How Is Climate Change Affecting Thailand's Agriculture? A Literature Review with Policy Update

Attavanich, Witsanu

Kasetsart University

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How Is Climate Change Affecting Thailand's Agriculture? A Literature Review with Policy Update

Witsanu Attavanich, Ph.D.
Associate Professor
Faculty of Economics, Kasetsart University, Thailand

ABSTRACT

Agriculture in developing countries is the most sensitive economic sector when it comes to climate change. Thailand is one of the developing countries where agriculture plays a significant role and is likely vulnerable to the changing climate. Past studies investigated the impacts of climate change on Thailand's agricultural sector, but they are fragmented, lack of synthetic results linking to national climate change policies. The objectives of this article are to review and synthesize recent studies investigating the climate change impacts on Thailand's agricultural sector and update the current state of climate change policies in the sector. Several policies implications can be extracted from the study.

INTRODUCTION

Recent series of the Intergovernmental Panel on Climate Change (IPCC) (e.g., 2013; 2014) indicate that greenhouse gas emissions and resultant atmospheric concentrations have led to changes in the world's climate conditions, such as increases in temperatures, extreme temperatures, droughts, and rainfall intensity. Such changes are expected to continue and agriculture is potentially the most sensitive economic sector to climate change especially to developing countries, given that agricultural production is highly influenced by climatic conditions (e.g., Attavanich *et al.* 2013; Attavanich and McCarl 2014; IPCC 2014; Brown *et al.* 2015; 2017).

Thailand is one of developing countries where agriculture plays a crucial role. Agriculture sector has been a major source of food for the Thai people and a major source of employment and revenue from exporting agricultural products. Although there were 30.7 % of total labor force with 5.8 million households in agricultural sector in 2017, agricultural sector contributed only 10 % of the gross domestic products implying that a majority of Thai farmers are poor and are likely vulnerable to the changing climate.

This article aims to review recent studies investigating the climate change impacts on Thailand's agricultural sector and update the current state of climate change policy in the sector. Details will be provided below.

CLIMATE CHANGE IMPACTS

In view of its importance to economic well-being, climate change impacts on Thailand's agriculture have been documented, dating back at least 30 years. A majority of studies attempted to project the impact of climate change on yield of major crops especially rice, but a few studies advanced the literature by quantifying the monetary impacts of climate change.

As early as 1987, the United Nations Environment Programme (UNEP) (1989) found that a doubling of CO_2 could increase the risk of yield variation and the loss of income to the farmers. Using the Crop Environment Resource Synthesis (CERES) model and climate input data derived from different general circulation models (GCMs), Center for Applied Economics Research (2000) revealed that rice grown under rainfed conditions in Thailand was found to be highly vulnerable to climate change due to an increase in greenhouse gases. Based on climate data from four GCMs, the study discovered similar declining trends in rice and maize yields overtime. Their magnitudes, however, vary depending on climate conditions, soil types and crop practice. Maize yields, for example, could drop from 5 % in Nakhon Sawan province to 44 % in Nakhon Ratchasima province. The impacts on rice yields could be even more extensive and diverse. Rice yields could drop by 57 % in Roi-et province, but increase by 25 % in Surin province.

Buddhaboon, Kongton, and Jintrawet (2005) simulated the effect of climate change on KDML 105 rice yield in Tung Kula paddy field by direct seeding method and set CO_2 concentration at 1.5 and 2.0 times of year 1980-1989 (normal year) in the period of 2040-2049 and 2066-2075, respectively. They reveal that climate change likely enhances overall rice yield. Similar finding was found in Isvilanonda *et al.* (2009) who concluded that climate change will enhance KDML 105 rice yield in the north-eastern and the northern regions using CropDSS simulation model. Using changes in yields data, they revealed that the total production of KDML 105 was projected to increase approximately 1.4 million ton, which was equivalent to US$413.4 million. On the other hand, Isvilanonda *et al.* (2009) projected that climate change could adversely affect Suphan Buri 1 rice yield in central plain with a reduction of about 0.249 million ton, creating a loss in value approximately US$59.1 million.

Unlike previous studies, Attavanich (2016) projected changes in rice production of the world's top ten major rice producers including Thailand, ranked as number 6th in the world, under future climate projections as reported in recent IPCC AR5 (IPCC 2014) and recent future socioeconomic scenarios from shared socioeconomic pathways (SSPs) as reported by IIASA (Riahi *et al.* 2017). SSPs describe plausible alternative trends in the evolution of society and natural systems over the 21st century at the level of the world and large world regions. They consist of two elements: anarrative storyline and a set of quantified measures of development. SSPs are "reference" pathways in that they assume no climate change or climate impacts, and no new climate policies (See more details in Brown *et al.* 2015).

With the spatial regression estimation, Attavanich (2016) projected that rice yield, rice acreage, and rice supply in Thailand generally tended to decrease under future changes in climate and socio-economic conditions. Fig. 1 demonstrated that rice yield in Thailand generally tends to decrease under future changes in climate and socio-economic conditions compared to the baseline. Rice yield was projected to drop as much as 48.12 % during 2090-2100 from the

baseline (1985-2005) under RCP 8.5 and SSP3. The positive impact on rice yield are revealed only in scenarios RCP 2.6 with SSP1 and SSP3. Moreover, by comparing impact of changes in climate and socioeconomic conditions on rice yields across top ten major rice producing countries, Attavanich (2016) revealed that, rice yield in Thailand were projected to decline in the smaller magnitude than Brazil, Myanmar, Indonesia, Philippines, and Vietnam in the worst-case scenario with SSP3 as shown in Fig. 2.

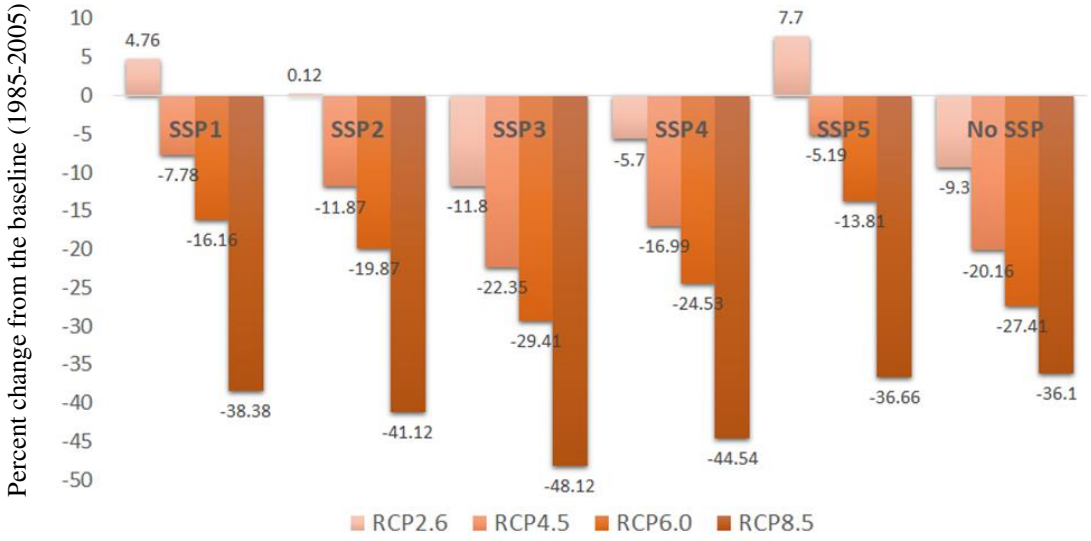

Fig. 1. Effect of changes in climate and socioeconomic conditions on Thailand's rice yield during 2090-2100.

Source: Attavanich (2016)
Note: SSP1 assumes low challenges to mitigation and adaptation; SSP2 assumes medium challenges to both; SSP3 assumes high challenges to both; SSP4 assumes that adaptation challenges dominate; and SSP5 assumes that mitigation challenges dominate

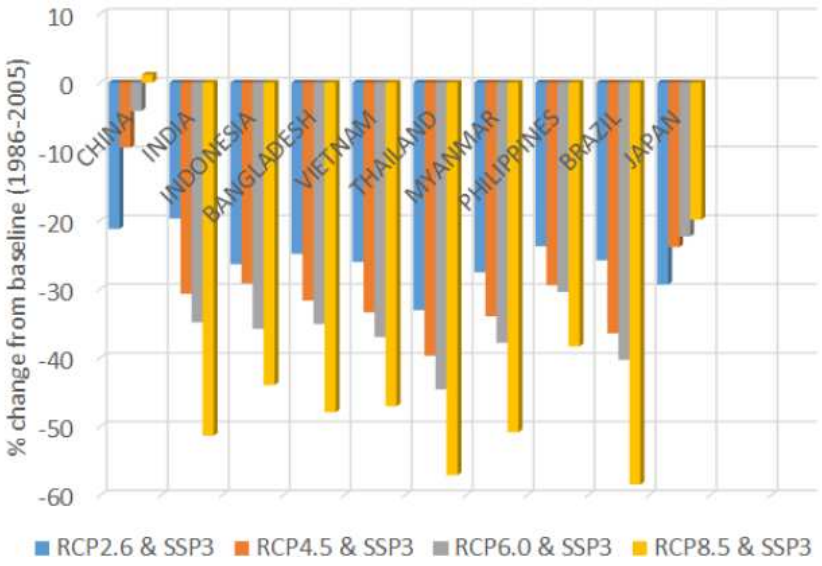

Fig. 2. Effect of changes in climate and socioeconomic conditions on Thailand's total rice supply across ten major rice producing countries during 2090-2100

Source: Attavanich (2016)

Unlike previous studies, Attavanich (2013) was the first to quantify the change in economic welfare of agricultural sector using the Ricardian approach under climate change scenarios derived from IPCC AR4 (IPCC 2007) and revealed that both temperature and precipitation significantly determine farmland values. Overall, the projected negative impacts of climate change on Thailand's agriculture ranged from US$24 to US$94 billion in accumulative term from 2005 to 2049. Attavanich (2017) refined the results found in Attavanich (2013) by: 1) Using the recent climate projections from IPCC AR5 (IPCC 2014); 2) Controlling for changes in socio-economic conditions reported by the Office of National Economic and Social Development Board; 3) Adding variables capturing climate variability and extreme events; and 4) Constructing the weighted average of climate data for each province from all climate stations within the radius of 250 kilometres from the centroid of the province.

Attavanich (2017) discovered that climate change was projected to adversely affect Thailand's agriculture ranging from US$17.91 billion to US$83.83 billion as shown in Figure 3. Damage values using projections from AR5 are smaller than those using projections from AR4. The calculated damage values in this study can be seen as the accumulative damage values from 2011 to 2045 or 34 years. Rainfed farms are more sensitive to climate change than irrigated farms. Climate change will adversely affect rainfed farms ranging from US$10.83 billion to US$63.42 billion, while for the irrigated farms climate change will generate the loss ranging from US$6.67 billion to US$20.41 billion (Fig. 3).

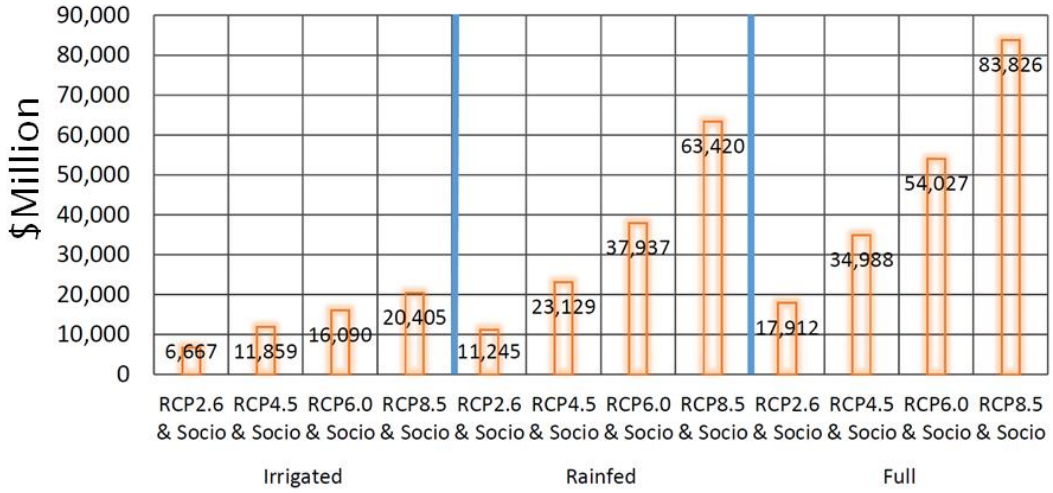

Fig. 3. Accumulative damage values from 2011-2045 in Thailand's agricultural sector
Source: Attavanich (2017)

At the provincial level, Attavanich (2017) projected that almost all provinces will be negatively affected by the climate change across all climate scenarios (Fig. 4). Southern, north, and northeastern regions are projected to receive higher negative impacts than east and central regions. Surat Thani's agricultural sector will receive the highest negative impacts from climate change followed by Nakhon Si Thammarat, Chumphon, Songkhla, and Nakhon Ratchasima, respectively.

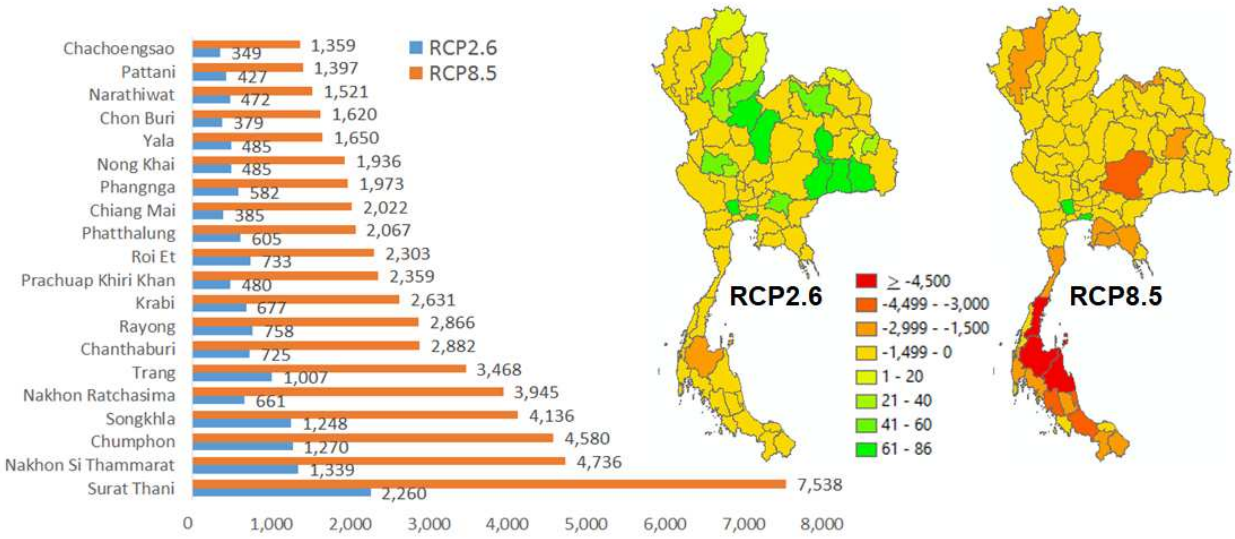

Fig. 4. Accumulative damage values from 2011-2045 at the provincial level ($Million)

Source: Attavanich (2017)

CLIMATE CHANGE POLICY UPDATE

To reduce damage generated by climate change, the Thai government led by Ministry of Agriculture and Cooperatives launched the first Climate Change Strategic Plan for the Agricultural Sector 2013-2016, which will be later called "the 2013-16 Strategy". The vision of the 2013-16 Strategy was to build the climate resilience for the agricultural sector, which leads to sustainable development under the world of changing climate. The 2013-16 Strategy emphasized on enhancing the knowledge of adaptation and the adaptive capability of farmers to deal with climate change problems in the short run, while mitigation to climate change by storing and reducing the greenhouse gas emission in the agricultural sector in the strategic issue 2 and implementation of the climate change strategic plan in the strategic 3 are less important issues.

Several obstacles of driving the 2013-16 Strategy were revealed by Attavanich (2017) including: 1) The budget used to run the climate change projects was not enough because almost all organizations did not have projects under the 2013-16 Strategy; 2) Indicators and objectives of the 2013-16 Strategy were not well-designed and unclear; 3) The high-level officers of the organizations usually give the last priority to the projects related to climate change since they were not included in the normal work plan; 4) There were a few meetings/seminars related to the climate change issues; 5) There was no integration of climate change policy and planning among all organizations; and 6) The central database related to technological knowledge and innovation related to climate change and agriculture was not well established.

To address several problems of driving the plan to effectively and efficiently deal with climate change impacts, the Ministry of Agriculture and Cooperatives launched the second Climate Change Strategic Plan for the Agricultural Sector 2017-2021, which will be later called "the 2017-21 Strategy". The current strategic plan solves several key weaknesses in the 2013-2016 Strategy. First, the current strategic plan has better indicators measuring effectiveness of the strategic plan. Second, the current strategic plan has provided participation opportunities to all stakeholders including public, private, and farmers. Third, the current strategic plan is supported by the National Agricultural Development Plan addressing the budget concerns. Fourth, the current strategic plan is consistent to and supported by other national plans such as the 12th National Economic and Social Development Plan for 2017-2021 and Climate Change Master Plan for 2015-2050. Fifth, it has assigned the specific responsibilities to responsible departments.

The current strategic plan has the vision that "agriculture has climate resilience and contributes to mitigate climate change problems under the sustainable development pathways". We can observe that the current strategic plan has added climate change mitigation effort in addition to the previous strategic plan (The 2013-16 Strategy). To fulfill the vision, several missions are planned to be implemented including: 1) Raise awareness of the impacts and convey information, knowledge and technology to development parties at all levels to enhance the readiness for climate change-related policies; 2) Develop the database, knowledge and technology under the cooperation from all sectors to support the adaptation to climate change; 3) Participate in mitigation of greenhouse gas emissions in the level consistent to the context of the agricultural sector and enhance a sustainable low-carbon growth; and 4) Push for the integration of adaptation measures and guidelines to cope with climate change in all sectors and at all levels. The conceptual framework used to construct the 2017-21 Strategy is demonstrated in Fig. 5.

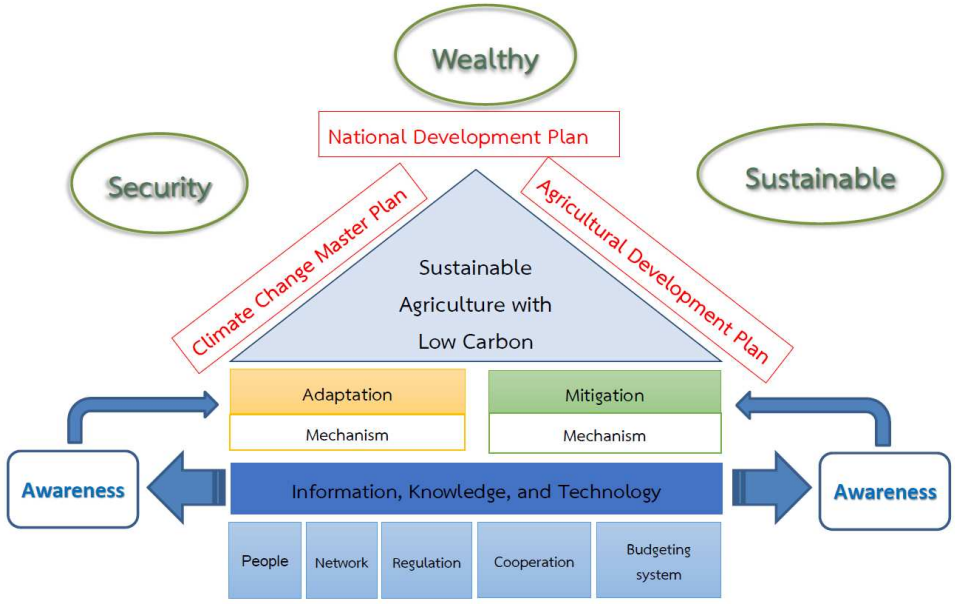

Fig. 5. Conceptual framework of the current Thailand's climate change strategic plan for the agricultural sector (2017-2021)

Source: Adapted from the subcommittee of driving climate change strategic plan for the agricultural sector (2018)

The goals of the 2017-21 Strategy includes: 1) All sectors have the higher level of awareness to the impacts of climate change; 2) All sectors obtain information, knowledge and technologies developed to support climate change adaptation thoroughly; 3) The agricultural sector has the contribution to reduce the greenhouse gas emission appropriately; 4) Integration and driving measures and guidelines to adapt to climate change with support from all sectors; 5) Farmers have a better quality of life, agricultural sector grows in the sustainable pathway and resilient to climate change, and strengthening national food security; 6) The agricultural sector has higher capacity for competition

There are four strategic issues that has been used to reach the energetic vision consisting of: 1) Collect, develop and set up the database, knowledge, technology, and innovation to raise the awareness of climate change; 2) Increase the ability of farmers, farmer institution, and related businesses to adapt to climate change; 3) Participate in reducing greenhouse gas emissions and develop a growth model with friendly environment; 4) Strengthen the capacity of management to cope with climate change in agriculture.

CONCLUSION

According to the literature review, the wide spatial differences of climate change impacts on yields among crops and economic welfare in Thailand were observed given the uncertainty of the GCMs suggesting that the vulnerability of agriculture to climate change varies according to crops, crop varieties, and location characteristics, in addition to the climate conditions. As land use and soil capacity in a particular area are suitable for many types of crops, the agriculture sector's vulnerability to climate change depends also on the ability of farmers to diversify their crops as well. The review also found that a majority of climate change impact studies in Thailand

emphasized only on certain areas and crops. Moreover, all studies focused on the climate change impacts on crop production. A few studies put attention to the economic welfare and market outcomes induced by climate change. Also, no study plays attention to the impacts of climate change across the food system and agricultural supply chains, which could have implications on food security. Therefore, more comprehensive studies are required to understand potential impacts on different area and crops and livestock across food system and supply chain. All in all, the review from this article can conclude that Thailand's agricultural sector has been negatively affected by changing climate and the negative impacts will be larger in the near future if there are no practical and effective policies to tackles with climate change. Southern and eastern regions of Thailand will be adversely affected by climate change higher than other regions.

For the policy perspectives, the first and second climate change strategic plan for the agricultural sector were well-designed and covered all issues to deal with climate change impacts. However, implementation of the plan in the real field has been much challenged and encountered several problems as described previously. The practical climate change action plan with changing the mindset of high-level officers, enough budgets and personnel for climate change projects plus providing participation of all stakeholders could ensure the success of the climate change strategic plan, which will finally enhance the well-being of Thai farmers and actors across agricultural supply chains.

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