CASE STUDY: Helping food system planners manage present-day climate risks for regional and global food security

Executive Summary: The Climate Science for Service Partnership (CSSP) China project has improved food security planning in China by developing climate-informed forecasting tools that help predict maize yields and assess the risks posed by drought, flooding, and climate variability. By providing earlier and more localised climate risk information, the programme is enabling policymakers, farmers, and agricultural planners to make better-informed decisions, strengthening the resilience of food production systems and supporting economic stability and food security both in China and globally.

The Challenge: Maize is a staple food in many parts of the world with a large fraction of global production concentrated in relatively small areas, such as China's Northeast Farming Region (NFR). China grows around 30% of the world's maize, and approximately 30% of that production occurs in the NFR. However, crop yields are highly dependent on weather and climate, with summer temperature and rainfall having a significant impact, with too much or too little having negative effects. This makes maize production susceptible to climate hazards, such as flooding, extreme heat and drought, which can have a large negative impact on China's maize production, increasing domestic maize prices, with potentially major implications for the global commodity market. Unexpected decreases in maize yield will not only cause economic losses, but will also negatively impact prices, trade and national and global food security.



Maize field and harvested maize sunning, China

Given the global nature of food imports and exports, being able to quantify the risks to agriculture posed by weather and climate variability and change has huge socio-economic benefits both within China and worldwide. There is a need for the provision of food security climate information to help inform long-term planning in agricultural investment at provincial, regional or national scales and help ensure the stability of the food system in China.

The Approach: Helping food system planners in China manage the present-day climate risks to domestic food production requires access to forecasts that can skilfully predict relevant weather conditions at useful lead-times. Through the CSSP China Project, researchers are improving our understanding of the current and future climate risks to globally important crops including maize. Met Office scientists have co-developed with users a pioneering climate-

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yield modelling framework for maize in the NFR, enabling province-level forecasts and future yield projections. The statistical approach developed links June–August temperature and precipitation during the main growing season (May to October) to province-scale maize yields and has demonstrated skilful retrospective prediction over the historic period. The subsequent forecasts can be issued in July, August, and September ahead of crop harvest in October. The developed approach requires relatively little training data and is computationally cheap to run, making it suitable both for locations where data are sparse and for use by relatively non-technical users. Used in concert with other modelling approaches, this approach can be part of a toolkit that enables decision-makers to better understand and manage climate risks to current crop varieties across regional and national scales.

Pathway to Impact: The first prototype Chinese-translated forecast products for the Northeast Farming Region were co-produced with colleagues at the Beijing Climate Centre (BCC) of the China Meteorology Administration (CMA) in 2022 and well received by users. In 2024, following user feedback, the forecasts were broken down into three provincial regions, Liaoning, Jilin and Heilongjiang, to provide more user relevant information and better support decision making. Further research was also undertaken to extend the forecasts so they can be issued earlier in the year, and which has enabled it to inform wider decision making. The risks of yield shocks in multiple provinces have also been considered, as simultaneous low-yield events across multiple provinces may result in more severe impacts. The statistical forecast methodology was applied to climate projections (Coupled Model Intercomparison Project Phase 6 (CMIP6)) to assess changes in mean yield and inter-annual variability in the 2020–2049 and 2050–2079 periods. Such simultaneous yield shocks are found to remain rare (around 10% of years for Liaoning-Jilin), however, some models indicate a risk of such yield shocks occurring in all three provinces simultaneously in up to 40% of years. Further research has investigated the potential impacts of climate change on maize yield in this region by the middle and end of the century to inform decision making around adaptation and resilience.



Damaged maize corn cobs due to uneven water supply

A benefit of the flexible statistical approach developed is its potential for modification to suit different spatial scales and incorporate knowledge about different crop varieties and types. Further work has investigated the feasibility of climate services to support sugarcane production. Sugarcane is a critical crop for southern China, particularly in Guangxi, which accounts for around 70% of China's sugarcane area and over 60% of national sugar output, supporting millions of livelihoods. Exploratory research has focussed on predictability of hazards such as spring drought, autumn drought, and frost events and engagement is continuing with CMA and provincial partners in China on the possibility of co-developing a prototype sugarcane climate service.



Harvested Black Skinned Sugarcane, Guangxi China

Peiqun Zhang, Senior Scientist, Beijing Climate Centre said: “We could apply the approach to explore a method for estimating the climatic growth of maize to help decision makers, including farmers, to counteract the risks associated with climate variability.”

Stacey New, International Climate Science and Services Manager at the Met Office said: “One of the greatest strengths of CSSP China has been the collaboration between UK and Chinese scientists, combining expertise, perspectives and local knowledge to co-develop climate services that address real-world challenges. The maize yield forecasting service demonstrates the value of this partnership, translating climate science into practical information that supports decision-making”.

Published Papers

- Cottrell et al. (2025), A data-driven model for quantifying how maize yields in North-East China respond to summer climate, *Environmental Research Communications*. 10.1088/2515-7620/adac33
- Cottrell et al. (2026), Impact of climate change on maize yields in North-East China, *Environmental Research Communications*. 10.1088/2515-7620/aea5ef