

THIS MONTH'S FEATURE

What will be the true impact of climate change, and climate change policies, on global crop production ?

Leading up to the Durban Climate Change conference, COP17, there were calls for agriculture to be given priority by the negotiators. Agriculture is the sector most vulnerable to climate change, but it is also a major cause, directly accounting for about 14% of greenhouse gas emissions ([Climate Change 2007, the Fourth Assessment Report \(AR4\) of the United Nations Intergovernmental Panel on Climate Change, IPCC](#)).

Calls for a global policy

The call, in the form of a letter released on December 3, came from 17 organisations including several UN agencies: FAO, UN World Food Programme (WFP), International Fund for Agricultural Development (IFAD) as well as the World Bank and the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS). When it came to it, however, the negotiators deferred the discussion on specific targets involving agriculture. Pressure to bring agriculture into the discussion had come largely from the developed countries but was not supported by many developing countries. For African countries, in particular, agriculture is much more important as an issue under adaptation, not mitigation. They want to see the industrial nations acting to reduce emissions from industry as a priority.

So there was no work programme on agriculture established at COP17, merely an exchange of views. A working group on Long-term Cooperative Action did however [conclude that a decision on agriculture will be made at COP18](#) which takes place November 2012 in Qatar. But it is very clear that developing countries will only move the agenda forward if adaptation is also covered

However, a number of UN agencies will be managing events during 2012 at which the agriculture and climate change agenda can be progressed. It does not necessarily require the involvement of the Climate Change forum for progress to be made. The CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), the FAO, and some of its products, such as a roadmap for "[Greening the Economy with Agriculture](#)" will be launched at key meetings over the course of the year. This will include the Rio+20 meeting to be held in Rio de Janeiro next June.

Which crop growing regions are most affected ?

- In Europe

The impact of climate change on crop productivity agriculture is complex. Changes in climate can affect water availability and therefore yields, risk from storm damage and incidence of pests and diseases. A useful information sheet has been published by the European farmers' organisations, the Committee of Professional Agricultural Organisations and the General Committee for Agricultural Cooperation in the European Union, Copa-Cogeca. This covers some of the more potential impacts on the more important crops that are grown in Europe (www.copa-cogeca.be/img/user/file/FT_EN/DOC/5658E.pdf).

Based on the PESETA study published in 2007 (<ftp.jrc.es/EURdoc/JRC55386.pdf>) Copa-Cogeca, quote that, by 2030, yields (compared with the period 1961-1990) could increase up to 70 % for certain northern EU regions but decrease by more than 22 % in southern regions. However, it is also pointed out that EU-27 reported emissions from "cropland which remains cropland" and "land converted into cropland" have decreased in the period 1990-2007 by 24% and 16% respectively.

The changing climate in Europe could lead to a shift of crop production to the north and to some higher altitude regions. There would be positive impacts as a consequence of longer growing seasons, new cropping opportunities from warmer winters as well as the reduction of frost frequency in autumn and winter.

In terms of potential mitigation actions, Copa-Cogeca highlight the opportunity from growing alfalfa as it can be important as a source of feed protein as well as delivering environmental benefits. In some EU areas, 0.4 ha of alfalfa is enough to produce one tonne of protein. This compares with 1.3 ha needed for soya. In the area of land freed up it would be possible to grow alternative food crops, energy crops or to reforest the land. Alfalfa, being a legume, captures atmospheric nitrogen and therefore does not require high mineral fertiliser application. This is potentially important as 48 % of the agricultural emissions in the EU-27 in 2007 were soil-related.

- In North America

Jerry L Hatfield, ARS - USDA, in "*Crop Adaptation to Climate Change*" (www.eu.wiley.com/WileyCDA/WileyTitle/productCd-0813820162.html)

explains that climate change is occurring across North America with changes in both temperature and precipitation patterns. He predicts that although the changes are not uniform, temperature patterns will increase overall. The southern US is expected to warm more than the upper portions of North America. Precipitation patterns show a very distinct seasonal and regional trend. The southwest US and northern Mexico show dramatic decreases in annual precipitation compared to the rest of North America.

Overall, in North America, the trends are for decreased summer precipitation. This will result in increased water stress on crops since most of the crops are grown during the summer and under rain-fed conditions.

There will need to be an increase of water availability to the crop to reduce water stress and the development and selection of crop varieties capable of coping with temperature extremes and exposure to water stress.

- In developing countries

CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS) released in October 2011, a series of studies focused on "climate proofing" crops critical to food security in the developing world (www.ccafs.cgiar.org).

The studies describe how specific adaptation strategies could neutralise or at least significantly lessen the impact of climate change on food production. They argue that investments are urgently needed to identify important genetic traits, including drought tolerance and pest resistance, which will be critical for helping farmers adapt to new growing conditions.

The studies developed by an international team of the world's leading climate and agricultural researchers aim to provide adaptation strategies for more than a dozen crops -- such as potatoes, beans, bananas and cassava.

The studies indicate that many of the critical traits farmers will need to deal with the hotter, drier, and in some cases, wetter conditions probably are to be found in seeds now safeguarded by international crop gene banks, many of which are controlled by multinational companies. However, there is also a rich vein of traits contained in the wild relatives of key crops. It will, therefore, require more intensive application of cutting edge biotechnology, including the use of the new tools of genomics and transgenics.

This led Bruce Campbell, CCAFS director to comment on the studies' findings: "These results offer plant breeders a strong foundation for establishing research priorities for the next two decades, which is about the time they will need to develop new generations of crop varieties suited to shifting agriculture environments."

As widely reported it is Sub-Saharan Africa which is most vulnerable to the impact of climate change. The scientists report that the potato, for example, is especially vulnerable to heat stress, which reduces growth and starch formation. Rising temperatures in southern Africa and tropical highlands worldwide could be particularly hazardous. Scientists believe that developing and distributing heat-tolerant potato varieties could reduce climate-related damage for about 65 % (7.7 million hectares) of the world's potato crop.

The potato crop could also be affected by the spread of the potato tuber moth, *Phthorimaea operculella*, which could spread northward and to higher elevations as a result of climate change.



Potato tuber moth - potential to spread north

On the positive side drier, warmer summers in some regions could depress the incidence of late blight, *Phytophthora infestans*.

- Tomorrow's growing conditions today

An initiative planned under the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is to show some farmers what conditions will be like for growing crops in 2030 when temperatures have increased, and to demonstrate how these farmers should adapt.

Julian Ramirez, a scientist based at the [International Center for Tropical Agriculture \(CIAT\)](#) in Colombia commented: "Climate change will significantly alter growing conditions, but in most places the new farming environment will not be novel in the global context - rather, the situation in the future will closely resemble conditions that already exist in other parts of the world."

For example, according to CCAFS analysis, by 2030, maize producers around Durban, South Africa, could face a one degree increase in temperature during the maize growing season. Studies by Stanford University and others indicate that such an increase would reduce yields by about 20% in the absence of adaptive measures. But maize farmers in Argentina and Uruguay

are growing maize successfully today under average temperatures that are three degrees higher.

Similarly, soya bean farmers in Argentina, as well as in the central and southern US, are already managing conditions similar to the ones that soya bean growers around Shanghai, China, will experience within about 20 years.

Andy Jarvis, a research theme leader for the CCAFS said: "If Chinese farmers want to continue growing soya beans, they need to look at the kinds of farming practices and crop varieties that farmers in northern Argentina and other analogue regions are growing."

Patti Kristjanson, another research theme leader at CCAFS summarised the situation for the developing countries: "Farmers already adapt to variable weather patterns by changing their planting schedules or moving animals to different grazing areas. What this study suggests is that the speed of climate shifts and the magnitude of the changes required to adapt could be much greater. In some places, farmers might need to consider entirely new crops or new farming systems.....in parts of East and Southern Africa, for example, temperatures may become too hot to maintain maize as the staple crop, requiring a shift to other food crops, such as sorghum or cassava, to meet nutrition needs."