Available online at www.sciencedirect.com
ScienceDirect
Journal of Integrative Agriculture
2014, 13(4): 657-659
April 2014

Editorial

Climate Change and Agriculture: Impact and Adaptation

The global food security will face great challenge and is expected to face even greater challenge under climate change. FAO's estimates show that the global food production should increase by at least 70% in 2050 over 2000 to meet the growing food demands (FAO 2009). However, the growth rate of agricultural productivity has been falling in recent decades. Moreover, food security in many regions in the world may face more challenge under climate change. While there will be positive and negative impacts with large uncertainty, most studies show that climate change for agriculture at global level is more harm than good (IPCC 2012). In addition to the long run climate change, rising frequency and severity of extreme events are also expected. Such long term climate change and extreme weather events will bring greater fluctuations in crop yields and food supplies and higher risks of food insecurity (IPCC 2012).

Understanding the impact of and adaptation to climate change on agriculture by region is critical important for climate change policy. Climate change and its impacts on agriculture are expected to vary significantly among regions. Facing climate change, how to evaluate the impact of climate change on agriculture, understand responses of farmers to climate change, and formulate appropriate national strategy to cope with climate change are of utmost urgency. Acknowledging the large number of studies on climate change in the literature, the overall goal of this special column is to provide additional evidences on the impacts of and adaptation to climate change on agriculture in the selected countries and regions through simulation models, empirical case study, and literature review. Five papers included in this column cover the impact assessment of climate change on agriculture in Asia and agricultural exports in the United States (US), farmer's adaptation measures through crop diversification and investing irrigation in coping with extreme weather events in China, and finances in mitigation of and adaptation to climate change for sustainable agricultural development.

On the impact of climate change on agriculture, Mendelsohn (2014) focused his study in Asia because Asia produces two thirds of the world's food but there is a large knowledge gap on the impact of climate change on agriculture in the literature. He applied a Ricardian analysis and showed that warming would cause damages to Asian agriculture. He also showed that, with carbon fertilization, the effects could be significantly reduced. Among Asian counties studied, the simulation results suggested that India is likely to be especially vulnerable. While this is one of first efforts to assess the impact of climate change on farmers' income in Asia, as the author also clearly stated in his paper, the estimated coefficients of impacts of climate change on farmer's crop net revenues in China may not be appropriate for other Asian countries, which will need further study. Mendelsohn (2014) also pointed out that there remains uncertainty around all estimates of what might happen such as carbon fertilization, agricultural growth, and the impact of climate change on agricultural prices in the future.

The impacts of climate change on agricultural prices through market based on its initial impact on agricultural production are also interesting topics. First, climate change is not neutral across agricultural commodities, which suggests that comparative advantage of individual commodity and therefore agricultural production structure will change. Second, the impacts of climate change also differ spatially or among regions/countries for a given product. The regional variations of climate change impact can change relative competitiveness of agricultural commodities across countries and result in regional and international trade. On this topic, Zhang *et al*. (2014) examined the likely impacts of climate change on the US agricultural trade. The US agriculture is selected for study because it is one of the largest agricultural exporters in the world. They applied a price endogenous model to simulate the impacts of alternative climate scenarios on agricultural trade and prices. The initial shocks to the model (impacts of alternative climate scenarios on the US crop yields in the US and the rest of world) were based on literature review. Their results show that the impacts

doi: 10.1016/S2095-3119(14)60752-8

on the US agriculture and trade could significantly differ between the scenarios with and without considering the impacts of climate change in agriculture in the rest of world. Zhang *et al*. (2014) concluded their paper with suggestion that climate change impact studies should account not only for climate impacts in the country of focus but also on changes in agricultural productivity due to climate change in the rest of the world.

Besides long run climate change, as mentioned above, the frequency and severity of extreme weather events have increased in the past and is expected to become more serious in the future. Rising frequency and severity extreme weather events have significantly damaged agriculture. For example, in China, annual average crop area suffering from drought increased from 11.6 million ha in the 1950s to 25.1 million ha in the first decade of this century (Huang *et al*. 2014). Given the rising risks posed by extreme weather events, the question on how to cope with extreme weather events is a very practical issue and should get much more attention. Specifically, how farmers have adapted to the changes in extreme weather events? What are major factors that may facilitate or constrain farmers' ability to take some adaptation measures? Answers to these questions are not only important for a better understanding of farmers' responses to climate change in short run, but also essential for policy makers in preparing and formulation of national/regional adaptation plans and supporting policies. However, as pointed out by Wang *et al*. (2014), the current level of knowledge is not sufficient to support the formation and implementation of national plan on adaptation to climate change. There are few empirical studies that has tried to understand farmers' adaptation behaviors, particular their abilities to adapt to the extreme weather events and major factors affecting their adaptation behaviors.

In this special focus, we have two empirically based studies that specifically focused on adaptation measures taken by farmers when they faced the extreme weather events. One looked at the mitigating risk of extreme weather events through crop diversification by farmers (Huang *et al*. 2014), and the other examined physical adaptation measures taken by farmers when they face drought (Wang *et al*. 2014). Based on a unique household data from a large scale survey in nine provinces in China, Huang *et al*. (2014) showed that there is evidence that on the average farmers did respond to the extreme weather events (e.g., drought and flood) by diversifying crops. Although the changing magnitude in term of the number of crops planted is small, it is statistically significant. Specifically, they showed that farmers' decision to diversify crops is significantly influenced by whether there was an extreme weather event in the previous year. They also showed that the larger farms, women and younger farmers are more likely to plant more of crops. Based on the results, they suggested that there is need for farmers' capacity building and that providing early warning information on natural disaster will help farmers to cope with the risk posed by extreme weather events.

Based on the other household dataset from a survey in three provinces in China, Wang *et al*. (2014) tried to understand actual adaptation measures taken by farmers and the effects of household and community assets on farmers' adaptation when they faced drought. In the analysis, they focused on the major irrigation infrastructure and called it as physical adaptation measures. Their results showed that although taking physical adaptation measure was expensive and not common on annual base, farmers did use more physical adaptation measures when they faced drought. Econometrical analysis revealed that both household and community assets significantly affected farmers' adaptation behaviors. For example, improving household's social capital and wealth, better community network, and availability of public anti-drought service all facilitated farmers' adaptation to drought. The paper concluded with some policy implications in investing agriculture to improve farmers' adaptation to climate change.

Obviously, investment in agriculture under climate change is a key in both agricultural adaptation to climate change and mitigating climate change through reducing agricultural emission. To what extent the potential impacts of climate change on agriculture would occur largely depend on whether these impacts could be coped with investments in agriculture. However, in this special column, Huang and Wang (2014) argued that adaptations to climate change need much more investment than those currently committed by national and international communities. They also pointed out that while agriculture is the most vulnerable to climate change, it is also one of major contributors of greenhouse gas (GHGs) emissions. Both mitigation and adaptation need substantial investment and financing. On this regard, Huang and Wang (2014) examine how finance can be used to achieve the joint objectives of development, mitigation and adaptation in agriculture in developing world. Based on the literature review, they examined major areas and successful cases in mitigation of and adaptation to climate change in agriculture that have worked in developing countries. To guide the financing, they provided a list of areas that have worked, could work and could be scaled up or transferred. In concluding their paper, Huang and Wang (2014) stated "mainstreaming agricultural mitigation and adaptation into agricultural development programs, enhancing local capacity, and considering different stakeholders' needs are major experiences for successfully financing sustainable agriculture under climate change".

HUANG Ji-kun
Editor-in-Chief for the Column
Center for Chinese Agricultural Policy
Institute of Geographic Sciences and Natural Resources Research
Chinese Academy of Sciences
Beijing 100101, P.R.China

References

FAO (Food and Agriculture Organization). 2009. *How to Feed the World in 2050*. FAO, Rome.

Huang J K, Jiang J, Wang J X, Hou L L. 2014. Crop diversification in coping with extreme weather events in China. *Journal of Integrative Agriculture*, **13**, 677-686.

Huang J K, Wang Y J. 2014. Financing sustainable agriculture under climate change. *Journal of Integrative Agriculture*, **13**, 698-712.

IPCC (Intergovernmental Panel on Climate Change). 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Special Report. Cambridge University Press, Cambridge.

Mendelsohn R. 2014. The impact of climate change on agriculture in Asia. *Journal of Integrative Agriculture*, **13**, 660-665.

Wang Y J, Huang J K, Wang J X. 2014. Household and community assets and farmers' adaptation to extreme weather event: the case of drought in China. *Journal of Integrative Agriculture*, **13**, 687-697.

Zhang Y Q, Cai Y X, Beach R H, McCarl B A. 2014. Modeling climate change impacts on the US agricultural exports. *Journal of Integrative Agriculture*, **13**, 666-676.