

## 論文の内容の要旨

東京大学大学院農学生命科学研究科農学国際 専攻

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論文題目 Impacts of Climate Change on Maize Production in China and the U.S. and Possible Risk Mitigation Strategies

(気候変動による中国とアメリカのトウモロコシ生産への影響とリスク緩和戦略の研究)

It has become increasingly clear among scientists that the continuous increase in atmospheric greenhouse emissions is changing the climate of earth. Among various climate change sensitive ecosystem, agriculture is a key sector to support the sustainable economic development of our society in this century. Given the fact that the share of maize production in China and the U.S. is over 50% of total maize production amount in the world, this thesis analyzed the interrelationship between climate change and maize production in China and the U.S. with a multidisciplinary approach, predicted the potential effects of climate change on maize production, and proposed alternative risk mitigation strategies to reduce the whole-country risk of maize reduction.

This thesis did three case studies in China and the U.S., where climate inputs, socioeconomic inputs, and technology improvement (with and without) were taken into the consideration. While the first study analyzed the maize production in the Midwestern United States and Middle China with a regression model, the following two studies separately analyzed maize production responses in the North and the South of two countries with Cobb-Douglas production functions and converted supply functions.

The major finding of the first case study is climate change will not universally cause negative

impacts of maize yields in the United States and China. The results of a simulation of climate change on maize yields over the period 2008–2030 showed that variation in regional climatic and economic conditions makes the impacts of climatic change on maize yields substantially different in different regions. Even with significant changes in climate conditions that alter the maize crop's growing environment and affect crop yields, a decrease in maize supply due to a decrease in maize yields would lead to an increase in the maize price, which in turn would induce farmers to add more investments in production inputs to raise yields. Thus, the decrease in actual yields may not be as dramatic as predicted in cases where only climate factor are considered.

The second study indicates that the impacts on maize production will likely be the opposite for the Northeast and the Southwest in China. The results indicate that the higher flexibility of production timing in the Southwest region allows it to better adapt to climate change than the Northeast region. Moreover, the gains in the Southeast may be able to outweigh the potential reduction of maize production in the Northeast region. When a further reduction of agricultural labour population occurs, maize production decreases more in the Southwest region, even when substitution of more machinery for human labour is allowed. This result reflects that terraced, sloped lands in the Southwest region limit the effective use of machinery.

The third case study indicates that under the same climate change South region tends to have opposite impacts relative to the North Central region in the U.S., implying that one region's losses can be partially offset by the other region's gains. The different responses imply that the South region could provide potential risk mitigation to climate change within the United States and could help the nation maintain its maize production balance.

All simulated results indicated that maize production could respond oppositely between countries and regions through 2030. It has been noticed that advanced international and inter-regional contracts and cooperation as well as policies could mitigate the entire-country risk of reduced production and to

stabilize regional agricultural labour force. Moreover, the gains in the Southeast may be able to outweigh the potential reduction of maize production in the North region in China and the U.S.

The risk mitigation strategies provided in this thesis are expected to impact the stability of food production self-sufficiency in China and the U.S. and the price stability of the international commodity market, as well as to be applied to other countries like Japan.

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**Keywords:** climate change, maize production, interrelationship, climate and socioeconomic inputs, risk, mitigation

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