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# Major Causes of Uncertainty in China's Simulations of Maize Adaptability to Future Climate Scenarios

**Stuart Anderson***

*Managing Editor, Journal of Natural Product and Plant Resources, United Kingdom*

***Corresponding Author:** Stuart Anderson, Managing Editor, Journal of Natural Product and Plant Resources,UK*

*E-Mail: robertwilliam40@aol.com*

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## ABSTRACT

*A climate-crop modeling approach has been frequently used to evaluate the possibilities of climate adaptation. Climate change effect studies have identified the various sources of uncertainty in anticipated agricultural yields, but they have not adequately evaluated the uncertainty in modeling crop adaptability to future climate. This study increases our confidence in projections of future climate impact on maize yields based on various adaptation strategies by advancing our understanding of the key sources of uncertainty in crop yield under various climate adaptations.*

**Keywords:** Climate, Agriculture, Maize

## INTRODUCTION

Crop output is predicted to be seriously threatened by climate change, which will increase the frequency and intensity of extreme climate events. The world's largest producer of maize is a staple grain and feed crop. Climate change has had a negative influence on maize production. For instance, it stated that past climate change has resulted in decrease in the average global output of maize. The anticipated worldwide maize yield will decline for every degree Celsius that mean air temperature rises in the future. In the absence of adaptation, climate change is predicted to reduce the production of Rainfed maize in China, the world second-largest producer of the grain, from 2010 to 2099 compared to 1976 to 2005. Due to the rising urbanization, farmland areas around the world have been decreasing. However, it is anticipated that the world population will surpass by 2050, leading to an increase in food demand. Global food security is under danger due to this imbalance between the supply and demand for food. A key strategy for addressing the food problem is raising yield per hectare, particularly for grain crops. An important need for climate change adaptation has arisen in order to maintain high maize yields in the future due to ongoing climate change, dwindling cropland around the world, and rising global food demand.

It has been common practise to adapt to climate change by changing planting dates, cultivars, planting densities, irrigation schedules, and fertilizer rates, among other strategies. Adjusting planting dates and switching cultivars have both been identified as two of the most successful adaption techniques. By utilizing climate resources to their fullest potential and avoiding high-risk periods of heat and drought stress, they could increase crop yields. In China between 1981 and 2009, data from field experiments showed that changing cultivars and planting earlier could extend the maize growth period by 6.5 days, offsetting the negative effects of rising temperatures on the length of the maize growth period. Our earlier research discovered that under warming scenarios, cultivar selection and planting date optimization might boost maize yield throughout China's maize belt. Optimizing planting date could have enhanced maize yield in the central US Maize Belt between 1980 and 2015. In Pakistan's semiarid environment, choosing the right cultivar and planting the crop at the right time could boost maize output between the years 2040 and 2070 in comparison to the years 1981 to 2010 by avoiding the high-risk window of excessive temperature fluctuations.

The choice of global climate models, emission scenarios, crop models, and gradients of adaptation options still leaves a lot of room for uncertainty when simulating yield responses to adaptation options based on climate-crop modeling, despite the fact that adaptation to climate change is widely acknowledged to have a great potential to increase maize yield. According to Kassie, switching cultivars did not increase maize production under other GCMs; however a medium-maturing maize cultivar could produce higher yields than an early-maturing maize cultivar under one GCM. Projecting the best planting dates under various GCMs and emission scenarios also involves significant uncertainties. Furthermore, depending on the crop models employed for simulation, different adaptation strategies contribute differently to crop yields. Despite the fact that numerous research have looked at the uncertainty in predicting the impacts of climate change without adaptation, the key causes of uncertainty in simulating the potential of various climate change responses have not been assessed. To increase our confidence in assessing the implications of climate change and to present effective adaptation options for policy-makers and stakeholders, it is crucial to comprehend the sources of uncertainty when modeling climate change adaptation.

As a case study region for this project, we chose four exemplary sites from China's Maize Belt. First, we evaluated how well three various maize models simulated phenology and yields. Then, the calibrated models powered by several GCMs from the Coupled Model Inter-comparison Project Phase 6 were used to evaluate the effects of climate change on yields under various adaptation choices under various emission scenarios. Quantifying future climate change at the study sites, evaluating the effects of future climate change on maize yield using three crop models, looking into the viability of various adaptation options to deal with the effects of climate change on maize yield, and identifying the main source of uncertainty in simulating maize adaptation to future climate change were our specific goals.

### *Snippets of sections*

Site, crop, and soil research data: To reflect the main rainfed maize planting zones of China's Maize Belt, four sites Huadian, Xiyang, Hebi, and Nanchong with diverse climates and cropping techniques were chosen. While Nanchong has a subtropical monsoon climate, Huadian, Xiyang, and Hebi all have a temperate monsoon climate. In Huadian and Xiyang, where maize is grown from May to September, the single maize cropping system is common. Contrarily, the widely accepted.

## DISCUSSION

In this study, we used three crop models and an ensemble to analyses the effects of future climate change on maize output at four distinct sites spread over China's maize belt. The emission scenarios used in this study were cmip6 scenarios with four different emission levels. Our findings demonstrated that the shorter maize growing period as a result of increasing temperatures would cause maize yields at Huadian and Nanchong to decline consistently across Gcms, crop models, and emission scenarios.

## CONCLUSION

Given that various crop models were employed in this study, there were no consistent findings addressing the effects of climate change on maize yield. In other words, the location, emission scenario, and crop model all had a unique impact on the direction and size of the yield decrease in the absence of adaptation alternatives. All three crop models determined that late planting will result in better yields for the three sites with a longer planting window under future climate conditions, while early planting.