3rd International Conference - Water resources and wetlands. 8-10 September, 2014 Tulcea (Romania);
Available online at http://www.limnology.ro/wrw2016/proceedings.html
Editors: Petre Gâştescu, Petre Bretcan; ISSN: 2285-7923; Pages:141-145; Open access under CC BY-NC-ND license

CLIMATE CHANGE IMPACT ON WATER RESOURCES IN AGRICULTURAL AND ADAPTATION: A CASE STUDY OF KANCHANABURI PROVINCE, THAILAND.

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ABSTRACT

Climate change is a global concern and also poses one of the biggest challenges to water resource. Climate change can impede ability of people, especially the poor in developing countries to secure safe and sufficient water supplies. Past statistical data reveal a change in climate associated with increasing number of extreme events. Water is indispensable resource for agricultural crop as its production requires high water quantity. As identified by Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), Southeast Asia is located in flood and drought prone areas affected by changing in precipitation and monsoon patterns. This paper aims to examine future climate projection in next 30 years (2024, 2034 and 2044) in Kanchanaburi province and to evaluate impact of climate change on water resource in agriculture crop. Four global climate models (GCMs), namely; ACCESS1-0, ACCESS1-3, ECEARTH and HADCM3 have been used to construct ensemble emission scenarios by using representative concentration pathway (RCP) 4.5 and 6.0. Anthropogenic greenhouse gas emission was used to simulate future precipitation, maximum temperature, minimum temperature and mean temperature. Results show that precipitation and temperature in Kanchanaburi province are expected to slightly increase in a future. Agricultural land tends to be decreased while urban and residential areas have tendency to expand. Adaptation in the agricultural sector is largely dependent on water availability and different socio-economic development scenarios. Knowledge of climate change and awareness in local community also plays a key role in creating water and agricultural resilience.

Keywords: climate change, water resource, Kanchanaburi, adaptation

1 INTRODUCTION

Climate change currently receives considerable attention at the global level. Climate change also poses one of the biggest challenges to water resources. Agricultural is expected to be one of the critical sectors that are highly vulnerable to climate change, especially in rain-fed agriculture area where crops largely depend on rainfall. Ability of people to secure safe and sufficient water supplies is also impeded by climate change and water related extreme events. Water is essential for crop production as it requires water for seed germination, root growth and nutrition. Crop yields may response in a changing mean temperature, precipitation, and extreme events, notably of droughts and floods. For example, corn and soybean yields has found to be nonlinear and inverted relationship with weather variables (Chen et al., 2016). Valverde et al. (2015) evaluate impact of climate change on irrigated agriculture in the Guadiana river basin in the south of Portugal and reveal an increase in crop irrigation requirement under future climate projection. Wang &Zhang (2015) studied variation of water resources in the Huang-huai-hai area of China and found that water resources were expected to change about -1.3 %, 1.0 % and -2.3 % in 2021-2050 relative to the reference period (1961-1990) while precipitation was projected to slightly increase in that period. Amelin and Pindado (2014) identified the threat of climate change to water resources and interlinkage area such as agriculture, soil and land management in Spain, focusing on measures and initiatives promoted by the central government and address efforts in cross cutting sectoral coordination,

Kanchanaburi province shares the largest area of Mae Klong river basin (19,414.25 square kilometers or 57.30 % of total basin area). There are two big dams in a province namely Srinagarindra and Vajiralongkorn. These dams were capable of providing water supply to drought area in rain-fed agriculture. The observed annual rainfall varies from 900 mm to 2200 mm and average mean temperature is 22 °C. Measurement of precipitation from 2006 to 2010 comparing to 30 years rainfall data (1971-2000) revealed anomaly precipitation pattern. Most of local people work in the field of agriculture which cassava and sugarcane occupy the main cropped land and categorized as major crops.

2 METHODS

To prepare future climate projections for 2024, 2034 and 2044, four climate models, namely; ACCESS1-0, ACCESS1-3, EC EARTH and HADCM3 have been included to construct four climate parameters; minimum and maximum temperature, average temperature and precipitation by using statistical method of pattern scaling. Two representation concentration pathways (RCP) 4.5 and 6.0 will be used to generate climate projection under different greenhouse gases emission scenario. Future climate parameters are computed to percent difference between projected and baseline data (1995). Adaptation practices would be examined by reviewing current and future provincial plans and policies, emphasizing on water resources for crop production. Suitable adaptation measures for agricultural water management under future climate extreme in Kanchanaburi province are recommended.

3 RESULTS

3.1 Precipitation (RCP 4.5 and RCP 6.0)

Precipitation projection tends to gradually increase from 2024 to 2044. The maximum projected increase of precipitation in 2024, 2034 and 2044 are 2.43, 3.24 and 4.00 % respectively. The highest increase occurs over area north of Kanchnaburi in Sangkhla Buri district while the lowest increase is located in Sai Yok district. In considering of precipitation projection under RCP 6.0, the same trend with RCP 4.5 is clear but percent change is lower than those appear in RCP 4.5. Projection of precipitation in Kanchanaburi province under RCP 4.5 and 6.0 has shown in Figure 1 and Figure 2.

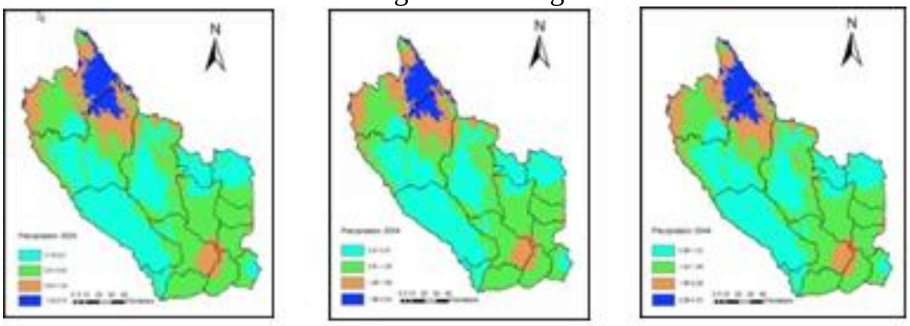

Figure 1. Precipitation projection under RCP 4.5

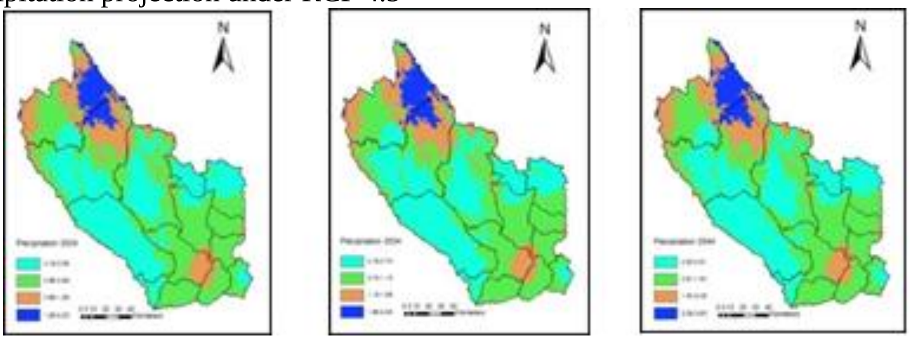

Figure 2. Precipitation projection under RCP 6.0

3.2 Mean temperature (RCP 4.5 and RCP 6.0)

Increases in mean temperature of about 0.50 to 1.00 degree Celsius (°C) are projected from 2024 to 2044 under RCP 4.6 and 6.0. The projected mean temperature change in the eastern part of province is higher than those appeared in the western part as shown in Figure 3 and Figure 4.

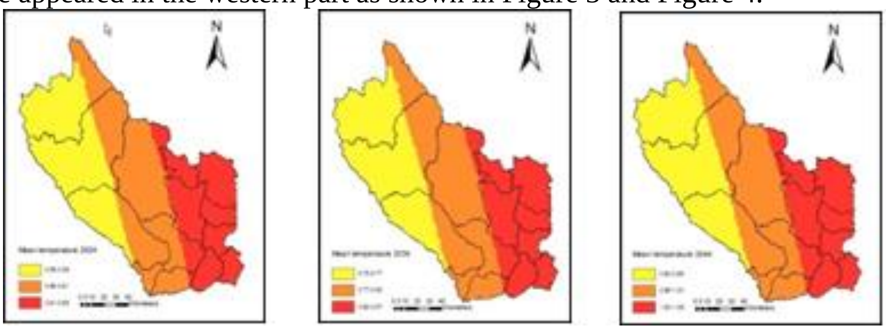

Figure 3. Mean temperature projection under RCP 4.5

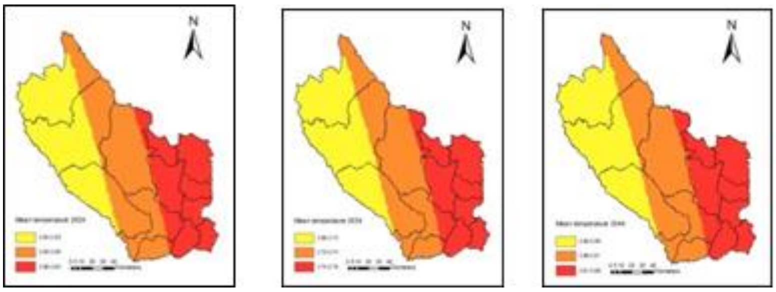

Figure 4. Mean temperature projection under RCP 6.0

3.3 Minimum temperature (RCP 4.5 and RCP 6.0)

Minimum temperature is projected to rise about 0.49 to 0.91 degree Celsius (°C) under RCP 4.5 and 0.45 to 0.83 degree Celsius (°C) under RCP 6.0 as shown in Figure 5 and Figure 6.

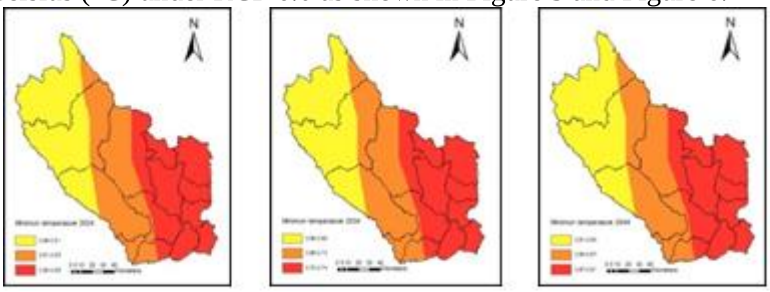

Figure 5. Minimum temperature projection under RCP 4.5

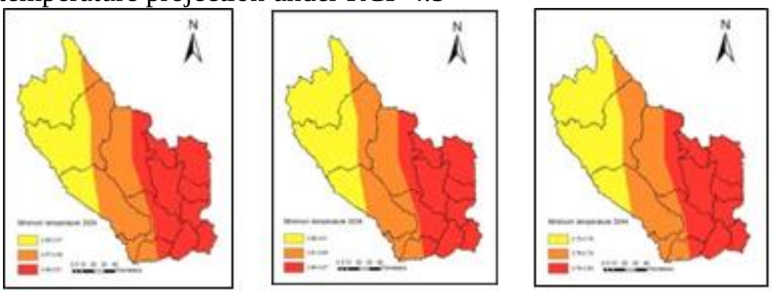

Figure 6. Minimum temperature projection under RCP 4.5

3.3 Maximum temperature (RCP 4.5 and RCP 6.0)

Maximum temperature change is projected to increase about 0.60 to 1.29 degree Celsius (°C) under RCP 4.5 and 0.55 to 1.17 degree Celcius (°C) under RCP 6.0 as display in Figure 7 and Figure 8. It appears that percent change in the maximum temperature for two emission scenarios is not much different.

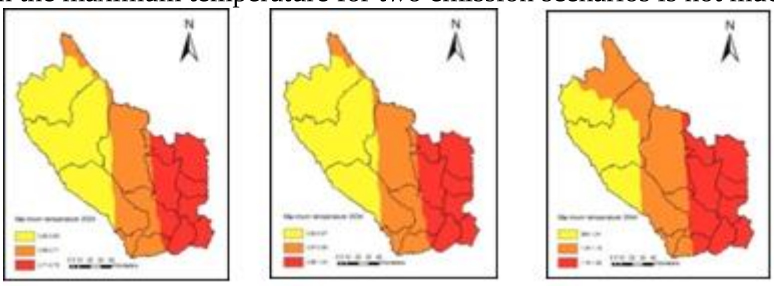

Figure 7. Maximum temperature projection under RCP 4.5

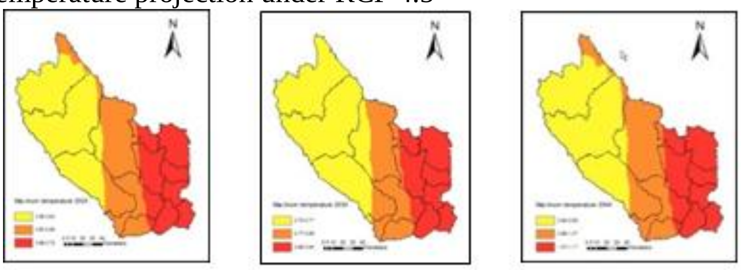

Figure 8. Maximum temperature projection under RCP 4.5

3.4 Land use

Change in land use is one of the socioeconomic drivers to worsen climate change impact on water resources. Conversion of forest land to other land use types is a major problem in Kanchanaburi province due to the increase in agriculture land (0.12%), water body (0.06%), urban and built up land (0.04%) and miscellaneous land (0.28%). It is expected that urban expansion will occur in a future, while agricultural land might slightly increase. Table 1. And Figure 9 reveal change in major land use type between 2007-2013.

Table 1. Land use change in Kanchanaburi province 2007-2013

Type of Land Use	Area (sq km) 2007	Area (sq km) 2013	% Change
Forest	12,224	12,127	-0.5
Agriculture	5,320	5,344	+0.12
Water	830	843	+0.06
Urban	557	563	+0.04
Miscellaneous	455	511	+0.28

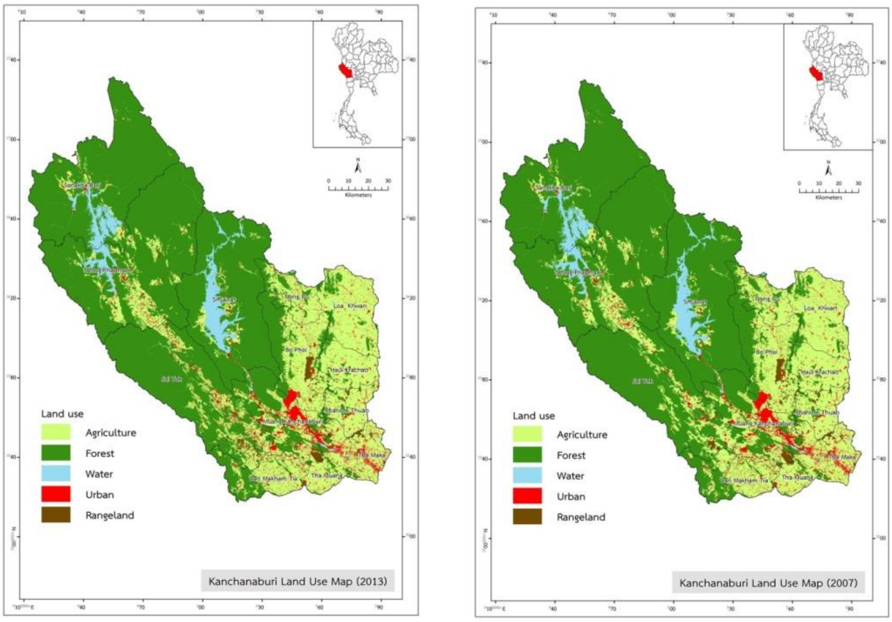

Figure 9. Change in land use between 2007-2013

4 DISCUSSION

Future climate projection of precipitation, mean temperature, maximum temperature and minimum temperature shows an increasing trend under two GHG emission scenarios (RCP 4.5 and 6.0). Maximum rainfall occurs in north of province where forest land dominates. Change in temperature is projected to rise in southern and eastern area of province where agriculture is a major use of land. Warming temperature and change in precipitation lead to shortage of water supply and degrade water quality. Even warmer temperature might be more favorable to some crops such as corn, but in case that there was enough water for crops in growing season.

It would be very important to plan for crop adaptation to climate change because water supplies are expected to be threaten with higher frequency of extreme weather events and long drought spell. Implementation of better water management strategies can capable of conserving water and make crop resilient from water shortage. Crop diversification is another adaptation strategy that is most effective at farm level response to climate change. Crop adaptation through control and optimize land use change is one of the effective adaptation strategies. Conversion of forests to arable land for agriculture and illegal lodging should not be further allowed in Kanchanaburi. Moreover, capacity building of smallholder crop farming allows farmers to improve crop farming practices and yields. Knowledge of climate change awareness and effective water management strategy, including conservation at smallholder crop farming level plays critical role in achieving water and agricultural resilience in sustainable manner.

5 CONCLUSION

Water availability is one of the most important factors to sustain crop productivity. There might be an increase in precipitation, mean temperature, minimum temperature and maximum temperature in Mae Klong river basin and Kanchanaburi province. However, seasonal rainfall variability must be taken into consideration when making a decision plan for crop cultivation. Crops should be grown in the area with high amount of rainfall and low rainfall variability. Socioeconomic change is very important in water resources and agriculture planning. As agriculture is a major driver of deforestation and other land use changes, measures that restrict agriculture expansion and retain carbon rich forest would help reducing future emission. Changing forest cover could lead to huge impact on hydrological cycle and water availability. Projection of future climate under different climate scenarios in Kanchanaburi province suggests the recent trend towards increases precipitation and temperature will continue. However, the challenges of climate change should be met through adaptation. It would be more proactive approach to develop adaptation strategies to manage agricultural water management.

ACKNOWLEDGEMENTS

This work was supported by Office of the Higher Education Commission, THAILAND.

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