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# Climate Change Impacts on Agricultural Products in Thailand: A Case Study of Thai Rice at the Chao Phraya River Basin

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**Abstract**

This study has focus specifically on the experience of Thailand's worst floods in Chao Phraya River Basin (CPRB). The economy was broadly affected by experiencing temporary halt in some production sectors of country. The study found that most of this was to the Thailand's agricultural products, as major agricultural products were Thai Rice, and Thailand was one of major rice producer and exporter in the world. In 2011, a total export value of Thai Rice was 210,527 million baht. However, the impact of tropical cyclone Nock-Ten on Thai Rice export was reinforced by an economic slowdown in Thailand during 2011-2012. Hence, this study diagnoses the impacts of flood on Thai Rice in CPRB, and recommends the guidelines for management of climate change impacts.

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## 1. Introduction

Global warming mainly causes climate change which influences direct agriculture as increasing the temperature, changing the rainfall rate, water-preservation and soil fertility. Also, the most of climate change impact on agriculture would appear to be the tropical region of the world. Thailand is located in the South

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East Asia with a total area of 51.36 million hectares, within the tropical belt will be most influenced [1], [2].

During the 2011 monsoon season occurred the great flood in Thailand. Beginning at the end of July through October, enhanced by the landfall of tropical cyclone Nock-Ten, have led to severe flooding that caused nation's most expensive natural disaster in 50 years, which makes the floods one of the top five in modern history of Thailand [3]. The World Bank has estimated 45.7 billion USD in economic damages and losses due to flooding [3], [4]. Most of this was to the Thailand agricultural products, especially "Thai Rice" productions as major agricultural products [3], [5]. Therefore, the purposes of this study explored the impact assessment of flooding on Thai Rice production in CPRB during 2011 to 2012, and suggest the solution of improving the guidelines for management of climate change impacts.

## 2. Literature Review

### 2.1. Climate Change and Flooding in Thailand

According to the United Nations Framework Convention on Climate Change define that the climate change means "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" [6]. Moreover, the Intergovernmental Panel on Climate Change also refers to "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer." It means to any change in climate over time, whether due to natural variability or as a result of human activity [7].

Moreover, the geography of Thailand is divided into five regions includes the North, Northeast, Central, East, and South regions. The Northern is the land of mountains with an average altitude of 200 meters. The Northeastern region is on a high plateau of dry land, which apparently rises from the Central region down towards Mekong River. Most of the Central area is the region of river basin as the CPRB, and is often called "the rice bowl of Asia." The East region is the important industrial areas of the country. Then, Southern Thailand is the narrowest part of the Malay Peninsula between the Gulf of Thailand and the Andaman Sea [8]. Further, these are three seasons: (1) the rainy season from mid-May to mid-October; (2) winter season from mid-October to mid-February; and (3) summer season from mid-February until mid-May [3]. Hence, the climate of Thailand is tropical and monsoonal, influenced by the northeast and southwest monsoon. It also brings relatively cool and dry weather across northern and northeastern, and brings plenty amounts of rainfall and moisture over the southern, central and northern sections of the country [3], [8].

### 2.2. Characteristics of Chao Phraya River Basins and Thai Rice

The CPRB was the largest river basin in Thailand, the most fertile region of the country with the largest irrigated area with a catchment area of 162,800 square kilometer or approximately 35% of the country's areas. It can be divided into eight sub-basins including the Ping, Wang, Yom, Nan, Chao Phraya, Sakae Krang, Pasak, and Tha Chin Rivers. The CPRB in the northern region of the country or known as the upper CPRB consists of Ping, Wang, Yom, and Nan Rivers. These tributaries flow from the upper basin to meet at Nakhon Sawan Province form the "Chao Phraya River" in the central region or known as the lower CPRB. After that the Sakae Krang and the Pasak joins the Chao Phraya Rivers, then the Tha Chin River branches at the main stream before entering the Gulf of Thailand at Bangkok and Samut Prakarn Provinces [3].

Thailand was the largest exporter and leading rice suppliers in the world, as well as chicken and shrimp products, processed foods such as canned tuna, and pineapples or 13.3% of a total number of Thailand's export revenue in 2008 [2]. Hence, rice was a main crop of agricultural cultivation in the lower CPRB because

this basin has the greatest advantage in production due to the high productivity of the land, irrigation systems, and the advanced technology used [2], [9]. Furthermore, the Thai Rice cycle and rice growing seasons starts in May and ends in September. It can be also divided into two main types by the rice cultivation: (1) in-season rice or known as the “Major Rice” (May to October); and (2) off-season rice or known as the “Second Rice” (November to April). Then, there are three types of rice cropping systems followed: single-cropped rice, double-cropped rice, triple-cropped rice. Single-cropped rice used 160-180 days (long-term rice varieties) was often planted under predominantly rain-fed conditions in the lower Mekong Basin (Northeast of Thailand), whilst types of double and triple-cropped rice used short-term varieties (90-100 days) and mainly concentrated in the lower CPRB of the country, because of received irrigation water around the year [5], [9].

### 3. Methodology

The study method of this paper was synthesized by the secondary data of Thai government reports and research papers based on the impacts of flooding on Thai Rice and flood victims and public sector in Thailand. Then, it was also analyzed the primary data by an in-depth interview with the 30 flood victims in CPRB such as the farmers and experts of public sector involved in flood and climate change. In addition, the summary of case study was integrated by the suggestion and solution of improving from the researchers and relevant organizations.

### 4. Results and Discussion

#### 4.1. Causes and Effects of Flooding in Thailand

According to the report of the Thai Meteorological Department presented the annual rainfall totals in 2011, this study determined that the flood frequency analysis using annual maximum daily flows for the three periods as the historical (1980–2004), near future (2015–2039), and late future (2075–2099) periods, was investigated by the three flow stations at Nakhon Sawan and upstream of Sirikit and Bhumibol dams [10].

In 2011, the southwest monsoon period of the end of July through October initiated tropical cyclone or Nock-Ten in the northern Thailand that flood waters moved downstream and fulfilled the lower CPRB, led to flood inundation of the country during the second half of year. Floods condition remained in some areas of lower CPRB until mid-January 2012 [3]. Then, at the beginning heaviest rains occurred across northern part of Thailand, before flood waters began to the central plain. The maximum flood extent crossed from northern to central part of the country (November 15, 2011), as well as the 55 provinces across the country. In addition, the Thai government lacked the drainage control systems (Dam management) and land-use control in the basin's areas such as the reduction of the farm holding land affected by the drainage control systems failed [11], [12].

#### 4.2. Flood Impact on Thai Rice

Thai government reports and publications represented the impacts of flood has small or absent effected on the overall of the Thailand agriculture export. The Asian Development Bank mentioned that the agricultural product export of Thailand was 13.3% of GDP. The projected average real growth of Thailand's economy was 4.4% per year over the 10-year baseline, but it interrupted from the historic flood that occurred during the last quarter of 2011. With the loss of production throughout the duration of the floods led to interception of the global supply chain for Thailand agricultural products [3]. Similar to the figure 1a showed that the export values of rice and products in the last quarter of 2011 (Green line) less than the 2010 (Red line), specific

distinction in the December between of 2010 with 2011 has decreased from 21,486 to 13,328 million baht. Then, the figure 1b illustrated that a total number of planted area and production quantity decreased from 2010 to 2011, which were occurred between the flooding phenomenon and damage of the country [8], [13], [5].

#### 4.3. Responses of Flood Victims and Relevant Public Sector

As mentioned that this study aims to understand the responses of flood victims and public sector involved in flood after the flood receded, particular to identify the impacts of flood on Thai Rice in CPRB. This section analyzes the findings in two major dimensions. Firstly, we interviewed the sample of farmers, who had planted the second rice in Chum Saeng district at Nakhon Sawan province. They indicated that there was a huge volume of water from lower northern Thailand attempting to move to the Gulf of Thailand. With each local government worked hard to protect its own areas from floods, and there were many districts forced to absorb massive amounts of water. Hence, the effect of inappropriate management and coordination, in the Nakhon Sawan province and neighboring provinces obstructed flood water flow. All districts were inundated with water more than 1 meter high in most areas, especially the planted area of second rice. In addition, they also mentioned that an official warning informed too late and there was much confusion. It was caused damage of the planted area of second rice, and their all rice products were not protected to solve any sudden problem by large flood.

Secondly, we determined a set of questions on the impacts of flood toward Thai Rice by interviewing experts of the national and local government officers involved in flood. According to the experts of the Thai Meteorological Department, Royal Irrigation Department, and Department of Disaster Prevention and Mitigation mentioned that they accepted the inappropriate management. In addition, there was no coordinate and collaboration between various agencies, resulting in duplication of work in many areas of the CPRB. Similar to the heads of Sena, Bang Ban, and Phak Hai districts at Ayutthaya province also referred that there was an official warning came too late, as well as unclear coping and prevention plans from the central government. Thus, this huge mass of water attacked as above second rice areas in Ayutthaya province and neighboring provinces.

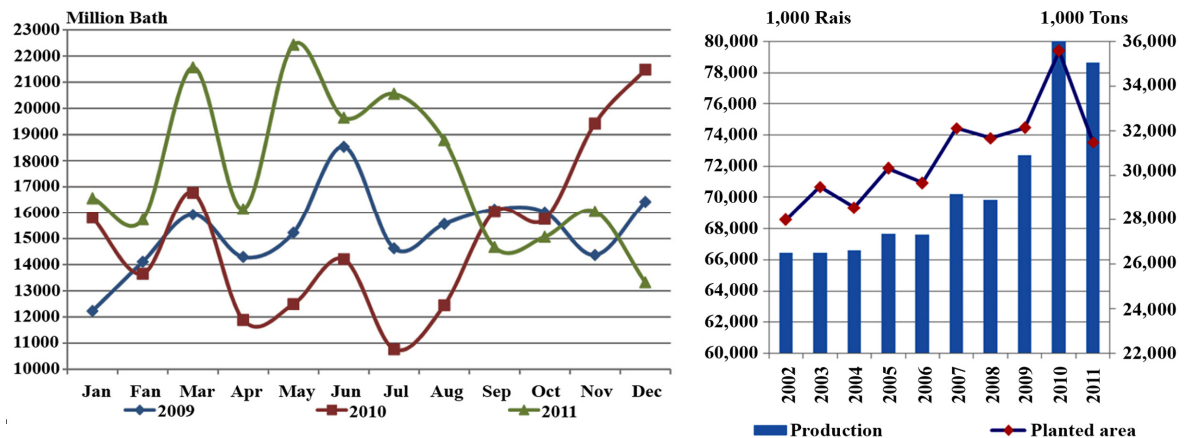


Fig. 1. (a) export values of rice and products by month, 2009-2011; (b) major and Second rice: planted area and production, 2002-2011

## 5. Conclusion

This study has integrated by the suggestion and solution of improving from the researchers and relevant organizations. Firstly, the relevant local organizations in study area should promote the natural disaster preparedness and coping mechanisms planning from climatic change for reduction of both direct and indirect effects such as forest and upstream conservation in the Northern region, and create and operate a local flood warning system, etc. Also, the empowering communities and farmers in the management of natural resources and agricultural productions will be offered knowledge and research such as crop diversification, improved crop varieties, and analysis of potential crop substitution in different regions. Especially, they will be provided financial assistance or emergency flood relief loans to cover damages in part of agriculture sector [8], [3], [4].

Secondly, the public sector involved in flood should be obvious regulation of the water management and flood control projects as implementation of prevention programs in long-term and contribution of the monitoring process from Non-Government agencies, and create water management projects to better prepare for flooding along the CPRB including: (1) control the amount of water passing the dams such as Bhumibol and Sirikit dams in the upper basin; (2) construction the new dam reservoirs in the northern region; (3) improvement of water resources and detention basin areas in the Nakhon Sawan and Ayutthaya provinces; (4) flood protection projects in the lower basin are the river diversion to the eastern part of Bangkok (as known flood way), and reform canal and drainage systems for protect urban area and agricultural cultivation [4], [11], [3]. In addition, they should joint clear regulation of urban and land-use planning projects in the CPRB of the central region and the flood-plain areas that used to be the area to retain water.

## References

- [1] Priyanka PD. Climate change impacts on tropical agriculture and the potential of organic agriculture to overcome these impacts. *Asian Journal of Food and Agro-Industry* 2009;10–17.
- [2] Minas KP, Frank JD. Crop Diversification in the Asia-Pacific Region. *Food and Agriculture Organization of the United Nations* 2001;130–146.
- [3] Aon Corporation. *2011 Thailand Floods Event Recap Report Impact Forecasting*. Chicago; 2012.
- [4] World Bank. *Thai Flood 2011: Rapid Assessment for Resilient Recovery and Reconstruction Planning*. Bangkok: Thailand; 2012.
- [5] Office of Agricultural Economics. *Thailand Foreign Agricultural Trade Statistics 2011*. Bangkok: Thailand; 2012.
- [6] United Nations. *The United Nations Framework Convention on Climate Change*. New York: USA; 1992.
- [7] Intergovernmental Panel on Climate Change. *Climate Change 2007: Synthesis Report*. Valencia: Spain; 2007.
- [8] Mekong Wetlands Biodiversity and Sustainable Use Programme. *Vulnerability Assessment of Climate Risks in the Lower Songkhram River Basin, Thailand*. Vientiane: Lao PDR; 2005.
- [9] Son NT, Chen CF, Chen CR. Mapping Major Cropping Patterns in Southeast Asia from Modis Data Using Wavelet Transform and Artificial Neural Networks. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 2012;421–425.
- [10] Taichi T, Junichi Y, Pongthakorn S. Impact of large-scale reservoir operation on flow regime in the Chao Phraya River basin, Thailand. *Hydrological Processes* 2012;26:2411–2420.
- [11] Graham E. Flooding in Thailand's Chao Phraya River Basin: A Study of Human and Environmental Causes. *Department of Geography and the Environment Fundamental Geographic Perspectives, University of Denver* 2012;3–6.
- [12] Francois M. The Closure of the Chao Phraya River Basin in Thailand: Its Causes, Consequences and Policy Implications. *Paper Presented at the Conference on Asian Irrigation in Transition—Responding to the Challenges Ahead*, Bangkok: Thailand; 2002.
- [13] Ogawa S, Rikimaru A, Nakanishi Y. Land Cover Analysis in Mekong River Basin and Chao Phraya Delta Using Remote Sensing Methods. *Transactions Japanese Geomorphological Union* 2006;27:221–233.