancer, endocrine disruption, reproductive disorders, and damage to the nervous system. Climate change is predicted to alter the geographic distributions, life cycles, growth rates, and population dynamics of insect pests around the world through higher temperatures and humidity. This may lead to increased use of pesticides and the remobilization of pesticides currently prohibited because of their serious toxicological effects on people and ecosystems. An overall increase in the use of pesticides to protect food production will increase the risk of contamination of foods with pesticide residues. The effects could be mitigated through biological control mechanisms, including biopesticides, and robust monitoring of pesticide concentrations across the food chain.

Mycotoxins: Secondary metabolites produced by several genera of fungi, mycotoxins persist during food processing. Because mycotoxins tend to be produced due to stressful or variable environmental stimuli, higher temperatures, droughts, unseasonable rains, increased pest damage, and flooding are likely to cause increases in mycotoxin contamination of staple crops, both in the field and in storage. Mycotoxin-producing fungi have already expanded their range into new geographic areas which lack surveillance and risk management capacity.

Emerging risks: The risks of food safety are not static, and new challenges are emerging. Microplastic pollution is now found across environments, including oceans, mountains, and the atmosphere. Novel food production systems, such as vertical farming, rooftop farms, and floating dairy farms, will present new food safety risks. Utilization of novel food sources, including insect consumption and cellular agriculture (the production of food products through cell culture), will require monitoring for traditional food safety hazards as well as potential allergenicity.

SOURCE

Climate Change: Unpacking the Burden on Food Safety (FAO, 2020)
www.fao.org/documents/card/en/c/ca8185en/