Food Security Pack

The International Climate Services team at the Met Office has developed an information pack about how climate change is likely to impact food security in the Northeast Farming Region of China. The Food Security Pack aims to provide evidence-based information to industry, policy makers, and farmers who can use this information to help them make decisions.

This work was conducted as part of the CSSP China project. CSSP China supports collaboration between the UK and China. It aims to develop capability to inform decision makers in climate mitigation and adaptation strategy and to underpin services to support climate and weather resilient economic development and social welfare. CSSP China is building strong, sustainable partnerships between the China Meteorological Administration (CMA), the Institute of Atmospheric Physics (IAP) and the Met Office, the UK's national meteorological service, and other key Chinese and UK scientific institutes.

If you would like to discuss the Food Security Pack further with a member of the International Climate Services team at the Met Office, please email WCSSPProgrammeOffice@metoffice.gov.uk. You can also contact us on WeChat.

We look forward to hearing from you!

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FOOD SECURITY PACK – Climate Change and Agriculture

Climate change

Climate change is already happening. China's Third National Communication on Climate Change[1] states that:

- Increasing greenhouse gas emissions from human activities have increased China's mean surface air temperature by 1.15 °C in the last 100 years.
- Temperatures in China are projected to rise between 0.26 °C and 0.61 °C per decade between 2011 and 2100 (RCP 4.5 and 8.5).
- Warming is projected to be larger in northern China than southern China.

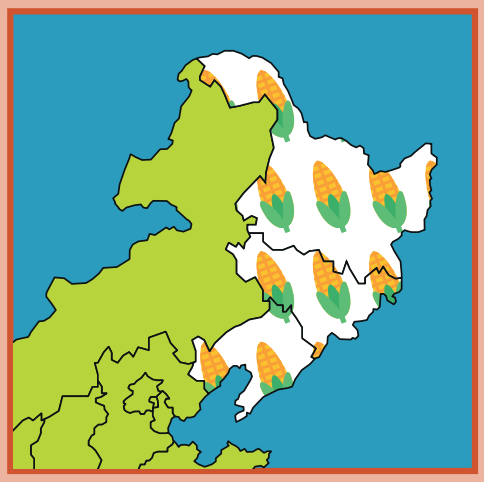
In 2020, China committed to reaching carbon neutrality by 2060[2].

Food security

The agricultural system is especially at risk from the effects of climate change.

China grows 30% of the world's maize, and 30% of this is grown in the Northeast Farming Region (NFR)[3]. Since maize is predominantly rain-fed, this makes maize production susceptible to climate hazards, such as drought.

Unexpected decreases in maize yield will not only cause economic losses, but will also negatively impact prices, trade and national and global food security.

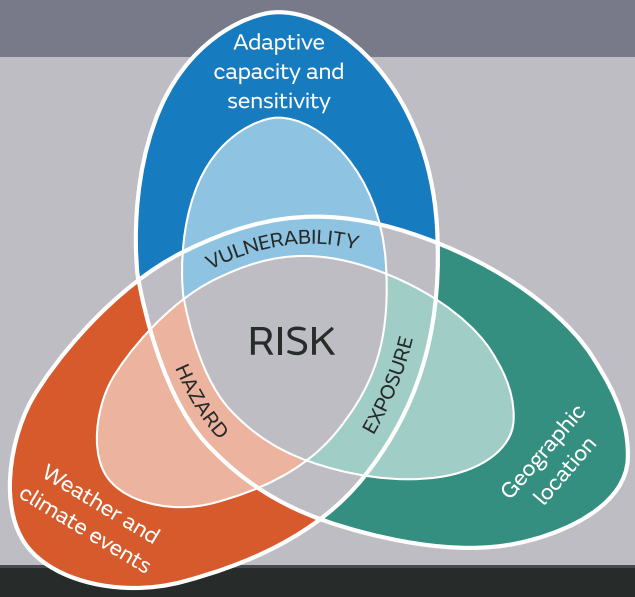


Risks and recommendations

Ensuring food security is one of the main goals of China's agricultural policy[4]. The impact of climate risk depends on the hazard itself, exposure to the hazard levels and vulnerability.

Recommended actions to reduce these risks include:

- Developing more efficient irrigation technologies
- Growing drought resistant strains of maize
- Assessing current drought exposure
- Adjusting the crop calendar to reflect the changing climate
- Reducing global CO_2 emissions



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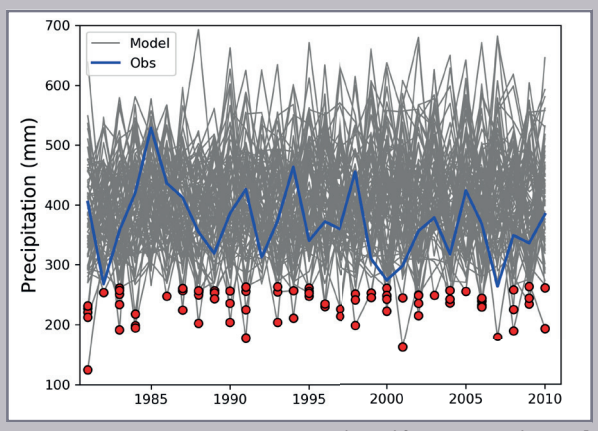
FOOD SECURITY PACK – Future Climate - Northeast Farming Region

Current drought risk

Drought is the dominant climate risk in the NFR. Climate models show that the observational record (blue line) underestimates current drought risk.

There is a 5% chance each year that there will be a more severe drought (red dots) than has been observed in the last few decades[5].

Farmers and local governments should make plans for this drought risk by investigating more efficient irrigation technologies.



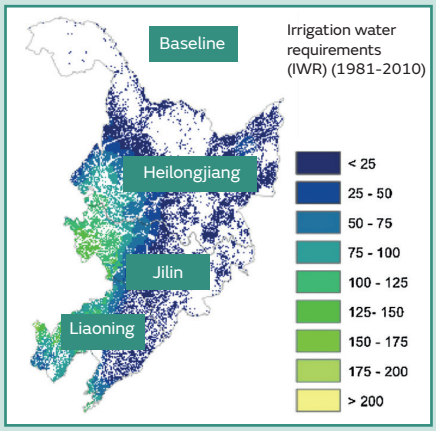
Adapted from Kent et al., 2019[5]

Current water stress risk

Water stress caused by the shortage of water can reduce biomass production and lead to maize yield loss[6].

Only 15% of maize in the NFR is irrigated but crop water requirements are > 25 mm across more than half of the NFR. Lack of water is especially damaging to maize development at the vegetative growth stage[6].

Irrigation will reduce the risk of crop yield reduction. Irrigation plans should consider the water demands at different developmental stages of the maize.



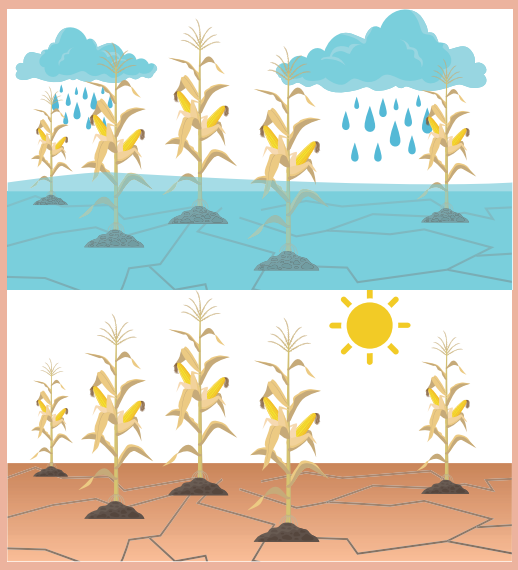
Adapted from Xu et al., 2019[6]

Other current climate risks

Flooding: Waterlogging disasters can affect maize crop yield[7]. Northeast China is projected to experience increased variation in precipitation in the future[1]. This may lead to more flooding and waterlogging events, Vdecreasing maize yield.

Heat stress: Temperature in the NFR has increased by 0.16 °C across the maize growing season since 1961. The largest changes (0.23 °C) occurred during the late growth phase, which is particularly sensitive to heat stress[1,8].

Typhoons: Since 2000, the area of land in the NFR at risk from typhoons is ~2% of the area at risk from other hazards[9]. Typhoons are relatively rare in northern China and the number of typhoons has decreased since 1950s[1], however, there may still be active typhoon seasons.



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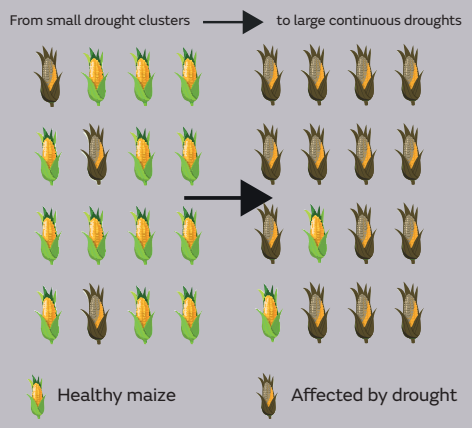
FOOD SECURITY PACK – Future Climate - Northeast Farming Region

Future drought risk

Droughts which cover less than 60% total area, are more likely to occur in small clusters. However, droughts which cover more than 60% total area tend to form a single connected cluster[10].

Future climate conditions will make it more likely for larger area connecting droughts to occur[10].

Large area droughts will require a regional, coordinated response. Irrigation systems should be planned in collaboration between the water, agriculture, and climate sectors.

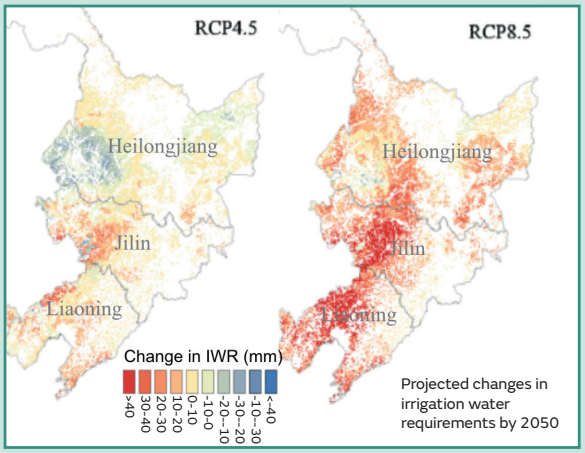


Future water stress risk

Both intermediate (RCP 4.5) and high (RCP 8.5) emission scenarios project an increase in the irrigation water requirements in the NFR by 2050[6].

Water deficit is expected to become the highest in the mid-season (G3) stage. This critical growth stage is when the maize plant develops from full cover to the start of maturity and is particularly vulnerable to water shortages.

Irrigation infrastructure and development of more efficient irrigation technologies crucial to secure maize production levels in the NFR.



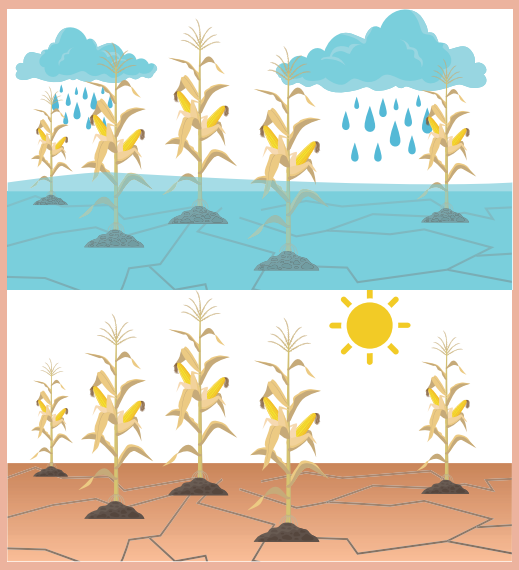
Adapted from Xu et al., 2019[6]

Other future climate risks

Flooding: Precipitation in China is predicted to increase by between 1.1% (RCP 4.5) and 1.6% (RCP 8.5) per decade, with greatest increases projected for north and northeast China[1]. There is projected to be a small increase in extreme rainfall events across the majority of the NFR[1].

Heat stress: Temperatures in China are predicted to increase by 0.26 °C (RCP 4.5) to 0.61°C (RCP 8.5) per decade[1]. Higher temperatures will increase the risk of heat stress. Cultivating high temperature resistant maize varieties may improve maize resilience.

Typhoons: At a global scale, climate models predict that typhoons will decrease in frequency and increase in intensity by 2100.



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FOOD SECURITY PACK – The Science Explained

Future drought risk

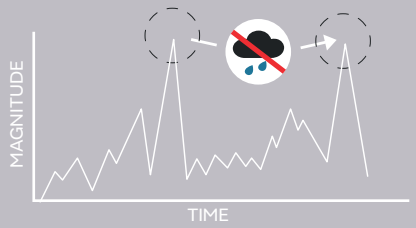
This Food Security Pack uses scientific research to provide robust climate information to help decision makers in the agricultural sector to plan for the future. This will enable China to increase food security and increase its resilience to current and future climate.

Predicting China's future climate

Climate models are run many times with different initial conditions. This helps us to understand the variability of present-day climate, especially the frequency of extreme events, such as droughts.

Computer models are used to:

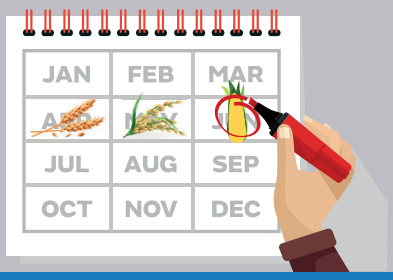
Climate models are also run decades into the future to understand how changes in greenhouse gas concentrations might change agriculturally important climate features such as temperature and rainfall.



Understand current climate variability

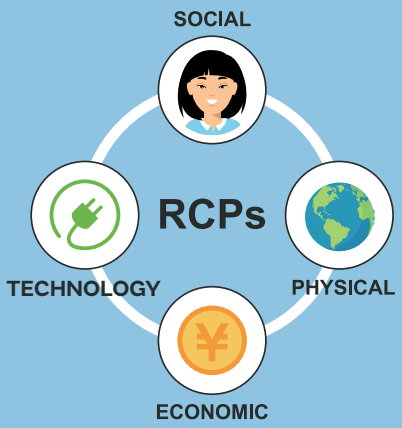
Climate scientists from the Met Office and CMA will work with agricultural leaders from China to provide climate information which helps aid decision making in the agricultural sector.

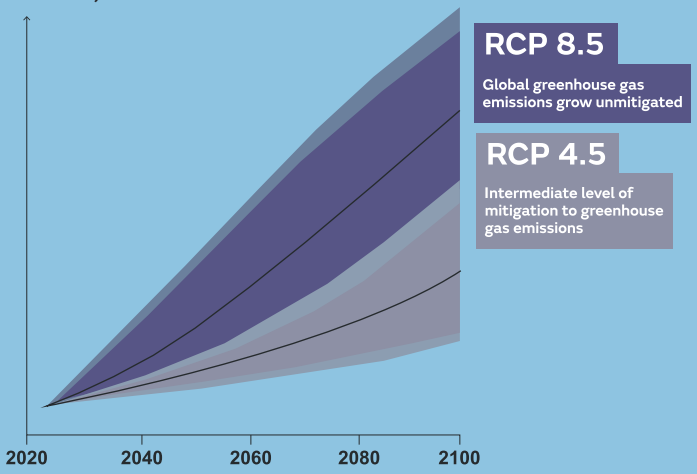
Provide future climate information to farmers



Scenarios

Our future climate is determined by ongoing and future greenhouse gas emissions. To explore a range of possible futures, climate models are run using different emissions scenarios, or "Representative Concentration Pathways" which assume different levels of policy response and socio-economic development. This Food Security Pack uses the intermediate (RCP 4.5), and high emissions scenarios (RCP 8.5).





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FOOD SECURITY PACK – References and Links

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Connect with the International Climate Services Team on WeChat to find out more about this work.

CSSP China is part of the Weather and Climate Science for Service Partnership Programme, supported by the UK-China Research and Innovation Partnership Fund as part of the Newton Fund. For more information, see https://www.metoffice.gov.uk/research/approach/collaboration/newton/cssp-china/index