The impact of climate change on food security

Edited by Ursula Human, Plaas Media

The Intergovernmental Panel on Climate Change (IPCC) recently released a special report on global warming. One of the chapters focusses on the impact of climate change on food security. In this article we feature a shortened version of this chapter's executive summary, which discusses the effects of climate change on cereal crop production.

The current food system (production, transport, processing, packaging, storage, retail, consumption, loss and waste) feeds the great majority of the world's population and supports the livelihoods of over one billion people. Since 1961, food supply per capita has increased by more than 30%, accompanied by greater use of nitrogen fertilisers (an increase of around 800%) and water resources for irrigation (an increase of more than 100%).

However, an estimated 821 million people are currently undernourished, 151 million children under five years of age are stunted, 613 million women and girls aged 15 to 49 suffer from iron deficiency, and two billion adults are overweight or obese. The food system is under pressure from non-climate stressors (e.g. population and income growth, and demand for animal-sourced products) and from climate change. These climate and non-climate stressors are impacting the four pillars of food security, namely availability, access, utilisation and stability.

More than just climate change

Observed climate change is already affecting food security through increasing temperatures, changing precipitation patterns, and greater frequency of some extreme events. Studies that separate climate change from other factors affecting crop yields, have shown that yields of some crops (e.g. maize and wheat) in many lower latitude regions have been negatively affected by observed climate changes, while in many higher latitude regions, yields of some crops (e.g. maize, wheat and sugar beets) have been affected positively over recent decades.

Based on indigenous and local knowledge (ILK), climate change is affecting food security in drylands, particularly those in Africa, and high mountain regions of Asia and South America.

Food security will be increasingly affected by projected future climate change. Global crop and economic models project a 1 to 29% cereal price increase in 2050 due to climate change, which would impact consumers globally through higher food prices; regional effects will vary. Low-income consumers are particularly at risk, with models projecting increases of one to 183 million additional people at risk of hunger across the shared socio-economic pathways compared to a no-climate change scenario.

While increased carbon dioxide (CO_2) is projected to be beneficial for crop productivity at lower temperature increases, it is projected to lower nutritional quality. For example, wheat grown at 546 to 586 parts per million (ppm) CO_2 has 5,9 to 12,7% less protein, 3,7 to 6,5% less zinc, and 5,2 to 7,5% less iron.

The distributions of pests and diseases will change, negatively affecting production in many regions. Given increasing extreme events and interconnectedness, the risk of food system disruptions are growing.

Varying effects among social groups

Food security and climate change have strong gender and equity dimensions. Worldwide, women play a key role in food security, although regional differences exist. Climate change impacts vary among diverse social groups depending on age, ethnicity, gender, wealth and class.

Climate extremes have immediate and long-term impacts on livelihoods of poor and vulnerable communities, contributing to greater risks of food insecurity that can be a stress multiplier for internal and external migration. Both the empowerment of women and rights-based approaches to decision-making, can create synergies among household food security, adaptation and mitigation.

Many practices can be optimised and scaled up to advance adaptation throughout the food system. Supply-side options include increased soil organic matter and erosion control, improved cropland management, and genetic improvements for tolerance to heat and drought. Diversification in the food system (e.g. implementation of integrated production systems, broad-based genetic resources and heterogeneous diets) is a key strategy to reduce risks.

In turn, demand-side adaptation, such as adoption of healthy and sustainable diets in conjunction with a reduction in food loss and waste, can contribute to adaptation through a reduction in additional land area needed for food production and associated food system vulnerabilities. ILK can contribute to enhancing food system resilience.

A look at GHG emissions

Around 21 to 37% of total greenhouse gas (GHG) emissions are attributable to the food system. These are from agriculture and land use, storage, transport, packaging, processing, retail and consumption. This estimate includes emissions of 9 to 14% from crop and livestock activities within the farmgate, and 5 to 14% from land use and land-use change, including deforestation and peatland degradation; 5 to 10% is from supply chain activities.

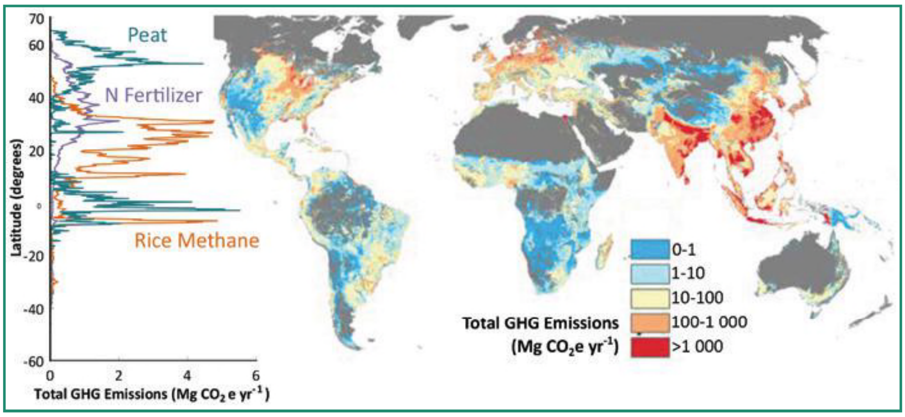
This estimate includes GHG emissions from food loss and waste. Within the food system, during the period 2007 to 2016 (*Table 1*), the major sources of emissions from the supply side were agricultural production, with crop and livestock activities within the farm gate and CO_2 emissions linked to relevant land-use change dynamics such as deforestation and peatland degradation.

Supply-side practices can contribute to climate change mitigation by reducing crop and livestock emissions, sequestering carbon in soils and biomass, and by decreasing emissions intensity within sustainable production systems. Options with large potential for GHG mitigation in cropping systems include soil carbon sequestration (at decreasing rates over time), reductions in nitrous oxide emissions from fertilisers and bridging of yield gaps.

Consumption of healthy and sustainable diets presents major opportunities for reducing GHG emissions from food systems and improving health outcomes. Examples of healthy and sustainable diets include foods that are high in coarse grains, pulses, fruit and vegetables, and nuts and seeds; low in energy-intensive animal-sourced and discretionary foods (such as sugary beverages); and with a carbohydrate threshold.

Meat analogues such as imitation meat (from plant products), cultured meat and insects may help in the

Figure 1: Cropland GHGs consist of CH_4 from rice cultivation, CO_2, N_2O and CH_4 from peatland draining, and N_2O from N fertiliser application.



**Total emissions from each grid cell are concentrated in Asia and are distinct from patterns of production intensity (Carrison et al., 2017).*

Table 1: GHG emissions (GtCO2-eq yr–1) from the food system and their contribution (%) to total anthropogenic emissions. Mean of 2007 to 2016 period.

Food system component	Emissions (Gt CO_2eq yr^{-1})	Share in mean total emissions (%)
Agriculture	6,2 ± 1,4	10 to 14%
Land use	4,9 ± 2,5	5 to 14%
Beyond farm gate	2,6[c] to 5,2	5 to 10%
Food system (total)	10,8 to 19,1	21 to 37%

transition to more healthy and sustainable diets, although their carbon footprints and acceptability are uncertain.

Reduction of food loss and waste could lower GHG emissions and improve food security. Combined food loss and waste amount to 25 to 30% of total food produced. From 2010 to 2016, global food loss and waste equalled 8 to 10% of total anthropogenic GHG emissions and cost approximately US$1 trillion per year.

Proactive measures

Technical options for the reduction of food loss and waste include improved harvesting techniques, on-farm storage, infrastructure and packaging. Causes of food loss (e.g. lack of refrigeration) and waste (e.g. behaviour) differ substantially in developed and developing countries, as well as across regions.

Agriculture and the food system are key to global climate change responses. Combining supply-side actions such as efficient production, transport and processing with demand-side interventions such as modification of food choices, and reduction of food loss and waste, reduces GHG emissions and enhances food system resilience.

Such combined measures can enable the implementation of large-scale land-based adaptation and mitigation strategies, without threatening food security from increased competition for land for food production and higher food prices. Without combined food system measures in farm management, supply chains and demand, adverse effects would include increased numbers of malnourished people and impacts on smallholder farmers. Just transitions are needed to address these effects.

For adaptation and mitigation throughout the food system, enabling conditions need to be created through policies, markets, institutions and governance. For adaptation, resilience to increasingly extreme events can be accomplished through risk sharing and transfer mechanisms such as insurance markets and index-based weather insurance.

Public health policies to improve nutrition, such as school procurement, health insurance incentives and awareness-raising campaigns, can potentially change demand, reduce health care costs and contribute to lower GHG emissions. Without inclusion of comprehensive food system responses in broader climate change policies, the mitigation and adaptation potentials assessed in the chapter under discussion will not be realised and food security will be jeopardised.

This article has been shortened for use in *Oilseeds Focus*. To read the full chapter, scan the following QR code or visit *www.ipcc.ch*.