Tropentag 2013, Stuttgart, Germany
September 17-19, 2013

Conference on International Research on Food Security, Natural Resource Management and Rural Development
organised by the University of Hohenheim

Assessment of Vulnerability Index on Climate Variability in the East of Thailand

Laitae, Chaniga, Suwanna Praneetvatakul*, Kampanat Vijitsrikamol and Nuchanata Mungkung

Department of Agricultural and Resource Economics, Faculty of Economics, Kasetsart University, Thailand

Abstract
Thailand, a crucial agricultural zone worthwhile, is facing climate variability and extreme events. At the regional level, the east of Thailand is a major fruit trees and rubber plantation zone. Climate variation is inevitably affected this essential agricultural region of Thailand. To guide a proper policy intervention, an assessment of vulnerability to climate variation plays an important role. The paper aims to assess the vulnerability index in the east of Thailand as well as farm-households in Tha mai and Khao khitchakut districts in Chanthaburi province. Primary data of a 452 farm-households survey and secondary data were utilized. The paper applies the vulnerability index classified into 3 factors based on Intergovernmental Panel on Climate Change (IPCC). They are 1) exposure: the nature and extent of changes to regions' climate variability, 2) sensitivity: the human-environmental conditions that can worsen the hazard ameliorate or trigger an impact of climate variation, and 3) adaptive capacity: a process through which societies taking the measures to reduce negative effects of climate variation. The results show that among the 7 provinces in the east of Thailand, Trat was the highest vulnerable province and Rayong was the least one. The significant exposure factors were temperature, average precipitation by month and drought risk. The important sensitivity factor was agricultural water resources. Last, the crucial adaptive capacity factors were poverty incidence, gross provincial product and household workforce ratio. Chantaburi province as the study area was found to be a medium vulnerable province (0.4633). When considering the Livelihood Vulnerability Index, farm households in Tha Mai (the main fruit trees area) revealed a lower vulnerable zone than those in Khao Khitchakut (the major rubber trees zone). Therefore, crop diversity, social integration and agricultural water management of farm-household are important adaptive strategies.

Keywords: Adaptive strategies, climate variation, East Thailand, vulnerability index

Introduction

The east of Thailand is a major economic tree plantation zone, especially fruits and rubber tree. In 2011, fruits production from the east was 72.93% of overall fruits production of Thailand (Office of agricultural Economics, 2012). This area is a high rainfall zone; the average rainfall in year 2009 was 1998.50 ml per year, which was over than overall average rainfall, and the rainfall trends to be increased in the future. (The Thai Meteorological Department, 2010). Climate variation is inevitably affecting this region. To guide a proper adaptive policy intervention, an assessment of vulnerability to climate variation plays an important role. The objectives of this study are 1) to assess the vulnerability index in the east of Thailand and 2) to assess the vulnerability farm-households in Tha Mai and Khao Khitchakut districts in Chanthaburi province.

* Corresponding author, e-mail address: fecoswp@ku.ac.th

Material and Methods

Data collection. Both secondary and primary data are gathered as the follows

- Secondary Data consisted of a) climate data e.g. Rainfall quantity, Maximum and minimum temperature (1982-2011) obtained from Thai Meteorological Department. b) risk index of drought and flood and landslide obtained from Department of Disaster Prevention and Mitigation and c) socio-economic data e.g. households' income, education, crop and water resource are from the Village Based Socio-Economic data 2011, collecting by The Community development Department and proportion of people below poverty line and Gross Provincial Product) GPP) data obtained from National Economic and Social Development Board.
- Primary data are gathered by interviewing farm-households under the research programme entitled "Integrated Adaptation Strategies to Climate Variability on the Production Potential of Agricultural Sector in Eastern Region of Thailand" funded by Kasetsart University Research and Development Institute (KURDI).

Vulnerability analysis.

The vulnerability indexes in this study were analyzed following ICRISAT/ADB guideline (DOA and ICRISAT, 2011). The data were normalized using functional relationship. The functional relationship to vulnerability is important for normalization of indicators. When the observed values are related positively to the vulnerability (for e.g. higher the variation in rainfall, higher the vulnerability), the standardization is achieved by employing the formula.

$$\text{index}_i = \frac{s_i - s_{min}}{s_{max} - s_{min}} \quad (1)$$

When the values are negatively related to the vulnerability (for e.g. higher the crop diversity, lower the vulnerability)

$$\text{index}_i = \frac{s_{max} - s_i}{s_{max} - s_{min}} \quad (2)$$

where s_i is the indicator for district d, and s_{min} and s_{max} are the minimum and maximum values, respectively.

In Household level, the vulnerability indexes are analyzed following Hanh, Reiderer and Foster (2008), Likelihood Vulnerability Index (LVI) which uses multiple indicators to assess exposure to natural disasters and climate variability, social and economic characteristics of households that affect their adaptive capacity, and current health, food, and water resource characteristics that determine their sensitivity to climate change impacts. The LVI is aggregated into IPCC's three contributing factors to vulnerability: exposure, sensitivity, and adaptive capacity and the Likelihood Vulnerability Index -IPCC (LVI-IPCC) is achieved by employing the formula,

$$\text{LVI-IPCCi} = (\text{expos}_i - \text{adapt}_i) * \text{sensi}_i \quad (3)$$

Where LVI–IPCCi is the LVI for districti expressed using the IPCC vulnerability framework, expos_i is the calculated exposure score for district i , adapt_i is the calculated adaptive capacity score for district i,and sensi_i is the calculated sensitivity score for district d The value of LVI–IPCC is from 1 (least vulnerable) to 1 (most vulnerable).

Results and Discussion

Provincial vulnerability

A set of indicator were selected for each of the three components of vulnerability

- Exposure component includes Drought Risk Index, Flood and landslide Risk Index, Rainfall quantity and Maximum and minimum temperature (1982-2011).

- Sensitivity includes Ratio of agricultural income per total income of households, Crop Diversity and Households' agricultural water resource.
- Adaptive Capacity includes Proportion of people below poverty line, Gross Provincial Product)GPP), Average farm size, Proportion of working age in a household, Number of Agriculture Service Centers, Number of information Centers and Proportion of people who participated in training related to environment and natural resources.

To evaluate vulnerability to climate variability of 7 provinces in the east, the indices for each component were analyzed. Table 1 shows indices and ranks of vulnerability in 7 provinces in the East. The indices range from 0.35-0.61 for exposure, 0.41-0.51 for sensitivity. Adaptation capacity contributed the greatest vulnerability index ranging from 0.34 to 0.62. The vulnerability indices were ranging from 0.39 to 0.54 and the greatest was found in Trat Province which was the highest vulnerability in exposure component. Sa Kaeo, Chachoengsao and Chanthaburi were categorized in the vulnerable provinces. On the other hand, Chonburi and Rayong, which were the highest adaptive capacity, were the Less vulnerable provinces. Considering the difference indices in each vulnerable level, exposure factors were temperature, average precipitation by month and drought risk were significant indices. The sensitivity component was agricultural water resources and adaptive capacity components such as household workforce ratio, proportion of people below poverty line and gross provincial product were also difference at the 0.05 significance level.

Table 1 Vulnerability index and ranks for seven provinces in the East of Thailand

Province	Determinants of vulnerability				Vulnerability level
	Exposure	Sensitivity	Adaptive Capacity	index	
Chonburi	0.45	0.41	0.38	0.41	Less vulnerable
Rayong	0.39	0.44	0.34	0.39	Less vulnerable
Chanthaburi	0.38	**0.51**	0.50	0.46	Vulnerable
Trat	**0.61**	0.47	0.55	**0.54**	Highly vulnerable
Chachoengsao	0.53	0.46	0.45	0.48	Vulnerable
Prachinburi	0.36	0.48	0.49	0.44	Moderately vulnerable
Sa Kaeo	0.35	0.49	**0.62**	0.49	Vulnerable

Household Vulnerability

This section emphasizes at household level. It uses both primary data from household surveys and secondary data to construct the index. The major components and the composite LVI for each district are presented in Table 2.

The flood and landslides risk index of Khoa kitchakut district (1.00) was higher than Tha mai district (0.50). Overall, Khoa kitchakut showed greater vulnerability on the natural disasters and climate variability component index than Tha mai. Khoa kitchakut also showed greater vulnerability on the Livelihood component than Tha mai. A higher percentage of Khoa kitchakut households reported relying solely on agriculture for income (Khoa kitchakut 0.90, Tha mai 0.81). In term of social network, Percent of households that have not participated to local group or government for assistance was also higher than Tha mai (the social networks component of Khoa kitchakut 0.29 and Tha mai 0.21).

However, Tha mai illustrated higher vulnerability on the Socio-demographic profile component than Khoa kitchakut. The dependency ratio of households in Tha mai was twice more than of khoa kitchakut's dependency ratio. Tha mai reported the less percent of households where head of household has attended school lower than secondary school than Khoa kitchakut's. The households in Tha mai district who perceived drought was more than households in Khoa kitchakut. When the Likelihood Vulnerability Index -IPCC was calculated, the overall the LVI -IPCC score of Khoa kitchakut was higher than Tha mai.

Table 2 Indexed classified by vulnerability components based on LVI-IPCC, Chanthaburi province, Thailand

Sub-component	District		Contributing factors	District	
	Tha-mai	Khoa kitchakut		Tha-Mai	Khoa kitchakut
Natural disasters and climate variability component	**0.44**	**0.56**	Exposure [1]	0.44	0.56
- Drought Risk	0.02	0.00			
- Flood and landslides Risk	0.50	1.00			
- Ratio of Climate Damage Cost per total income (10 years average)	0.79	0.79			
- Ratio of Climate Prevention Cost per total income (10 years average)	0.46	0.45			
Water resource component	**0.39**	**0.35**	Sensitivity [2]	0.39	0.35
- Percent of households that don't have water supply in their agricultural area	0.13	0.26			
- Percent of households perceiving drought	0.66	0.44			
Socio-demographic profile component	**0.30**	**0.22**	Adaptive Capacity [3]	0.35	0.37
- Dependency ratio	0.26	0.11			
- Percent of female-headed households	0.18	0.23			
- Percent of households where head of household has attended school lower than secondary school	0.47	0.30			
Livelihood component	**0.54**	**0.59**			
- Percent of households dependent on agriculture as the main source of their income	0.81	0.90			
- Average crop diversity index (= 1/(no. of crops grown by a household +1))	0.27	0.29			
Social networks component	**0.21**	**0.29**			
- Percent of households that have not participated to local group or government for assistance	0.21	0.29			
LVI-IPCC index])) 1] - [3] *([2([				0.04	0.07

Conclusions and Outlook

Vulnerability index is a useful to guide adaptive policy to cope with climate variation. In the east of Thailand, most provinces considered to be vulnerable to climate variation. The significant indicators were temperature, precipitation and drought risk, and agricultural water resources. The crucial adaptive capacity components were poverty incidence, gross provincial product and household workforce ratio. At household level, farm-households in fruit tree zone revealed lower vulnerability than those in rubber tree area. Therefore, crop diversity, social integration and agricultural water management of farm-households are important adaptive strategies to relieve vulnerability to climate variability.

References

DOA and ICRISAT. 2011. Stakeholder Consultation Workshop and Policy Dialogue Meeting for Thailand: Adaptation Strategies and Layers of Resilience to Climatic Related Shocks in Asia. May 31 - June 1,2011, Bangkok, Thailand.

IPCC. 2001. Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report. Retrieved from http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm

Hahn, M.B., Riederer, A.M. & Foster, S.O.. (2009). The Livelihood Vulnerability Index: A Pragmatic Approach to Assessing Risks From Climate Variability and Change - A Case Study in Mozambique. *Global Environment Change*, *19*(1), 74–88.

The Thai Meteorological Department. (2010) .*Thailand Annual Weather Summary 2009.* Retrieved from http://www.tmd.go.th/climate/climate.php?FileID=5.