FOOD SECURITY, CLIMATE CHANGE, AND HEALTH

Global environmental climate change, covid-19, and conflict threaten food security and nutrition

Sheryl L Hendriks and colleagues describe the global risks and vulnerabilities associated with health, food security, and nutrition

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September 2021 saw the United Nations Food Systems Summit (UNFSS) take place in New York. It focused on the "three Cs" that are driving disruption to food systems and threatening recent progress in mitigating hunger, malnutrition, and undernutrition: global environmental climate change, covid-19 disease, and conflict. Summit delegates from 183 countries agreed that business as usual would not lead to the change necessary to achieve the sustainable development goals. Summit participants called for urgent action at scale.

The three Cs interact on five mediators ("five Fs") upon which food systems depend: the geopolitics of our global food, fertilizer, finance, fodder, and fuel systems (fig 1). Our global food supply system is fragile and vulnerable to the impacts of each driver or mediator. However, all can interact to amplify the downstream effects on people, their health, and diets. For example, decreased food availability has financial impacts (and vice versa). In a vicious feedback loop, undernutrition affects the ability to produce food, and lack of food availability can lead to conflict (and vice versa), while environmental climate change can cause both.

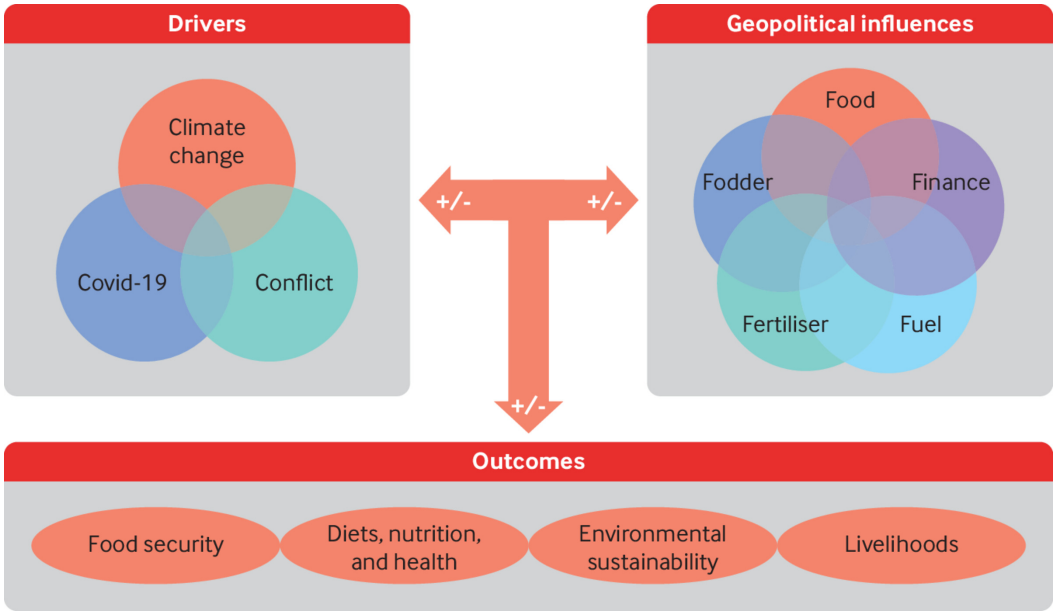

Fig 1 | The "three Cs" and "five Fs" of concern

Environmental climate change, food security, and nutrition

Environmental climate change threatens food security and nutrition[1] through interconnected impacts on soil, crop growth, animal survival, and labor productivity.

Soil is affected by sea levels rising, resulting in the loss of coastal agricultural land and saltwater ingress.[2] Soil volume is affected by desiccation, leading to loss with tilling and strong winds, while floods cause erosion.[2] Climate change also affects microbial populations and their enzymatic activities in soil.

Crop growth is directly affected by environmental climate change. Direct impacts come from sustained changes in temperature, increased crop respiration and evapotranspiration, and water availability.[3] Agroecological conditions could change crop suitability in different regions. Some crops have been introduced in places unsuitable for local climates, requiring substantial resources (especially water) for

cultivation. Climate shifts could also affect soil microbial populations and their activities, affecting human health.[3] Environmental climate change can affect the suitability of crops for different regions as well as crop duration (the time from planting to harvest),[3 4] affecting diets. Climate and environment change may alter the balance of national self-sufficiency away from domestic supply, possibly increasing the need to import (more) food and potentially creating vulnerability to food shortages.

Direct losses in animal productivity and increased mortality of herds may occur owing to environmental climate change, which would affect livelihoods, especially in tropical and Mediterranean regions that are expected to experience greater rises in temperature and reductions in availability of water. In addition, more frequent and severe (mega) droughts, floods, fires, and heat waves may lead to famine, with dire consequences for livelihoods and migration, and the need for humanitarian food assistance.[2 5]

Indirect changes owing to climate change may occur through a shift in weed flora and higher animal and plant diseases, pests, parasites, and vectors (for example, locust plagues in east Africa and bluetongue disease in cattle).[3 6] Climate change alters habitats, and forces plants, animals, and humans into contact in a way that would otherwise not occur, encouraging spillover events. Disease outbreaks may lead to greater use of antimicrobial agents and a higher incidence of antimicrobial resistance. Climate change also affects labor, lowering productivity in raised temperatures and—in extremes—making it impossible to work.[7]

Recent record heatwaves in India highlight the impact of climate change on human health. Extreme heat events are predicted to increase in occurrence and intensity in the coming decades.[1] Excessive heat and extended exposure to excessive temperatures, especially in areas not accustomed to high temperatures, cause excess morbidity and mortality directly from heat illness and aggravation of comorbid conditions from corollary events such as wildfires and air pollution.[8] Climate change directly affects health through heat stress and dehydration[5] and changes in nutritional state as food availability falls. It indirectly affects food systems (box 1) by increasing vulnerability to diseases such as covid-19 (which further impacts labor potential and thus agricultural production and poverty).

Box 1: Potential threats from extreme flooding and their impact on food systems

Torrential rain caused severe flooding and landslides in the south east of South Africa during 11-13 April 2022. The event caused 448 deaths, displaced more than 40 000 people, and destroyed more than 12 000 houses, numerous schools, healthcare facilities, and infrastructure. The flooding washed away roads, electricity infrastructure, and water and wastewater supply lines. Sewerage plants were flooded. What water supplies remained in service were contaminated by waste, chemicals, and other pollutants washed into water systems.

The South African National Institute for Communicable Diseases identified five health risks arising from the flooding[9]:

- Acute events such as drowning and trauma
- Non-communicable disease risks resulting from non-adherence to medication regimens, a lack of access to health services, and disruption to medicine supply chains.
- Damage or disruption to healthcare infrastructure and systems that affect the treatment of direct health emergencies (such as injury) as well as other services, including care for people with covid-19
- Mental health problems, including the onset of anxiety, depression, and post-traumatic stress disorder for people who have experienced floods
- Increased risks of infections

The floods caused disruption across the food system, including damage and destruction of food manufacturing, storage, transportation, and markets. Families' access to clean, potable water and food sources was severely affected. Household incomes and livelihoods were stalled, restricting access to vital food and nutrition, including essential school feeding programs that most children rely on daily.

Finally, conflict causes (and is caused by) food insecurity, and both can be exacerbated by climate change. Climate change also drives conflict by increasing competition around limited natural resources and income opportunities,[10] thus it can drive population migration and displacement, directly and indirectly increasing poverty and disease.

Conflict and system connectedness

Food price increases make a healthy diet less affordable and can cause conflict. For example, in 2010 and early 2011 several disruptions led to price rises. Drought disrupted grain production in Russia, Ukraine, Kazakhstan, the US, and China. Floods destroyed a million tonnes of grain reserves in Pakistan. Torrential rains affected Canada's wheat production and the quality of fodder in Australia and northwestern Europe. In addition, frost devastated Mexican corn crops in February 2011.[11] As a result, prices of staples rose steeply, triggering food riots worldwide and contributing to (if not causing) the Arab Spring of 2011.[11]

In 2021, conflict or insecurity was a primary cause of acute food insecurity in 24 countries or territories, affecting around 139 million people—40 million more than in 2020.[10] In 2022, the global crisis initiated by the invasion of Ukraine shows the deep connectedness of global food security, highlighting structural market issues and the impact of reliance on imports for staple foods, fodder for livestock, fertilizer, and fuel. Increases in the price of oil and gas for domestic power or heating mean that many people lack money to buy and prepare healthy food. The cost of food has also risen through impacts on fertilizer prices (ammonia is made from gas), fodder, and manufacturing, refrigeration, and shipping. Almost one third of the globally traded cereal supply and a large proportion of traded oil seeds and fertilizer reserves are held hostage to crippled transport systems, closed ports, and financial markets blocked by sanctions,[12] putting further pressure on food prices. Such impacts may synergize with those of climate change. For example, India, affected by a record heatwave, has banned wheat exports. Concern surrounds food production in France and China following extreme weather events.

The confluence of these factors demands careful reflection on the coherence and comprehensiveness of national policies related to climate change, emergencies, food security, health, nutrition, and trade.

How covid-19 has exposed nutritional issues as a core vulnerability

The covid-19 crisis is unique. The pandemic added an additional shock to a world already struggling with a confluence of economic, climate, and conflict crises. We have thus seen disruption of financial markets and global food supply chains (as occurred with the global financial and food crises of 2008 and 2011). We also see perturbation of domestic food production systems, as occurred with recent Ebola outbreaks and major weather events such as cyclones in southern Africa and droughts in eastern Africa. Moreover, the economic impacts of the covid-19 pandemic have increased the number of people struggling to feed themselves, and some have

had to reduce their meal sizes or to eat less often. As a result, the demand for food assistance and the reliance on charity and social support is growing worldwide.[13]

People who were malnourished—whether undernourished or obese—were disproportionately affected by covid-19 mortality and by post-acute sequelae of covid-19 infection (long covid),[14] both of which may affect future food production and put strain on health systems. Meanwhile, climate change will lead to further spillover events whereby diseases of animals cross to and spread among human hosts.[15 16] Furthermore, diversion of public expenditure into climate or health related emergencies threatens public health protection and acute health services[17] and limits investment in climate mitigation.

Environmental climate change and policy considerations

To improve global food security in future, efforts must be made to curb further environmental change while preparing for changes that are happening. This means simultaneously reducing greenhouse gas emissions and increasing the resilience in food systems to protect food security and health.[4 18] Collaboration is needed between professionals and policy makers across agriculture, climate, energy, health, and political economy if the complexities, interlinkages, and trade-offs in future policy choices are to be understood and solutions identified. Focus should lie on interactions between the three Cs and five Fs on policy choices, trade-offs, outcomes, and potential unintended consequences.

Consideration of climate change is vital. The supply of food, fertilizer, and fodder must be diversified and selected based on climate resilience and reducing the impact of production, processing, and transport as drivers of climate change. A rapid move from fossil fuels to renewable power generation will help limit climate change and its impact on production while protecting economies from shocks in fossil fuel prices and protecting human health. However, care must be taken: switching from crops for food to crops for biofuel may increase food prices and risk fuel price shocks, especially in the event of crop failures related to climate change. Moreover, each policy choice may change practices and patterns in animal rearing and crop production, with trade-offs for climate and health, potentially exacerbating risks and vulnerabilities.

Thought must be given to increasing sustainable local food production and encouraging seasonal consumption. This reduces carbon emissions for transport (including air miles) and refrigeration. Food processing brings its own carbon cost but can also lower the energy requirements for storage (such as refrigeration) and related emissions. Reduction in ruminant meat production and consumption and a move to the consumption of local, seasonal produce may mitigate climate change and improve health in high-resource settings. Changes in the process of crop production can also help: "no till," and more advanced mixed crop and crop rotation approaches can reduce soil loss while improving soil health and lowering the need for fertilizer and pesticides.

Governments need to pay attention to ensuring the availability of food stocks to buffer changes in food availability triggered by climate, conflict, or pandemics. After the 2007-8 food price crisis, many countries in the global north and the Gulf states began investing in agricultural production in the south to diversify supply and support demand across a range of crops. Employment and out-grower contracting could benefit local household food security[19]; however, foreign direct investment in agriculture might shore up food security in the global north while undermining national food security in the south. Moreover, such practices risk raising hidden costs (externalities) in the food system, increasing environmental and health risks.[20]

Covid-19 and climate change expose deep inequalities at the individual, social, and national levels. Access to services, technology, and innovation—related to climate or health—are affected by disparities and will likely exacerbate inequality. Care must be taken to protect poorer nations, such as those in the global south, when food, fertilizer, and fodder supplies become disrupted. In the scramble to find alternative sources of food after the February 2022 invasion of Ukraine, powerful nations could exploit these inequalities in the "richest purchaser wins" approach to global procurement and diversification of sites of food and fodder production, fertilizer manufacturing, and fuel sourcing.

In future, the geopolitics of food production, sourcing, and supply could put more pressure on the global south, potentially having a negative effect on local people's livelihoods and food security.

Key messages

- Global environmental climate change can lead to challenges related to health, food security, and nutrition
- Environmental climate change interacts with covid-19 and conflict, and drives food insecurity and malnutrition
- Every public policy choice has opportunities, threats, and trade-offs that can affect health, food security, and nutrition for communities directly and indirectly through supply and market challenges, conflict, and geopolitics

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