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# Influence of Climate Change on Food Security and Agricultural Adaptations in China

**Fengjin Xiao*, Yaoming Liao and Juqi Duan**

*National Climate Center, Chinese Meteorological Administration, China*

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***Corresponding Author:** Fengjin Xiao, National Climate Center, Chinese Meteorological Administration, Beijing 100081, China

**Abstract**

Climate change characterized by global warming has seriously affected natural systems, the human economy, and agricultural production. China feeds 20% of the world's population with 9% of the global total arable land. Climate change poses risks and challenges to agricultural production and food security in China, the world's largest producer and consumer of food products. Agriculture is one of the sectors most vulnerable to climate change. Climate change and extreme weather events affect the quantity and quality of arable land, crop growth, and suitable planting areas, leading to the aggravation of the occurrence of crop diseases and insect pests and reduction in the yield and quality of major grain crops, which ultimately significantly affect the crop production and food security in China. We also put forward effective countermeasures for agricultural adaptation to climate change in China.

**Keywords:** Climate change; Food security; Influence; Adaptation; China

## Facts about Climate Change in China

Global surface temperature in the first two decades of the 21st century (2001-2020) was 0.99 °C higher than 1850-19009 [1]. The rate of temperature rise in China is higher than the global average level in the same period, which makes it a sensitive area to global climate change. From 1951 to 2021, the annual average surface temperature in China has shown a significant upward trend, with a warming rate of 0.26 °C per decade, higher than the global average warming rate of 0.15 °C per decade in the same period. The annual average precipitation has shown an increasing trend, with an average increasing rate of 5.5 mm per decade [2]. China locates a monsoon climate region characterized by a complex and diverse climate. Affected by the monsoon climate, the temporal and spatial distribution of precipitation is extremely uneven, gradually decreasing from the southeast coast to the northwest inland. The annual average precipitation is up to 2660 mm in Dongxing, Guangxi, in southern China, while in Tuokesun, Xinjiang, Northwest China, it is at least 8 mm.

The precipitation occurring between April to September accounts for 80% of the annual total precipitation. Affected by the strength and retreat of the monsoon each year, the area is prone to drought and waterlogging. Extreme weather and climate events tend to get more intense, which further increases the risks posed by climate change, and ultimately intensifies short-duration heavy precipitation events. Since the beginning of the 21st century, the number of days of droughts in China has increased by 21%, and the number of days with high temperatures has increased by 40%. The intensity of typhoons landing in China has increased significantly in the past 20 years [3]. China's climate risk index has shown a generally upward trend. From 1991 to 2021, China's climate risk index has increased by 54% compared with its average value recorded from 1961 to 1990, and the level of climate risk will further increase.

## The Impact of Climate Change on Agriculture and Food Security

Agriculture plays a fundamental role in China's sustainable economic development, providing large amounts of raw materials for industrial development and human food. Agricultural production still relies on weather and climate conditions althouth agriculture science and technology continue to improve. Climate change affects food production in complex ways [4-5].Under the influence of climate change, China's agricultural cropping systems and agricultural production structure, as well as the

regional distribution of agricultural crop production, change correspondingly, leading to fluctuations in China's grain output and thus affecting the national food security. Climate change can result in unsuitable areas for grain cultivation, and drought and extreme weather events reduce grain production. Climate change can also increase the incidence of diseases and pests, enhance soil erosion, reduce soil quality, and affect agricultural production.

## Climate change has led to black soil degradation in China

Cultivated land is the foundation for sustainable agricultural production and food security. Northeast China is one of the three largest black soil regions in the world, and the degradation of black soil in this area is prominent, caused by climate change as an important factor. The increase in temperature raises the decomposition rate of soil organic matter and the rate of soil carbon emission, which further leads to the reduction in the soil organic carbon content. In addition, soil erosion, caused by extremely heavy rainfall, has become an increasingly serious concern. The soil thickness in black soil farmland slopes has decreased from 80-100 cm before the reclamation process to 20-30 cm, and the organic matter content of black soil has decreased from 10% to 3% [6]. Soil erosion has led to the decline in soil organic matter and degradation of physical and chemical properties and ecological functions, the degradation of black soil will have a significant adverse impact on agricultural production and food security in China.

## The intensification of extreme weather events has aggravated the risk posed to food security

With global warming, natural disasters and extreme events occur more frequently and thus have more serious impacts in recent years. The main natural disasters in agriculture include floods, droughts, hail, frost, and typhoons. The area prone to annual natural disasters reaches $48.7 \times 10^6$ hectares, accounting for 44.8% of the total area in China [7]. The annual grain loss caused by meteorological disasters and extreme weather events exceeds 50 billion kg, accounting for more than 10% of the total grain output. Drought has the greatest impact on agriculture, affecting the area of 19.8 million hectares every year, and in the major grain-producing areas, it has been more serious [8]. In 2016 affected by El Nino and La Nina events more rainstorm and drought occurred in China, caused 9.3 million hectares of croplands were prone to drought, the grain production was reduced by 24.4 million tons [9].

## Climate change has led to a decrease in the output and quality of major grain crops

Climate change affects the yield of crops. Due to the temperature rise, the yield per unit area of winter wheat, corn, and rice in China decreased by 5.8%, 3.4%, and 1.9%, respectively. Changes in precipitation have a slight impact on wheat, reducing the yield per unit area by 0.2% [10]. In addition, the reduction in sunshine hours across the country has also had a specific negative impact on the yield of grain crops in China. Climate change also has a certain impact on grain quality. With the increase in $CO_2$ concentration in the atmosphere, more carbon is absorbed into the internal circulation of agricultural products, thus reducing the absorption of nitrogen. The protein content of crops decreases with the increase in the carbon to nitrogen ratio, resulting in the decline of quality [11]. The increased extreme weather events such as high temperature and drought also affect the formation of the quality of grain crops. In addition, climate change has led to the aggravation of the occurrence of crop diseases and insect pests, which has a specific adverse impact on the formation of yield and quality of grain crops [12].

## Climate change has affected China's agricultural multiple cropping systems

Under the background of climate change both the temperature and accumulated temperature in most areas of China have increased. The northern boundaries of the double cropping and triple cropping belts have moved northward, westward, and high-altitude areas [13]. The multiple cropping index has increased, expanding the planting area and increasing the grain yield per unit area. Since the 1980s, climate change has caused a northward shift by 310 km in the northern planting boundaries of winter wheat in Shandong and Hebei, as well as a westward shift by 95 km in the southern planting boundaries of winter wheat in Guizhou province, with a total increase of 177,500 $km^2$. The rice planting area in Northeast China has increased, and the rice field planting center of China has moved northeast by about 2 latitudes; the suitable southern planting area for the double rice cropping system has moved northward by nearly 300 km and continued to expand. Climate change causes the expansion of suitable corn-growing areas in China.

## China's potential for grain production under future climate change

The research shows that the rice growth period in China will be shortened by 7-8 days, and the growth period of winter wheat will be shortened by 17 days; furthermore, the output of grain crops will be reduced by 10% as the temperature rise of 1 °C in the future [14]. With shortening the growth period, the duration of dry matter accumulation by crops through photosynthesis is reduced, and the quality is also decreased accordingly. It is predicted that by 2030, the potential for the production of major grain crops may decrease by 5%-10%. From 2071 to 2100, in China, the potential for winter wheat production will decrease by 10%-30%, while the potential for rice production will decrease by 10%-20%, and the decrease by 5%-10% in the production potential of corn [15]. Climate change and extreme weather events have led to natural fluctuations in grain production in China, with increasing rates from 10% in the past to 20% in the future and even more than 30% during the years of extreme weather events.


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## The Countermeasures for Agricultural Adaptation to Climate Change

### Increasing the multiple cropping index

The potential of light and temperature in agricultural production should be exploited to develop multiple cropping systems. Under future global warming, the planting boundaries would be extended northward by making the best use of heat resources in Northeastern China. In the middle and lower reaches of the Yangtze River, the rice-wheat cropping system is mainly practiced. The increase in effective accumulated temperature in agriculture caused by global warming can contribute to the stability of triple cropping systems. In the northern region, the early-maturing and mid-late maturing varieties of rice are transformed into medium-maturing and late-maturing varieties.

### Adjusting the planting system and crop structure

Climate change causes a northward shift in the climatic belt. Therefore, the planting system and crop structure should be adjusted accordingly, and the crops suitable for the climate of the specific region should be planted according to the climatic characteristics, corresponding adaptation measures should be further adopted.

### Breeding new crop varieties with strong stress resistance

Based on temporal and spatial differences in frequency, intensity, and type characteristics of agro-meteorological disasters in China under global warming, it is necessary to appropriately select and cultivate new crop varieties with high yield, high quality, and strong resistance that are suitable for grain production and management practices.

### Strengthening infrastructure construction for disaster mitigation

Strengthening the construction of agricultural infrastructure and improving the comprehensive agricultural production capacity are the strategies for coping with agricultural and natural disasters. We will strengthen the construction and maintenance of agricultural infrastructure and also the resilience of agriculture-based livelihoods to agricultural disasters and develop the ability to drain and irrigate farmland. Furthermore, we adjust the investment subsidies or measures for small and micro farmland water conservancy facilities and also significantly expand these facilities.

### Establishing the agricultural insurance system

We will further strengthen the agricultural and meteorological disaster insurance schemes, improve the standard system and laws and regulations of agricultural weather insurance and also the risk management in agrometeorology, cooperate with the government to strengthen the construction of the disaster prevention capability evaluation framework, train professionals for meteorological disaster prevention, and expand the agricultural and forestry meteorological disaster prevention services through insurance companies.

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## References

1. IPCC (2021) Climate change 2021: The phusical science basis. Cambridge University Press, Cambridge, USA, pp. 1-41
2. CMA Climate Change Centre, 2022. Blue Book on Climate Change in China (2022). Science Press, Beijing, China, pp. 11-46
3. Chao QC, Yan ZW, Sun Y, Jiang ZH, Liao H, et al. (2020) A recent scientific understanding of climate change in China. China popu Reso Environ 30(3) : 1-9.
4. Walter LF, Andreia FFS, Ulisses MA, Erandathie L, Felix KD, et al. (2022) An overview of the interactions between food production and climate change. Sci Total Enviro 838(Pt 3): 156438.
5. Zhou GS (2015) Research prospects on the impact of climate change on agricultural production in China. Meteor Environ Sci 38(1): 80-94.
6. Bai RH (2005) The climate change and the blackland degeneration in Song Hua River area. Heilongjiang Qixiang 3: 6-8.
7. Du X, Jin X, Yang X, Yang X, Xiang X, Zhou, Y (2015) Spatial-temporal pattern changes of main agriculture natural disasters in china during 1990-2011. J Geo Sci 25(4): 387-398.
8. Li WJ, Qin ZH, Lin L (2010) Quantitative analysis of agro-drought impact on food security in China. J Natural Disaster 19(03): 111-118.
9. Yang WZ, Zhang BW, Fu RM (2017) Summary of flood and waterlogging in 2016. China Flood Drought Manag 27(01): 26-29.
10. Zhou SD, Zhou WK, Lin GH, Qiao H (2013) The impact of future Climate change on China's food security. J Nanjing Agri Univ (1): 56-65
11. Chen RS, Guo XN, Xiong B, Wang Y, Chen Q (2021) Climate change, land degradation and food insecurity: linkages and potential solutions. Acta Ecol Sini 41(7) : 2918-2929.
12. Peng JJ (2017) A summary of the impact of climate change on global grain production. World Agri 5: 19-24
13. Yang XG, Liu ZJ, Chen F (2011) The Possible Effects of Global Warming on Cropping Systems in China: Possible Effects of Future Climate Change on Northern Limits of Cropping System in China. Sci Agri Sini 44(8): 1562-1570.
14. Yuan B, Guo JP, Zhao JF, Ye MZ (2011) Possible impacts of climate change on agricultural production in China and its adaptation countermeasures. Agri Sci Tech 12(3): 420-425.
15. Yuan J, Xu JP, Sun LJ, Zhang XZ, Wang XL (2015) Study on the future climate change and its influence on the growth stage and yield of wheat in Weifang City. Asian Agri Res 7(3): 82-84.



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