

# Impact of Climate Change on Agriculture-Evidence from China

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**Abstract.** Based on the rapid, diverse and complex background of global climate change, this paper comprehensively analyzes the impact of many factors directly or indirectly caused by climate change from the aspects of external factors to internal factors and talks about the impact on agricultural production and life due to agriculture itself, factors affecting agricultural protection, and the use of pesticides. This paper analyzes the impact of different factors on the quality of agricultural production and finds effective alternatives to pesticides to fight against pests and diseases, focusing on how to maintain the same amount when reducing the use of pesticides and how to protect the environment and so on. From this article, investors can take into account some ways to protect the environment while maintaining high quality. This paper has important reference significance for the use of pesticides under climate change and the response measures for crop planting boundary changes.

**Keywords:** Agriculture; Climate change; Pesticide.

## 1. Introduction

Agriculture is the basis of human survival and the cornerstone of the development of countries. Every country relies on agriculture or the trade of agricultural products. In today's world, it still has 733 million people stuck in starvation. And, for human beings, it satisfies the problem of food and clothing for the ever-growing population. Agricultural technology can improve agricultural production efficiency, crop yield and agricultural product quality, increase farmer's income, and promote the sustainable development of the global agricultural economy [1]. Hence, promoting agricultural modernization is an inevitable requirement for realizing moderate development. It is also the bounden responsibility of every young person in the new era of the globe.

Agricultural production is affected by a variety of factors, such as temperature, sunlight, humidity and so on. The impact on China's agriculture is particularly prominent. In the history of agricultural development, climate has played an important role in affecting the production of agriculture. Along with climate change, crop planting boundaries have been changing. For example, an area which was mainly grown crops such as wheat and rice, now plants rice and maize. This area changes its humidity, from semi-moist condition to moist condition. And with the global temperature rising, rice planting boundaries expand to the east and north.

Since 1985, there have been many large-scale warm winter weather in China. The climate warming is most obvious in Northwest, North China and Northeast China, and precipitation in North China is the same. The rainfall has also decreased significantly, and there is a trend of warming and drying. Climate warming is not only affecting our ecology environmental, socioeconomic development, etc. have a significant impact, and have brought about agricultural production Huge losses.

Due to climate change, it has happened like crop-growing boundary movement, the diseases of pests, overuse of pesticides and so on. Thus, farmers should change the strategy they have used before to a new one so that satisfy the different situation. For example, adjust the type of crops, use natural enemies to resist pests, etc. This research aimed at analysis the influence the climate change take to China's agricultural production, and come up with relevant suggestions. For a better way to assist agricultural workers.

## 2. Impact Analysis

### 2.1. Boundaries

Now, conditions are different. In the new area that did not suit them to grow, for example, seldom area in north east China, somewhere was not suitable to growing the rice, now, with the boundary. Come with the climate change, some crops have migrated to areas where they do not suit them. With changes, local farmers choose to grow maize on account of global warming making the area warmer. Specifically, the temperature in Northeast China has generally shown a monotonous upward trend in the past 50 years. However, the availability of water and solar energy for agriculture is also decreasing [2]. From the report of IPCC (Intergovernmental Panel on Climate Change), it shows that China will be one of the most affected areas. Even though the warmer climate can let the planting area of winter wheat expand to the planting area of spring wheat, but the higher temperature made the decline of production of wheat. The solution to the change of climate is to adjust the species and planting area on time.

Take the northeast China as an example. In the past 50 years, the temperature in Northeast China has generally shown an increasing trend, which shows that the average temperature, average maximum temperature, and average minimum temperature have all shown a significant upward trend. The average temperature has risen by 1.5 Celsius degree in the past 50 years, with a warming rate of 0.3 Celsius degree per decade [3]. In the background of global warming, the frost-free period of northeast region, there has been a decrease. But it causes an increase in grain. In this situation, it made the boundaries expand a lot, many areas that were previously unsuitable for growing crops have been reclaimed, increasing the area of arable land and grain production. And the decrease of frost-free period, here are allowed to plant medium-late maturing crops. Adjust the frame of local crops, to deal with the climate change and keep up the security of grain when this region faced the extreme weather caused production fluctuates. It also ensure the production is sustainable, and avoid the shortage by reduction of output of traditional crops.

### 2.2. Pests and Diseases

Rising temperatures, a humid climate and increased levels of carbon dioxide in the atmosphere can lead to a high incidence of many weeds, pests and diseases. Warming climate leads to longer survival of pests and diseases. Global warming made the odds increasing of warming winters, so that the damage level of it is increasing [4]. Some pests and diseases are not suitable for the winter environment. However, with climate change, its survival rate and reproduction rate have gradually increased, and it grows and spreads rapidly in a more conducive environment for survival, which affects the healthy growth of crops, resulting in crop production due to pests and diseases. In order to better adapt to the environment, some pests and diseases will even have species variation [5]. It also produces the generation of pests per year, increasing their populations. As mentioned earlier, the shifting geographic ranges mean crops and ecosystems are facing new threats (e.g. the spread of worm). Because of global warming, the seasonal distribution and water and heat balance has been broken. As a result, the frequency and persistence of pests and diseases are increasing. Some pests and diseases are also becoming more and more resistant, and traditional or common pest control methods are beginning to fail, and the healthy growth of crops is facing more severe challenges. It also brings new challenges to the local ecosystem.

### 2.3. Pesticide

With the change of climate, the environment indirectly affects the use of pesticides. As this text mentioned before, the rising temperature caused by global warming can cause a high incidence of weeds, pests, and diseases. In order to control the damage by pests, for example, the situation of lack of water made pesticides less effective, extreme weather made applying pesticides difficult, farmers use pesticides to cut the number of pests, while leading to the side effects of overuse of pesticides. Such as fewer natural enemies, soil degradation, groundwater contamination, and the spread of

resistant weeds. Through these cases, a lot of pollution has been created. It has become the biggest problem to restrain green development.

### **3. Suggestions**

#### **3.1. Suggestion on Crop's Boundaries**

Crop distribution refers to the proportion of different crops planted (e.g. grain-economy-feed ratio) and spatial distribution; According to the existing research, the adjustment of crop layout includes three aspects: the change of crop planting boundary, the change of crop planting proportion within the region, and the overall movement of crop planting area. For facing the challenge of planting boundary changes, it is important to plant suitable crop in the area where are new for them. In the aspect of agricultural science, it urges to exploit stress-resistant varieties. Cultivate drought-tolerant, high-temperature, and salinity-tolerant crop varieties (such as drought-tolerant maize, water-logging tolerant rice) to adapt to the extreme climate of the new planting area. Then, planting form innovation. For example, in the northern boundary area of winter wheat cultivation, wheat and corn are intercropped. On the one hand, this effectively utilizes the newly added heat resources in North China and increases the yield of winter wheat-summer corn. On the other hand, it facilitates the implementation of mechanized operations and improves the farming efficiency at the junction of agriculture and animal husbandry In arid and water-scarce regions such as the Loess Plateau, in response to the intensification of climate fluctuations, a rotation model has been adopted for water-consuming and drought-resistant crops. If water-consuming crops were planted in the previous year, drought-resistant crops would be planted in the following year. This approach not only saves water resources but also effectively adapts to the climate changes caused by warming and drying severe drought and water shortage [6].

#### **3.2. Suggestion on Pests**

In order to prevent the above from happening, it is better to establish an effective early warning mechanism for crop pests and disease. As soon as a trend in pests and diseases is detected, pesticides are sprayed or biological control is carried out immediately to curb their development.

In summary, the best solution is to grow crops in the appropriate regions, investigate the ecosystem and climatic conditions of the area in advance, plant crops reasonably, minimize the loss of manpower and material resources, and save costs. Because agricultural planting relies heavily on the weather, and it is vital to comply with local weather and ecosystem to plant the suitable crops, the insects that live in the local environment are one of the biggest influencing factors.

#### **3.3. Suggestion on Usage Amount of Pesticide**

Since the time the pesticides were invented, pesticides have become an inseparable part of agricultural production. It has greatly increased the yield of crops and protected them from pest infestation. In agricultural production activities, chemical fertilizers and pesticides are important substances to protect the growth of crops, especially when the pests and diseases are serious, they will be treated with corresponding pesticides [7]. However, excessive use has led to a series of consequences, such as toxin accumulation, natural enemies reduced, and the number of resistant pests has increased.

To deal with it, here are some answers from three aspects.

First, optimize pesticide use techniques. Precise pesticide application, reduce the wastage of pesticides, thus decrease the pollution of the environment and groundwater, protect the security of human beings. And the usage of sustained-release pesticides, reduce the impact of rainwater erosion and prolong the efficacy of the drug, it has maximum enhance the efficacy of pesticides.

Second, to make the policy, restrain overuse and led to transform. For example, pesticide reduction policy and pollution regulation. To reduce the usage of drugs, rational selection of medicines, then, strictly control the amount of use according to the instructions, to achieve the goal of drug reduction

[8]. Develop a land restoration plan, made microbial remediation of pesticide-contaminated farmland, and here also some similar methods to biologic remediation, prevention of natural enemies. This pest control method is to effectively control the number and species of pests by introducing natural enemies of pests. For example, predatory insects such as ladybugs and natural enemies such as aphids can be used to control the number of virus-transmitting insects such as aphids, thereby indirectly controlling the spread of viral diseases. By stocking these natural enemy insects, the dependence on chemical pesticides can be reduced to some extent [9]. Reduce pollution to the environment to a certain extent. Plant resistance breeding. In practical application, it is necessary to breed plant varieties with high resistance to improve the resistance to pests and diseases during the growth process, so as to reduce the use of chemical pesticides. Therefore refrain from the secondary pollution of farmland, and avoid extra energy for renovation.

Third, explore the sustainable agricultural form. Agricultural production has a huge demand for natural resources such as land, water resources, and energy, and if they are not used rationally, it will lead to excessive consumption and waste of resources. By promoting the transformation of agricultural production methods and adopting water-saving irrigation, organic fertilizers, biological pesticides and other technologies, farmers can effectively reduce the consumption of resources, realize the recycling and economical utilization of resources, and lay the foundation for future agricultural development and sustainable economic growth [10].

#### 4. Conclusion

Based on the rapid, diverse and complex background of global climate change, this paper analyzes many factors that are directly or indirectly caused by climate change from environmental drivers to farmers' own activities, and talks about the impact on agricultural production and agriculture itself, which themselves affect agricultural protection, as well as the use of pesticides. This paper analyzes the impact of different factors on agricultural production quality, focusing on reducing pesticide use, the instead methods of reducing pesticide use and how to maintain the same quantity when protecting the environment. From this article, investors can consider some methods of how to maintain high quality while protecting the environment, and analyze the macro and micro effects of environmental and human factors on agriculture and crop planting.

Due to time and resource constraints, this article may have some shortcomings and some limitations. This paper lacks structured data to support practical references. However, this article is still a reference.

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