CLIMATE CHANGE AND FOOD SECURITY IN THE 21ST CENTURY

Resource scarcity trends, including climate change, point to a future "food crunch", but we now have a moment of opportunity to agree on a global food security strategy, asserts Alex Evans. This must include not only a climate change deal, but a major shift in agricultural practice.

World Vision's food security project in Laos helps poor households reduce their dependence on wet season rice, teaching new farming techniques to improve crop yields and introducing alternative income-generating activities. **Photo:** *Albert Yu/World Vision*

Global food prices have eased significantly from their record highs in the first part of 2008, as commodity markets have weakened with the world-wide economic downturn. However, this does not mean that policy-makers around the world can breathe a sigh of relief. For one thing, even at their somewhat diminished levels current prices remain acutely problematic for low-income import-dependent countries and for poor people all over the world.

The World Bank estimates that higher food prices have increased the number of under-nourished people by as many as 100 million, and the UN Food and Agriculture Organisation puts the global total of under-nourished people at over a billion. Looking to the medium and longer term, moreover, food prices are poised to rise again.

RESOURCE SCARCITY TRENDS

Although many policy-makers have taken a degree of comfort from an OECD–FAO report on the world's agricultural outlook to 2017,[1] which argued that food prices would shortly resume their long-term decline, this report largely overlooked the potential impact of long-term resource scarcity trends – notably climate change, energy security and falling water availability.

These trends, together with competition for land and higher demand resulting from increasing affluence and a growing global population, represent a major challenge for global food security.

Climate change (discussed in more detail below) will result in an increase of 40–170 million in the number of under-nourished people world-wide, according to the Intergovernmental Panel on Climate Change. While higher average temperatures may, up to a point, lead to yield increases in higher latitudes, lower latitudes (where most developing countries are located) will start to see negative impacts immediately. Increases in the frequency and severity of extreme weather and climate-driven water scarcity also will affect food production, as will the need to reduce greenhouse gas emissions from agriculture, which accounts for as much as 32% of emissions.

Energy security also affects food prices in multiple ways, from fertiliser prices, on-farm energy use and transport costs, to using crops to produce bio-fuels – the single most important driver of food price increases in recent years. While oil prices have fallen dramatically since the summer of 2008, prices are set to rebound sharply when the world emerges from the downturn – pulling food prices up with them.

Water scarcity is likely to be among the most serious impacts of climate change. Half a billion people live in countries chronically short of water; by 2050, exacerbated by unsustainable water usage, that number will rise to more than four billion. Agriculture, which accounts for 70% of global fresh-water use, will be particularly vulnerable.

Competition for land is likely to become a major problem. To meet rising global demand for food, increased acreage will be needed, but demand for land for other uses – such as bio-fuels, timber, carbon sequestration, forest conservation and city expansion – is also intensifying.

Demand for food, finally, will rise over coming decades as world population increases towards 9.2 billion in 2050. Growing affluence and rising expectations mean that ever more people are eating "Western" diets rich in meat and dairy products, increasing demand for crops as animal feed. The World Bank projects that by 2030, world-wide demand for food will increase by 50%.

There is therefore a real risk of a "food crunch" at some point in the future, which would fall particularly hard on import-dependent countries and on poor people everywhere. But this outcome is not inevitable. Instead, policy-makers should use the current easing in food prices as a moment of opportunity in which to identify and agree on a global food security strategy. Beyond aiming to increase world food production dramatically, it must aim to make the world's food production and distribution systems more resilient, more sustainable and more equitable. To this end, in my report *The feeding of the nine billion* I offered ten key recommendations for

action on agriculture, agricultural trade, an emergency global food security system, and (recommendation 10) a comprehensive global deal on climate change [the focus of this excerpt].

Agriculture and climate

Since the last major swing in the earth's climate some 11,500 years ago, humans have lived in unusually stable times, which have proved highly conducive for agriculture. Today, this relative stability is at risk, with the earth likely to warm by 0.2°C per decade for the next twenty years, and by between 0.6° and 4.0°C by the end of the century, depending on future emissions. What does this mean for food production?

Higher temperatures can be seriously detrimental to agricultural productivity. A major study at the International Rice Research Institute in the Philippines in 2004, for example, found that "grain yield declined by 10% for each 1°C increase in growing-season minimum temperature."[2] The 2007 IPCC *Fourth assessment report* states that in low-latitude regions "even moderate temperature increases (1–2°C) are likely to have negative yield impacts for major cereals",[3] while effects on crop yields could be positive in higher latitudes (such as North America) at least in the early decades of the century. William Cline of the Center for Global Development underlines a further significant unknown: the extent to which increased concentrations of CO_2 in the atmosphere will cause a "carbon fertilisation" effect that could increase crop yields (plants use CO_2 in photosynthesis, and higher CO_2 levels reduce plants' water loss through respiration). For most developing countries, Cline finds unambiguously negative results: Africa faces 17% lower yields with carbon fertilisation and 28% without; Latin America, 13% lower with and 24% without; and in India, the range of possibility is between –30% and –40%.[4]

Changes in water availability will be another highly significant impact of climate change on agriculture, and will also expose hundreds of millions of people to additional water stress during this century. More than a sixth of the world's population live in river basins fed by glaciers or snowmelt, and are likely to see more flow in winter and less in summer.[5] Sea-level rise will reduce freshwater availability in coastal areas through salinisation of groundwater and estuaries. Increased variability and intensity of rainfall will increase the risk of floods and droughts, and again, current models predict more rain at higher latitudes, and less in the tropics.[5] The impacts of these changes will vary widely. In Africa, between 75 million and 250 million people are likely to be exposed to additional water stress by 2020, and yields from rain-fed crops in some countries could be reduced by up to 60%. By the 2050s, freshwater availability in Central, South, East and South-East Asia is projected to decrease.[6]

Sudden-onset weather shocks will have further impacts on agriculture. Principal among these will be extreme weather events such as hurricanes and floods, which in 2008 (Cyclone Nargis, for example) had major impacts on agricultural yields.[7] Significantly, extreme weather events are often overlooked in estimates of the effect of climate change on agricultural yields.

Agriculture's own emissions have a significant impact on climate change: food and agriculture are responsible for up to 32% of man-made greenhouse gas emissions if deforestation is also included. Given that total emissions will need to fall by as much as 85% by 2050 (even more in developed countries, under an equitable global regime), agriculture will have to play its part.[8] Agriculture is likely to need to become a net sink for emissions rather than a net source of them. Planting trees or making increased use of bio-char as a form of carbon sequestration is one way to achieve this; improving land and soil management is also critically important.

The outlook

Many highly populous developing countries face strongly negative impacts on agriculture even over the next few decades, and catastrophic impacts over the longer term. In the short term, adaptation to climate change will be crucial for their food production and food security. But without adequate, and early, emissions reduction, there is a real long-term possibility of climate change impacts being so severe that adaptation *in situ* becomes effectively impossible for the majority of people in these countries.

Globally, the effects of climate change on agriculture are uncertain, but the long-term outlook for aggregate global yields is more uniformly negative under "business-as-usual" emission scenarios. Thus, the outlook for global food production is contingent on the agreement and implementation of a comprehensive global deal to stabilise greenhouse gas concentrations at a safe level – even as agriculture itself faces the significant challenge of becoming a net "negative emitter". Achieving these demanding goals will require major shifts, both within agriculture and beyond it. The fact that the history of agriculture is so full of creativity and innovation gives real grounds for hope about prospects for feeding nine billion people even as climate change makes itself felt; but the scale of the challenge means that sustained action can be put off no longer. ■

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[8] IPCC, *Change 2007: Mitigation*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (eds B Metz *et al.*), 2007