PEOPLE'S PERCEPTIONS ON CLIMATE CHANGE: CASE STUDY IN GROUNDWATER IRRIGATION PROJECT IN THAILAND

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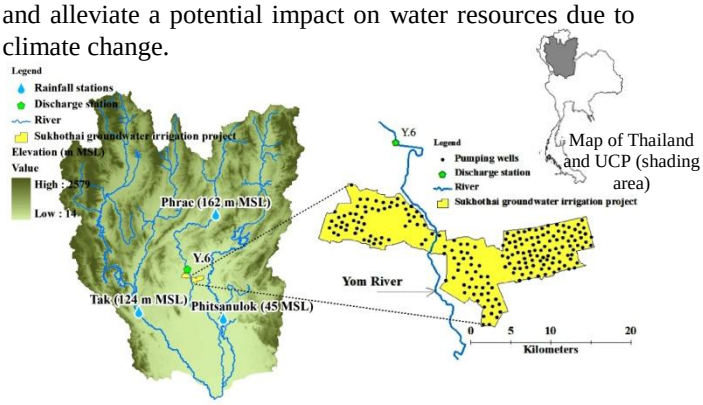
1. INTRODUCTION

Several studies focus on projection of climate change impacts at both micro and macro scales using a simple and very sophisticated mathematical models. However, fewer studies were done from a bottom-up approach, e.g., using local people's perception on climate change (LPPCC). Climate change is now certain and it is accelerated by human activity. Alteration of water resources is expected as the first response of climate change impact worldwide. In Thailand, Pratoomchai et al. (2014) used three global climate models associated with 12 scenarios for projecting groundwater resources in the Upper Chao Phraya River basin (UCP) in the near future (2026-2040). 9 out of 12 scenarios indicate that mean annual groundwater recharge might be decreased from 9.7 to 13.9% relative to 1986-2000. This might cause a maximum reduction in groundwater storage by 1.5 km^3. Run out of river discharge during the dry season (November to May) especially for the Yom River is commonly seen on mass-medias.

Meanwhile, what are a local people's thoughts and how they respond on water resources in a context of climate change is keen interest to researchers. This study was revealed LPPCC associated with the long-terms ground truth (observed climate data) analysis. It will benefit for formulating a policy framework to response and alleviate a potential impact on water resources due to climate change.



UCP basin and hydro-meteorological stations | Sukhothai groundwater irrigation area

Fig.1 Study area: Sukhothai groundwater irrigation project and hydro-meteorological stations

2. STUDY AREA

We conducted a questionnaire survey in Sukhothai Groundwater Irrigation Project (SGIP) in Thailand. The SGIP covers an area approximately 200 km^2 and is located in the Yom River basin (sub-basin of the UCP, see **Fig. 1**). There are 204 groundwater pumping wells distributed in the SGIP.

In addition, there is no big reservoir in the Yom basin. According to the Royal Irrigation Department, there often be floods took place from September to October and zero discharge in the dry season especially from February to the middle of May. Growing rice normally two crops per year (wet and dry seasons) is a main source of income. Whenever the surface water is not available (surface water shortage), abstraction of groundwater is commonly in practice for alleviating the surface water shortage.

3. METHODOLOGY

The study was done using questionnaire survey. It had a total of 52 questions actually; however, we can categorize them for 5 groups (i.e., general information, people's perceptions on climate change in the SGIP for both past and future, drought, flood, and other natural disaster as well as their knowledge on technology such as early warning system). Regarding to a costly of our approach; therefore, only one study area that intensive use of groundwater for irrigation was selected.

Not only the questionnaire survey was used but a long-term analysis of observed hydro-meteorological data was conducted along with the LPPCC analysis. Comparison between LPPCC results and the ground truth was applied to assess their consistency.

4. RESULTS

Hydro-meteorological trend analysis

We analyzed a number of days in a year that had a maximum air temperature above or equal to 34.7 °C (hot days), which is the threshold (critical) air temperature value to reduce Thai rice production (Jongjaidee et al., 2010). **Fig. 2** shows annual variability of days that had air temperature above the threshold value from 3 observed weather stations (i.e., Tak, Phitsanulok, and Phrae stations) during the latest 62 years (1951-2012). 2 (Tak and Phrae stations) out of 3 stations indicated that the number of critical temperature days trend to be increased with statistically significant ($p<0.05$).

There was approximately 1,168 mm, which was averaged from 3 stations, in mean annual rainfall. **Fig. 3** shows the same fashion as the critical temperature days but it is a number of rainy days or wet days. Again, we found a discrepancy among 3 observation points in trend analysis. The Phitsanulok and Tak stations showed generally decrease in the number of wet days. On the other hand, the Phrae station showed increasing in the wet days. Kuraji et al. (2009) also found increasing in annual rainfall in northern region of Thailand especially for high altitude stations.

Fig.4 shows a number of days in a year which has non-zero flow at the Y.6 gauging station (see **Fig.1**). This analysis used the observed daily river discharge from 1955 to 2006 (52 years). We found approximately 85 days or only 23.3% of time in a year had instream river flow (non-zero discharge). This indicated that the SGIP is located in intermittent river flow area. However, it was clearly seen that the number of non-zero flow days were increasing

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trend. This was agreement with the increasing in annual rainfall at the upstream station (Phrae station, see **Fig.4**).

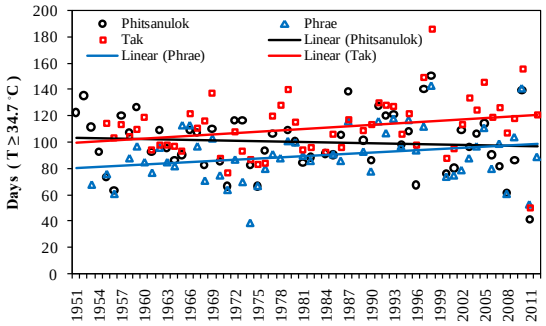

Fig.2 Variability of a number of hot days

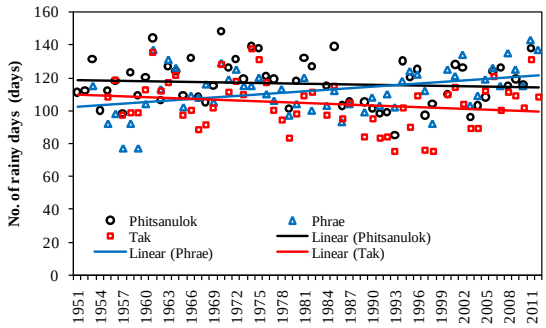

Fig.3 Variability of a number of rainy days

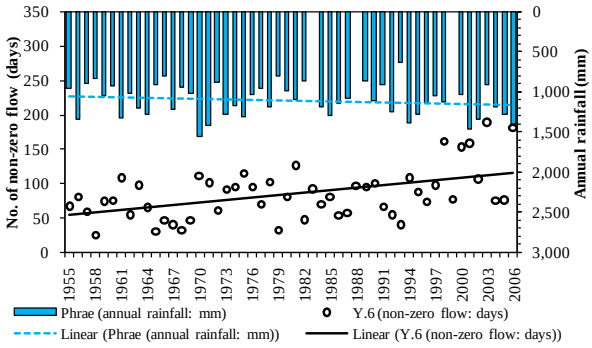

Fig.4 Variability of a number of non-zero flow days and annual rainfall at Phrae station

Local people's perception on climate change

There were a total of 102 answering the questionnaire (they also represented for 102 families). We summarized key answers as shown in **Fig. 5A**. Nearly 100% of them lilied and used groundwater for growing rice for two crops annually. A majority of the answer (93.1%) believed surface air temperature increasing trend relative to the past 30 years. This is showed agreement with the general long-term observation of the air temperature (**Fig.2**). There were not clear perceptions on rainfall changes. 50.0% expressed decreasing in rainfall but approximately the same percentage (46.1%) responded increasing trend.

There was agreement that the surface water was not enough to a demand (growing rice). This is proved in **Fig.4** that approximately 85 days (completely in the wet season) in a year have non-zero discharge and no reservoir for storing surface water during the wet season in the SGIP. Therefore, one available and popular option to grow their corps is abstracting groundwater.

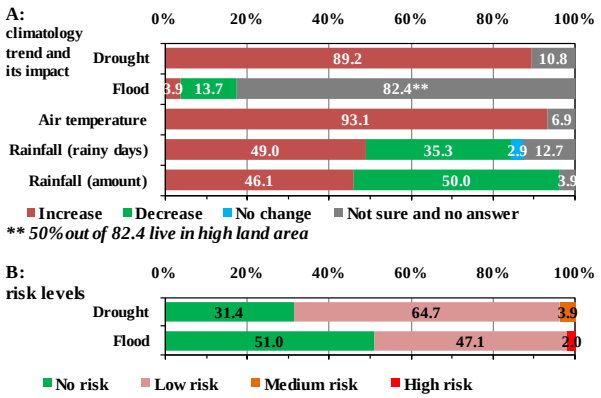

Fig.5 Local people's perception on climate change and its potential impacts (A) and risk levels (B)

High percentage of 89.2% showed drought was a big problem for them to grow rice and trend to increase in the future. However, very a few percentages (3.9%) worry about drought situation in the future (**Fig.5B**). That because almost families reliable in groundwater resources capacity and a majority opinion (80%) believed the groundwater will never run out from the SGIP.

5. DISCUSSION AND CONCLUSIONS

This study shows LPPCC and reveals the long-term keys hydro-meteorological recorded trends. In the SGIP, groundwater plays significant role for maintaining people's life in a comfortable way (growing rice for 2 crops annually) even though facing with surface water shortage. Seriously, the majority of local people misunderstood on sustainable groundwater use. Depletion of groundwater will be occurred because expansion in rice growing area and increase in cropping intensity. In the big picture, reduction in rainfall and groundwater recharge in the basin, which were the results of future projection (Pratoomchai et al. (2014)), might bring a negative impact on groundwater use in the SGIP. At this point, enhancing knowledge on occurring and circulating of groundwater is urgently for implementing. Improving rice specie is also need for coping with surface air temperature rise.

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