MISPERCEPTIONS OF CLIMATE CHANGE RELATED HAZARD RISKS: A CASE STUDY FROM MOUNTAINOUS AREAS OF NORTHERN THAILAND

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1. INTRODUCTION

Scientific evidence indicates that climatic changes, mainly rainfall changes, are increasing the risk of droughts and floods and the compounding of events (for example, heavy rain leading to landslides and soil erosion) around the world (Petley, 2012). When such events can adversely affect elements of human systems, they assume the characteristics of a hazard. Southeast Asian countries such as Thailand are already experiencing climate change and an increasing frequency of climate-related hazards, such as droughts, floods and landslides, which have resulted in substantial impacts in many areas. The mountainous area of northern Thailand is not exempt from these hazards. To develop appropriate policies and responses, it is important to anticipate the nature of expected changes and to understand how climate change related hazards are perceived, experienced and interpreted by local people (Hartter et al., 2012). However, in some instances, there is a possibility of misleading personal experience or misperception leading to risks of hazards being misjudged. Thus, this study aims to investigate the differences between local people's perceptions and scientific observations of climate change related hazards by comparing available physical datasets. This study helps identify the needs in terms of actions and information to give, which reduce the effect of potential natural hazards in the mountainous areas of northern Thailand.

2. STUDY AREA

Yang Luang village lying 5km west of Mae Chaem city in the mountainous Mae Raek Basin (**Fig. 1**) is selected as a study area. This village is selected because it has suffered from drought, flood and landslide in the past years. Local people's experiences of various climate-related hazards strongly influence their perceptions, which is very important to be studied for hazard management. It receives around 881mm annual rainfall. It has 227 households with about 900 people. Agriculture is their main source of livelihood. Most of the farming is rain-fed and only limited area has irrigation facilities. Irrigation water is managed from Mae Raek a sub-tributary of Mae Chaem River flowing through the village, a small (Hui Ta) reservoir, and one community managed irrigation system. Pipe water, groundwater, rainwater and bottled water purchased from the market are the major sources of domestic and drinking water.

3. METHODOLOGY

3.1 Data collection: Data were collected from primary as well as secondary sources in August 2013. Qualitative and quantitative participatory approaches were used in primary data collection. Altogether 87 households were randomly sampled and surveyed. The questionnaire included both open- and close-ended questions. Secondary data (observed daily rainfall, discharge and relevant literatures) were collected from various sources.

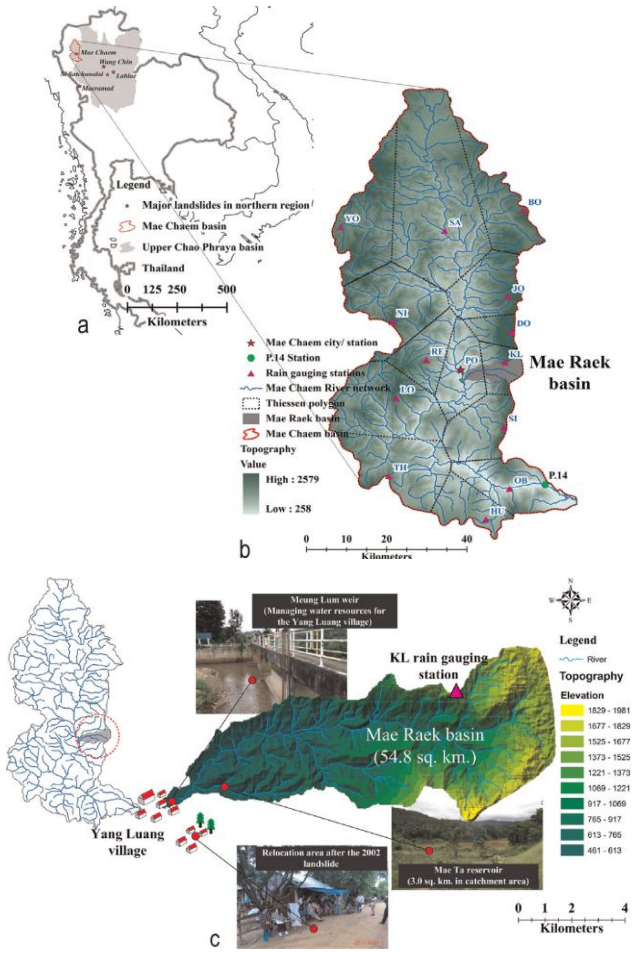

Fig.1 Upper Chao Phraya Basin (a) and Mae Chaem Basin (b) including hydro-meteorological stations. (Note: YO-Mae Yod, SA-Mae Sa, BO-Bo Kaeo, NI-Mae Ning, JO-Mae JonLuang, DO-Doi Inthanon, RE-Research Station, PO-Pou, KL-Mae Klang, LO-Mae Long, SI-Sirikit Plantation, TH- Mae Tho, OB-Ob Luang, and HU-Huay Bong rainfall gauging station. (c) Yang Luang village in Mae Raek Basin.

3.2 Data analysis:

Household data analysis: In addition to simple descriptive statistics (summation and frequency), fisher's exact test and multinomial logistic regression were applied in the data analyses. The choice of the explanatory independent variables is based on data availability and literature. A range of climate attributes variations is hypothesized to influence people's perception of climate change related hazards.

Hydro-climatic data analysis: Descriptive statistics, such as sum and frequency, were used to analyze changes in the long-term annual rainfall, accumulated monthly rainfall, total rainfall during the peak rainy months (August, September, and October), and the number of rainy days. Additionally, the Standardized Precipitation Index (SPI) was calculated for 1, 2, 3, 4 and 6-month time

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scales to assess the dry (drought) and wet (flood) conditions in the study area.

4. RESULTS AND DISCUSSION

Local people have perceived droughts, floods, and landslides as major hazards related to climate change (mainly rainfall changes), which are causing social disruption and economic hardships in YLV. The local people's perceptions vs. scientific observations of climate-related hazards are presented below.

4.1. Local people's perceptions vs scientific observations of drought: 77% of households have perceived an increase in the severity of dry conditions in recent decades, which they reported as drought. The drought events that the households recalled were those of 1998, 2000, 2002, 2009, 2010 and 2012. Those who have perceived a decrease in the number of rainy days and late rainfall are most likely to perceive an increase in the frequency of drought. The analysis of rainfall data from the Mae Chaem station does not imply less rainfall (amount) in the perceived drought years (1998, 2000, 2002, and 2011). Water availability in the MRR and Mae Ta reservoir is largely controlled by the rainfall upstream of the MRB. Multi-temporal SPI analysis using the precipitation data from the KL station (upstream of MRB) indicated low SPI values ($\leq$ -1.0) for the perceived drought years (1998, 2000 and 2002). It supports that the droughts and decreasing water availability in the MRR and Mae Ta reservoir in 1998, 2000 and 2002 resulted from less rainfall in the upstream region of the basin. This finding confirms that the local people have perceived drought but have not correctly perceived the exact cause of decreasing water availability in the nearby water sources.

4.2 Local people's perceptions vs scientific observations of flooding: Overall, 84% of the households have experienced floods. 92% of the households understand that heavy (high amount) rainfall near the headwaters of the MCR and MRR result in increasing water levels downstream of MCR and its backflow causes flooding in their village. The understanding of floods due to heavy rainfall was more developed than the understanding of landslides and the unintentional damming of rivers. An analysis of the rainfall data from the Mae Chaem station demonstrated an increasing trend in annual- and total-rainfall during the peak rainy months (August–October) in the last 30years. These results correspond with the local people's perceptions of flooding due to increasing rainfall. However, as discussed in later Section 4.3, the frequency of rain-triggered landslides has increased in Thailand, which may further increase the damming of rivers and flood hazards in the YLV. The villager's efforts towards flood mitigation alone cannot lead to effective results without considering landslide mitigation measures.

4.3 Local people's perceptions vs scientific observations of landslide: The majority (69%) of households perceived rainfall as the principal trigger of landslides. Nearly 40% of households have experienced landslides in the last two decades and reported major landslide events in 2002, 2003, and 2004. Among these landslide events, they remember the 2002 landslide as the most disastrous, which resulted in severe socio-economic consequences. The perceptions of the changes in the amounts of rainfall were found to significantly influence the perception of a decreasing frequency of landslide. Although 61% of households perceived increasing rainfall in the last two decades, they were the most likely to perceive a decreasing frequency of landslides. This perception possibly occurred because the households have not experienced any landslide disasters since 2004. However, studies by Kuraji et al. (2009), Petley (2012) and Fowze et al. (2012) support the possibility of increasing landslide frequency and the associated risks of landslides in mountainous northern Thailand in the future. A comparison of these scientific observations to the local people's perceptions shows that they correctly perceived landslide events and their causes (heavy rainfall) but not the increasing landslide risk at their location.

5. CONCLUSION

Results indicated approximately 77% of local households have perceived drought but have not correctly perceived its cause. In addition, 92% of households perceived that flooding resulted from increasing rainfall around the headwaters of the MCR and MRR. Scientific studies demonstrated that the frequency of rain-triggered landslides in Thailand is increasing, which may increase the damming of rivers and the flood risks in YLV. The villagers' efforts towards flood mitigation alone cannot lead to effective results without considering landslide mitigation measures. Thus, awareness and adaptation programs should be focused on both landslide and flood mitigation. Additionally, the most disastrous landslide in 2002 mainly shaped the perceptions of the local people regarding landslides. Overall, 61% of households correctly perceived that landslides occur due to increasing rainfall. However, the respondents were not aware of potential increases in landslide frequency. A hazard awareness campaign should be implemented to correct this low perception of potential landslide risk. This information is useful for decision makers who need to understand and facilitate climate change and its related hazard management at a local level in the mountainous areas of northern Thailand as well as other places.

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REFERENCES

Fowze, J.S.M., Bergado, D.T., Soralump, S., Voottipreux, P., Dechasakulsom, M. 2012. Rain-triggered landslide hazards and mitigation measures in Thailand: from research to practice, Geotext. Geomembr. 30:50-64.

Hartter, J., Stampone, M.D., Ryan, S.J., Kirner, K., Chapman, C.A., Goldman, A. 2012. Patterns and perceptions of climate change in a biodiversity conservation hotspot. PLoS One 7(2): e32408.

Kuraji, K., Mie, G., Kowit, P. 2009. Inter-annual and spatial variation of altitudinal increase in rainfall over Mount Inthanon and Mae Chaem Watershed, Northern Thailand, Hydrol.Res.Lett.3:18-21.

Petley, D. 2012. Global patterns of loss of life from landslides. Geology 40: 927-930.