Review

Climate change and food security in East Asia

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Climate change causes serious food security risk for East Asian countries. The United Nations Framework Convention on Climate Change (UNFCCC) has recognized that the climate change will impact agriculture and all nations should prepare adaptations to the impacts on food security. This article reviews the context of adaptation rules and current policy development in East Asian region. The UNFCCC and Kyoto Protocol have established specific rules for countries to develop national or regional adaptation policies and measurements. The current development of the ASEAN Strategic Plan on food security is inspiring, but the commitments to implementation by its members remain an issue of concern. We suggest that the UNFCCC enhances co-operation with the Food and Agriculture Organization (FAO) and other international organizations to further develop methodologies and technologies for all parties. Our findings suggest that agriculture is one of the most vulnerable sectors in terms of risks associated with climate change and distinct programmatic initiatives are necessary. It's imperative to promote co-operation among multilateral organizations, including the UNFCCC, FAO, World Health Organization, and others.

Key Words: climate change, food security, adaptation, East Asia, UNFCCC

CLIMATE CHANGE AND ITS IMPACTS ON FOOD SECURITY

Food security exists when "all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."[1] This widely accepted definition points to four dimensions of food security: availability; accessibility; stability of food supply and utilization of food.[2] Global climate change will contribute to food insecurity and have negative effects on these food security dimensions.

The Intergovernmental Panel on Climate Change (IPCC) Assessment Report shows that climate change will have adverse effect on the environment, economics and agricultural food systems in developing countries. While considerable uncertainty remains with regard to the impacts of global warming on national and regional vulnerability in terms of food security, some risks have been identified. These risks include: increasing CO_2 fertilization affecting the growth seasons of crops; increasing variability of precipitation leading to more frequent and extreme flooding and drought events; as well as increasing variability and declining runoff in rivers leading to decrease crop productivity. Unless well managed, they may in turn increase security problems in the region.

In East Asia, climate change is likely to undermine meteorological conditions, affect the coastal area and fishery industry, and cause declining crop yields as well as resulting in short term agriculture production disappointments. It would also damage food transportation and the storage system, and lead to rising food prices. These adverse effects are likely to cause widespread hunger and malnutrition, social unrest or even mass population displacement in this region. The primary drivers of climate food security risk in the region are changes in CO_2 concentration, temperature and precipitation.

Increase of CO_2 fertilization

Although the rising atmospheric CO_2 concentration might increase crop production, the current yield of tropical rice can decrease by 17 percent with a 2° Celsius increase in temperature as a result of the greenhouse effects.[3] This will pose a great challenge for adequate food production and supply in East Asian and Southeast Asian countries, especially after the rising rice price in 2008. East Asian countries, including Taiwan, and Southeast Asian countries are especially vulnerable to the adverse impacts of climate change, because the temperatures in these countries are already higher than what is normally suitable for crop production.

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Temperature changes

Temperature changes would reduce agriculture productions due to heat stress, and increase the danger of wildfires. Global warming is likely to increase the frequency and intensity of extreme events, which will have catastrophic outcomes on social and agriculture system, including loss of life, injury and illness, crop yield disruptions, and livelihood shocks. The changes in frequency of extreme events during the crop yield season would cause more ravages than climate change since they disrupt crop growth and reduce production.[4] Extreme events will also cause the increase of morbidity and mortality of people exposed to vector borne diseases, such as malaria; as well as water borne diseases like cholera and gastrointestinal disorders. It might lead to massive scale cross borders epidemics, reduce labor, and have impacts on local and regional agriculture productions.

Precipitation changes

Climate change is likely to change precipitation patterns. The frequency of heavy precipitation and long drought may increase. Heavy precipitation will cause soil erosion. Longer and persistent droughts will enlarge affected areas and is likely to cause decrease water availability, lower yields, increase livestock deaths, as well as contributing to the loss of biodiversity. Changes in precipitation patterns might also cause water stress because of the reduction of runoffs in major catchments. These are likely to undermine livelihoods, agriculture production and lead tensions over the management of trans-boundary water resource;, especially the major river systems of the Indo-Chinese Peninsula, originating from melting glaciers in the Himalayan Mountain Range.

ADAPTATION STRATEGIES TO CLIMATE CHANGE BY THE INTERNATIONAL SOCIETY

The UNFCCC was established in 1992 and entered into force on March 21, 1994. It aspired to set the framework for the effective resolution of six greenhouse gases[5] and prevent adverse impacts of global warming. The Convention sets ultimate objectives and principles for all Parties to adopt policies and measures for "stabilization of concentration of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[6] The Kyoto Protocol established later contains the commitments and obligations of the Annex I Parties. The Protocol confirmed a reduction target of five percent below 1990 levels for the first commitment period from 2008 to 2012[7] and assigned quantified emission limitations or reduction obligations to the Annex I Parties. The Protocol finally entered into force on February 16, 2005.

Adaptation rules of the climate convention

FCCC Article 4, para. 1, subpara. (a) states all parties to "develop, periodically updated, [and] publish" national communication in accordance with Article 12, and also "make available to the Conference of the Parties." Subpara. (b) of this article also requires that all parties "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emission by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;" In order to implement this obligation under the convention, the context of the national communication of each party shall include both national or regional mitigation and adaptation policies and measures based on Article 4 and Article 12. In order to implement the obligations in Article 4 of the convention, Article 10, para. 1, subpara. (b) of the Kyoto Protocol also requires all parties to "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change." The programmes mentioned here include agriculture. The protocol also encourages the development of adaptation technologies and methods that would improve adaptation to climate change.

In 2007, the IPCC defined that climate-related adaptation involves any type of adjustment, including anticipatory, autonomous and planned process to respond to actual or expected climate effects. The main purpose of adaptation and related technologies is to improve flexibility to uncertain future impacts; however, both the UNFCCC and Kyoto Protocol do not define the term of "adaptation" within the articles. Instead, UNFCCC only requires all Parties to "take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example, impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change". Therefore, the Parties could define by themselves in their own interpretation in accordance with their national circumstances.

Since anthropogenic emissions from various economic activities cause the accumulation of greenhouse gases in the atmosphere, which lead to dangerous interferences with the climate system, the adaptation activities should be limited within the extent of those individual or regional activities taken in combating the "adverse effects of climate change". The term of adaptation could be defined as any adjustment in behaviors or activities to enhance the viability of social and economic activities and reduce the adverse effects of climate, and "take advantage of the opportunities that their climate environment provides,"[8] irrespective of the "lack of full scientific certainty". According to the precautionary principle, all parties are also required to "cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of these areas." Therefore, all parties have the alternative of organizing or planning anticipatory adaptation to climate change at several levels with an aim of reducing the vulnerability of the society and economy by either lessening potential impact or increasing adaptive capacities.

Based on the burden sharing and the equity principle, the convention emphasizes on those developing country

parties, especially those that are "particularly vulnerable to the adverse effects of climate change," to be given full consideration. Therefore, the Parties listed on Annex I not only should take the lead "in combating climate change and the adverse effects" but also should "provide new and additional financial resources to meet the agreed full cost incurred" by the non-Annex I Parties in developing related adaptation policies and measures. The financial mechanism established by Article 11 could also provide other financial resources to assist non-Annex I Parties in complaining with their commitment on publishing national communications under article 4, para. 1 and article 12.

Changes in climate patterns would affect water resources for agriculture, changes with regard to season length and other related sectors such as fisheries and forestry. The geographic impacts of global warming vary from region to region and therefore it is difficult for the Climate Convention to regulate a "one size standard" adaptation model for all parties; however, regional cooperation and alliance should be encouraged since neighboring states share similar natural resources and weather patterns. A joint planning process of adaptation policies and measures could enlarge synergy in improving both national and regional agriculture production.

The UNFCCC Secretariat provides four adaptation methodologies for all parties.[9] The Kyoto Protocol also encourages them to develop related technologies and measures for improving adaptation to climate change. The current adaptation technology for agriculture includes using biotechnology in seed development, improving irrigation, improving long-term weather and short-term climate forecasting, and others such as changing farming practice by using crop rotation and improving crop distribution networks for example. These principles could assist the parties to develop accurate and appropriate adaptation measures and policies.

Cooperations of international organizations

The Committee on World Food Security (CFS) under the Food and Agriculture Organization of the United Nations (FAO) Council has highlighted climate change impacts on food security since 2003.[10] The UNFCCC and several international organizations, including the FAO, jointly established the Climate Agenda program in 1996 to integrate a framework on all international climate research and studies of socio-economic impacts on climate variability and their effects on ecosystems.[11] Furthermore, in order to respond the request of the Nairobi Framework after the 12th Conference of the Parties (COP), the FAO provided technologies and technical advices to the UNFCCC Secretariat for developing adaptation methodologies and technologies used in the agriculture and forestry sectors. These international organizations have established a comprehensive and integrated framework on climate change and food security concerns.

In order to provide new and additional financial resources to assist developing country parties, the convention also established a financial mechanism, which is entrusted to the Global Environment Facility (GEF) as the operational entity. The GEF provides guidelines and $50 million USD during the fiscal year of 2005-2007[12] for non-Annex I Parties to develop adaptation projects. The COP meetings also established the Least Developed Countries Fund, Special Climate Change Fund and Adaptation Fund by giving additional financial resources to support developing country parties for adaptation activities. However, the GEF only supports a global agriculture project named "Global Alternatives to Slash and Burn Agriculture Phase II"[13] in 1996 with coverage of Asian nations. The operation of the Kyoto flexible mechanisms also contributes $200 million USD per year to the agriculture sector and is likely to reach 1-1.5 billion USD in the first commitment period from 2008-2012. Compared with an expected cost of $100 billion USD per year for climate adaptation relevant to the poor rural developing country parties in 2030, the investments and financial resources from the above-mentioned international climate mechanisms are only a small share of the cost for domestic development of adaptation and mitigation activities.

Food security depends on more complicated social-economic conditions[14] because climate change can affect food availability and the accessibility of food. The current suggested methodologies and technologies are not in detail for the parties to realize impacts on rural socio-economic development and food security; therefore, more communication and cooperation are necessary for the UNFCCC and FAO to develop more methodologies and technologies for all parties to develop domestic or regional adaptation strategies on agriculture and improve food insecurity.

The development of climate adaptation measures on agriculture might cause conflict with international trading activities. Therefore, Article 3, para. 5 of the UNFCCC states "measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade." The term "measures" includes the mitigation and adaptation measures taken by all parties in combating climate change. The nations shall prevent any violation of WTO rules when making adaptation policies and measures in agriculture, including processes and production methods (PPMs), subsidies, technical regulations and standards, non-discrimination principles, most-favoured-nation principle and national treatment principles. These principles shall also be applied in regional and multilateral cooperations.

Actions in the East Asian region

The member states of the Association of Southeast Asian Nations (ASEAN) adopted a five year (2008-2013) Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) on March 2009 with the goal "to ensure long-term food security and to improve the livelihoods of farmers in the ASEAN region." This Strategic Plan also identified that climate change is an impact factor to food security. The ASEAN members are preparing to "conduct studies to identify possible impacts of climate change on food security; identify measures to mitigate/adapt impacts of climate change on food security; and develop collaboration with other ASEAN sectoral bodies, which addresses impact mitigation and adaptation of climate change."

To implement this action plan, the ASEAN Ministers on Agriculture and Forestry (AMAF) will coordinate with other ASEAN sectoral bodies to monitor the implementation of all member States. The Working Groups under AMAF are in charge of developing implementation measures for all member States. Each member states is also required to produce a monitoring report for compliance reviews by the ASEAN Secretariat annually.[15] This Strategic Plan is led by the Ministers of the member states, but not the ASEAN Secretariat. The implementations might vary because of specific domestic conditions and political stabilization. Different implementation methods also show that Southeast Asian countries still consider that agriculture and food security issues to be strongly domestically focused and leave very limited space for joint actions.

The Asia-Pacific Economic Cooperation (APEC) has not yet linked the issues of climate change and food security together. The Lima Declaration of the Sixteen APEC Economic Leaders' Meeting in 2008 did not consider climate change as a potential concern on agriculture production. The Declaration emphasized the increases of technical cooperation and the improvement of efficiency in terms of food storage, transportation and distribution systems to achieve food security in the APEC region.[16] However, the APEC prepared the "2009 APEC Climate Symposium" meeting from the 12th to the 15th of July, 2009 in Singapore to discuss adaptation strategies for APEC members.[17] After this symposium, the Member Economies might identify climate change as an impact sector on agricultural production and food security in this region. Since APEC agreements have non-binding commitment among the member states, the response to impacts on food security and the development of the adaptation strategy will only rely on individual efforts or bilateral agreements of the member economies.

CONTINUING REGIONAL ADAPTATION STRATEGIES ARE NECESSARY

The IPCC reports already identified that agriculture impacts in tropical areas will be more adverse than other regions.[18] Formulating adaptations strategies as well as responding to the impacts of agriculture and addressing food security are main tasks for countries in the East Asia region. Developing regional adaptation measures and policies would enlarge the effects and synergize the efforts of East Asian nations.

Except regional and international cooperation in dealing with the adverse impact of climate change to agricultural production, the parties of UNFCCC could also jointly implement regional adaptation policies and measures on food security. Article 4, para. 2 of the Climate Convention allows Annex I Parties to implement jointly mitigation policies and measures with other parties that are not listed on the Annex I. This article only mentioned that the parties are able to implement mitigation activities jointly. It does not restrict joint adaptation policies and measures undertaken by the parties. The uneven geographic impacts caused by climate change lead to different influence on agriculture and temperature changes threatening food security in tropical nations. Therefore, the states within the region could jointly implement adaptation policies and measures. The joint adaptation actions could synthesize efforts and cost in dealing with the alterations in regional precipitation as well as the rising temperature.

Responding to the requirement of developing adaptation policies and measures, the UNFCCC shall initiate a much closer communications and cooperations with the FAO to develop more adaptation methodologies and technology for application by all parties. Regional cooperation could not only synthesize the adaptation cost and efforts but also bring extra financial assistance from international organizations and developed countries. On the regional level, ASEAN members should strengthen commitments on the implementation of the strategic plan and also cooperate with other organizations on many levels. Regional adaptation policies and measures would improve domestic policies on combating climate impacts and achieve its sustainable development goal.

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AUTHOR DISCLOSURES

The authors report no conflicts of interest.

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東亞之氣候變遷與糧食安全

氣候變遷對東亞國家的糧食安全有嚴重的影響。聯合國氣候變化綱要公約(以下簡稱公約)已經認定氣候變遷將對農業造成侵害，並要求各國應準備各種調適方法以因應侵害。本文檢視公約中關於調適的條文以及現今東亞地區各國的調適政策發展，發現公約以及京都議定書已經有特定的法條要求各國發展國內或區域的調適政策與措施。而東南亞國協最近所發佈之糧食安全的策略計畫正是呼應公約的要求所做的區域調適計畫，儘管在執行部份或因各國能力與遵約的意願不同，可能在整體執行效果上有所差距，卻證明了東協國家已經開始正視並對氣候變遷與糧食安全議題有所行動。本文建議既然氣候變遷對農業的影響最大，最需要開發更多各種不同的方法與發展更多計畫以利各國相關部門應用。所以公約應該加強與聯合國糧農組織、世界衛生組織與其他國際機構的共同合作，以開發出更多的調適方法與技術供各國參考。

關鍵字：氣候變遷、糧食安全、調適、東亞、 聯合國氣候變化綱要公約