Climate

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Nutrition. The big picture
Impact on water, crops and food

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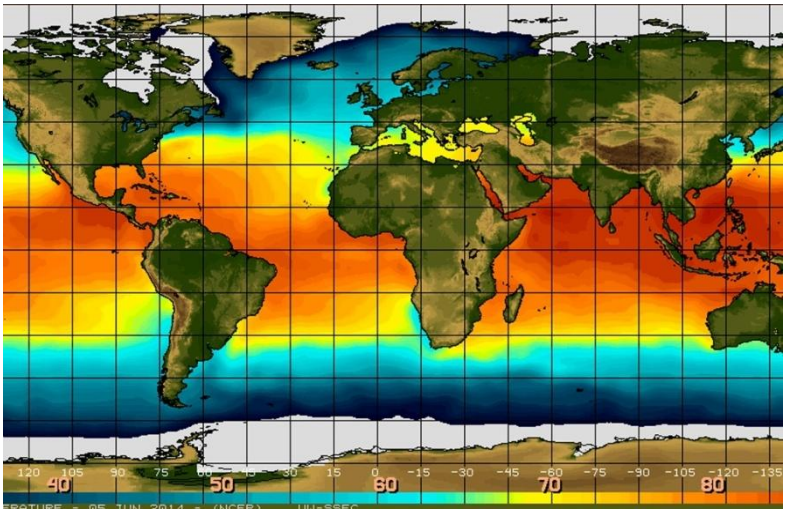
Access December 2009 Tony Michael, Colin Butler on climate change here
Access January 2014 Tony McMichael on climate change here
Access March 2014 IPCC report on food systems impacts here
Access March 2014 IPCC report on health impacts here
Access April Editorial on climate change and food systems here
Access May Editorial on climate change and food systems here
Access May 2014 Tony McMichael, Helen Berry, Coin Butler on climate change here
Access June 2014 Colin Butler on climate change here
Access this issue Source, Tony McMichael's Top 5 texts

Editor's note

This continues the *WN* series concerning the effect of climate change on food systems, public health and on societies, economies, politics, the living, physical world and the biosphere. This is one of the *WN* series that address 'the big picture' – the social, cultural, economic, political and environmental determinants of food systems and supplies, and thus what populations eat and their nutritional status. Tony McMichael, and also Colin Butler have written extensively on climate change, and on its impact on food systems and on human health. Links to some of their work, including previous *WN* contributions, and letters in *Feedback* in this and the previous issue, are above.



A predicted El Nino climatic oscillation in 2015 will warm the equatorial oceans (above) and adjoining land masses and make existing global warming more severe in its effects on food supplies

The currently recognisable face of climate change is predominantly one of increases in heatwaves, severe weather disasters, longer mosquito seasons and bleached corals. But these may be only the curtain-raisers. The likely and much greater threat to human health and physical survival will be from regional food and water shortages, to which climate change will be a major contributor.

Over the past 7,000 years, food shortages due to natural climate changes and fluctuations – droughts, drenching rain, locust plagues and so on – have been the main killer (1).

Initial impacts

Food and water, both sensitive to climatic-environmental conditions, are the basic necessities of life and health. The results of many modelling studies, using a range of climate change scenarios, indicate that moderate warming may benefit crop yields in mid- to high-latitude regions – at least during the first rise of 2-3 degrees Celsius – but will reduce yields in seasonally dry and low-latitude regions. The northern region of South Asia, much of Sub-Saharan Africa and parts of Central America are vulnerable – and so, therefore, are child (physical and mental) development, general health, well-being, and social stability in those populations (2,3).

Yields of crops and livestock are generally sensitive to climatic conditions, and can be impaired by quite small changes in temperature during the growing season (4).Between 1980 and 2008 potential gains in crop yields from technological and other advances appear to have been largely offset by rising temperatures in many cropping regions (5). Yields of wheat, rice and corn from one-third of the main cropping regions in eastern Asia, Europe and North America appear to have peaked in recent times (6). India's rice yields peaked a decade ago, and South Asia's 'green revolution' has tailed off. Downturns in yield are also anticipated in parts of sub-

Saharan Africa, southern Europe, the US Midwest, and southern Australia.
Can estimates of changes in yields be converted into estimates of consequence adverse health effects? Both quantitative and qualitative studies are needed to clarify many of the complex causal influences that influence nutrition and health. For simpler relationships such as floods that destroy family food stores, standard epidemiological research methods may suffice.

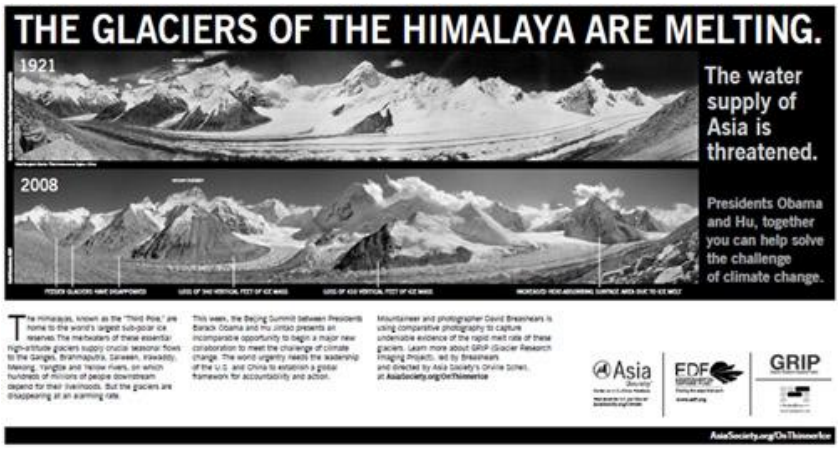
However, qualitative research becomes an essential ingredient in characterising indirect and delayed climate-and-health relationships, many of them mediated by social conditions and the disruption of natural systems. An important research challenge, for example, relates to clarifying and quantifying how climate-related harvest failure leads to local or regional food shortage, increased food prices, nutrition deficits, impaired child development and greater risk of childhood death. Multidisciplinary methods are now evolving and useful estimates are emerging (7)

Climate change influences food yields in a myriad ways. Photosynthesis peaks within its 'just-right' temperature, and then declines at higher temperatures (8). The same is true for rainfall and soil moisture. Extreme weather events, droughts, climate-triggered infestations and infections all reduce yields. Early on, extra CO_2 may 'fertilise' growth of plants, especially the many 'C3' plants (such as wheat, rice and barley) that evolved several hundred million years ago when atmospheric CO_2 levels were higher than in recent times. But field studies indicate that any such benefit is annulled by further warming. Meanwhile, other feedbacks occur. For example, a 1 degree Celsius rise causes soil bacteria to give off twice as much CO_2 while reducing the soil's moisture-retaining capacity, and heavy rainfall accelerates erosion.

In principle, we humans produce food to eat, stay healthy and survive. In practice the economic weight of the agricultural sector (and food exportation) often eclipses health and environmental sustainability. Yet the mix of rising temperatures, more severe droughts in vulnerable regions, shifts in rainfall geography and seasonality, acute weather disasters and the encroachment of climate-sensitive pests and plant diseases pose obvious threats to agriculture and food sufficiency in many regions.

Some resolution of the underlying 'greenhouse' over-drive that is causing climate change should, however, come from the food-and-nutrition quarter. Increasing public concern over energy use and greenhouse emissions, when this is explicitly and publicly linked to food systems and products, may reorient food preferences and motivate – or even force – reforms in food production, such as reducing greenhouse-potent methane emissions from livestock production. Offshore, the known many health benefits of seafood, the stocks of which are increasingly threatened by ocean warming, acidification and shifting currents, should be reinforcing national and international marine conservation policies.

Impact of loss of Himalayan glaciers



A huge advertisement in The New York Times in 2009 warned the leaders of the US and China – and the whole world – that the water supply of Asia is threatened by melting Himalayan glaciers

Meanwhile, water security is threatened both by climatic changes and by the inexorable rise in demand from more people, more irrigation, industrial intensification, and rising urban expectations (lawns, swimming pools, car-washes, and so on).Warming increases evaporation and total rainfall increases accordingly – but changes occur in the place, season, amount and pattern of rainfall. Globally, currently wet regions will get wetter and dry regions will get drier; many monsoon systems will shift and weaken (2). In parts of southern Australia more of the wheat-nurturing winter rain now falls in the Southern Ocean, and less on land, than in past decades. Water insecurity is beginning to cast long shadows over food prospects.

In South Asia the two main water sources for hundreds of millions, the Brahmaputra and Indus rivers, derive almost one-third of their flow from the annual thaw of the Tibetan glacier, which is losing mass as warming proceeds. The Ganges, Mekong, Yangtze, Yellow and Red rivers, originating on that plateau, will be affected too (9). 'Water wars' – recently acknowledged as becoming likely by the president of the World Bank Jim Yong Kim (10) – may arise under pressures from climate change, population growth and the demands of agriculture, industry and cities.

There is great complexity – biophysical, ecological, social and political – in all of this. However, the more we understand the complex ways in which climatic and environmental conditions affect food yields and nutrient quality and then (as also conditioned by social and cultural circumstances) the nutrition and health of humans, especially children, the clearer becomes the centrality of food and nutrition to life, health, social cohesion and our future. That greater awareness should help to drive overdue radical policy changes that may yet secure a future habitable, fairer and well-fed world.

References

1 O'Gráda C. *Famine: A Short History*. Princeton University Press, 2010.

2 Porter J, Xie L, Challinor A, *et al.* Chapter 7. Food Security and Food Production Systems. In: Field CB, Barros V, Dokken DJ, *et al* (eds.). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Volume I: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, 2014.

3 Cribb J. *The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It.* University of California Press, 2010.

4 Lobell D, Field C. Global scale climate-crop yield relationships and the impacts of recent warming. *Environment Research Letters* 2007. doi:10.1088/1748-9326/2/1/014002.

5 Lobell D, Schlenker J, Costa-Roberts J *et al.* Climate trends and global crop production since 1980.*Science* 2011, **333** (6042), 616-620.

6 Grassini P, Eskridge K, Cassman K *et al.* Distinguishing between yield advances and yield plateaus in historical crop production trends, *Nature Communications* 4, 2013, DOI: doi:10.1038/ncomms3918

7 Lloyd S, Kovats R, Chalabi Z. Climate change, crop yields, and malnutrition: development of a model to quantify the impact of climate scenarios on child malnutrition. *Environmental Health Perspectives* 2011, **119**(12): 1817-1823.

8 Peng S *et al.* Rice yields decline with higher night temperature from global warming. *Proceedings of the US National Academy of Sciences (PNAS)* 2004, **101(**27): 9971–9997

9 UNESCO-SCOPE-UNEP. *The Third Pole*. Policy Brief 13, June 2011. See also: http://www.tpe.ac.cn

10 Elliott L. Climate change will 'lead to battles for food', says head of World Bank. *The Guardian*, 3 April 2014. http://www.theguardian.com/environment/2014/apr/03/climate-change-battle-food-head-world-bank

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