Food forecasting

Combining crop and climate models could predict failed harvests and help us understand how crops respond to climate change, writes Andrew Challinor.

Most of the world's food is grown in the tropics, where a few important food crops feed an increasing population in developing countries. It is here that people are particularly vulnerable to climate change. So how will staple tropical crops such as rice and maize respond as climate changes, potentially producing completely new conditions? It's difficult to know for sure because plants are complex biological systems, and we can't be certain how they'll respond. It's also impossible to know exactly what the climate will do.

Our best approach is to combine crop and climate models. Researchers can grow plants in plastic tunnels with increased carbon dioxide or at higher temperatures, and make computer simulations of how a whole crop might respond under different conditions. But such models usually need information about the weather over a particular plot, whereas climate models tell us about average weather conditions over a large area (upwards of 600 square kilometres).

To tackle this mismatch of scale we have examined rainfall and crop yield over India. The good news is that they are related even over large areas. So we have designed a new, large-area, crop model which will work on the same scale as climate models. We tested this model by using it with seasonal weather predictions. These predictions don't say with certainty what the weather (and hence the crop) will do because we can't measure the atmosphere precisely enough to know what it will be doing in a few months. But we can use probabilities to describe what is likely to happen. For India we found that crop failure may be predictable a few months before the harvest. A predictive system based on these techniques could give advance warning of a likely food shortage, allowing relief resources to be mobilised in good time.

Pictures: Tim Wheeler

Combined with our best climate models, the new crop model can also begin to tell us how the harvest might look in fifty or a hundred years time. We expect crops to respond to changes in rainfall, atmospheric carbon dioxide and temperature. Higher carbon dioxide may mean higher yields, but higher temperatures may shorten the time crops take to mature, and so reduce yields. Also, high temperature episodes near the flowering period in certain crops can seriously reduce yields. In winter wheat, for example, these episodes can reduce the number of grains setting in each ear. Our crop model has all these processes in it. What's more, we can look at how a change in crop type, or in planting date, may affect yields. In other words, we can begin to say what climate change might mean for the millions of people who live in the tropics, and how they might best adapt to it.

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