University of Reading

IMPACT CASE STUDY

Crops and climate change

Helping to ensure food security

As our climate changes, there will be big impacts on crop production. Understanding what these changes will be, and how they affect crops can only help us to better prepare for the future and help to ensure food security. Research funded by the Natural Environment Research Council at the University of Reading aims to understand how climate variability and change affects crops in order to identify adaptation options for agriculture.

Climate change will impact negatively on our ability to maintain our production of food

Research

The Food and Agriculture Organisation of the United Nations estimates that the world needs to produce 50% more food by the year 2030. This increase in production is vital due to increases in human population and other factors such as changes in diet. However, climate change will impact negatively on our ability to maintain our production of food, and if we do nothing, then levels of productivity will steadily decline across the world. Furthermore, we will be more vulnerable to the negative impacts of extreme weather, which we expect to become more frequent.

Research is concerned with developing crop simulation models and, for the last ten years, this body of work has been brought together in the Crops and Climate research group at the University of Reading – an interdisciplinary group of crop scientists, meteorologists and physicists aiming to improve projections of the impacts for climate change on crops using advanced crop and climate simulation techniques.

The research group has been involved in work which has developed a new global crop model, and the outcomes from this have enabled the provision of scientific advice to the UK Department for Energy and Climate Change on the effects of different greenhouse gas mitigation policies on global crop production. Further outcomes of this research include a novel web-based tool to identify potential adaptation practices for crop production in the future, and this is now being used as a training aid for agricultural staff in the developing world.

The research used a crop simulation model known as GLAM (General Large Area Model), which reproduces the impacts of climate variability and change on crop yield, and includes the effects of high temperature extremes. The model was originally produced from research at, and funded by, the University of Reading. This initial work led to further research funded through a NERC consortium grant, which developed the model to make it suitable to provide projections for changes in crop productivity across the world under different climate change scenarios. This has then been used to assess the possible impacts that potential climate mitigation policies may have on crops.

This work directly fed into the AVOID research programme of the UK Department for Energy and Climate Change, which examines the potential impacts that policy could have on global and regional climate. The GLAM crop model which this research developed was used as part of AVOID to assess the possible impacts that mitigated and unmitigated climate scenarios could have on crop yields at the global scale.

As an alternative approach to informing agricultural adaptation to climate change, the knowledge and datasets from GLAM were also used to develop a tool to identify analogue climates. This work was done in collaboration with international non-governmental partners as part of the Climate Change, Agriculture and Food Security

programme of the Consultative Group on International Agricultural Research (CGIAR). The climate analogue tool identifies locations today that have a climate similar to a particular location's future projected climate, and these locations represent a source of potential adaptation practices for crop production.

Impact

The crop simulation model, which was developed to predict the impacts of climate variability and change on crops, has been used to provide advice to the UK Government on avoiding dangerous climate change brought on by greenhouse gas emissions. The implications for agriculture of a range of policy decisions on greenhouse gas emissions were made available to the UK Department for Energy and Climate Change (DECC) through the outputs of the AVOID project, as a direct result of this research. Simulating crop impacts under various mitigation climate scenarios provided information on the potential efficacy of mitigation in reducing the negative impacts of climate change on crop productivity. An independent evaluation for DECC of the AVOID programme in 2012 concluded that 'the AVOID programme is delivering interesting and useful policy-relevant work which has helped inform policy'.

The impact of GLAM crop model simulations can also be demonstrated by their incorporation into evidence on the potential impacts of mitigated and unmitigated climate change that was compiled in information which was distributed to delegates at the UN 16th Conference of the Parties (COP-16) at Cancun, Mexico.

The climate analogue tool, developed as part of this research, identifies locations globally that have present climates which are similar to the future projected climate of a user-specified location. Agriculture practiced at these locations provides potential adaptation options for the user-specified location in the future. This resource is being promoted and distributed by the Climate Change, Agriculture and Food Security (CCAFS) programme of Consultative Group on International Agricultural Research (CGIAR). Although climate change will bring entirely new climates, it is thought that more than 70% of the climate patterns expected in 2030 already exist somewhere on Earth today, and the climate analogue tool finds them. The tool is online (available at gismap.ciat.cgiar.org/Analogues), so anyone can ask where on Earth there is currently a climate like the climate expected in 2030 at any given location. This could be used to look for pre-adapted crop diversity, and for useful techniques to make use of that diversity.

CCAFS are now using this tool to train relevant personnel in the developing world, where climate change is expected to have a larger impact on agriculture, in order to aid agricultural adaptation to climate change in these places. Specifically, it is being used to inform adaptation to future climate via the CCAFS Farms of the Future project which to date has been active in Nepal, Ethiopa, Tanzania, Costa Rica.

While the tool is of primary use to farmers and breeders, helping them to narrow the choice of species and selections for a given location, it also has a more broad use in highlighting the need to access plant genetic resources from other countries and to locate areas that need urgent conservation. Thus, the climate analogue tool is also being used to spur implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture. No country is self-sufficient in plant genetic resources, and all depend on genetic diversity in crops from other countries and regions. International cooperation and the open exchange of genetic resources are therefore essential for food security. The fair sharing of benefits arising from the use of these resources is being practically implemented at the international level through the Treaty and its Standard Material Transfer Agreement.

On the CCAFS website, Michael Halewood, the scientist leading the Treaty implementation project, is quoted as saying: 'one of the most frequently cited justifications for the multi-lateral system of access and benefit sharing of the Treaty is interdependence; countries depend on plant genetic resources from other countries. That's going to increase with climate change. Countries are going to need more access, which means they need the Treaty. Our work helping countries implement the Treaty dovetails beautifully with the Climate Analogue Tool, and use of the tool will be mainstreamed into the research supported by the project.'

Funding:

The crop model described was initially developed with seed funding from the University of Reading. Further development was supported by a NERC consortium grant looking at 'The global impacts of climate change, a multi-sectoral analysis'. The consortium was led from Reading, and the work on crops and climate change all took place at the University of Reading.

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NATURAL ENVIRONMENT RESEARCH COUNCIL

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