Chapter 4 Vulnerability and Adaptation

By

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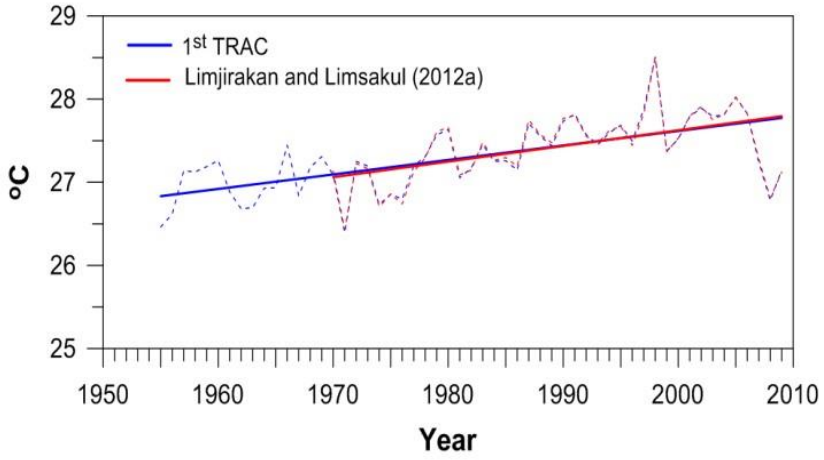
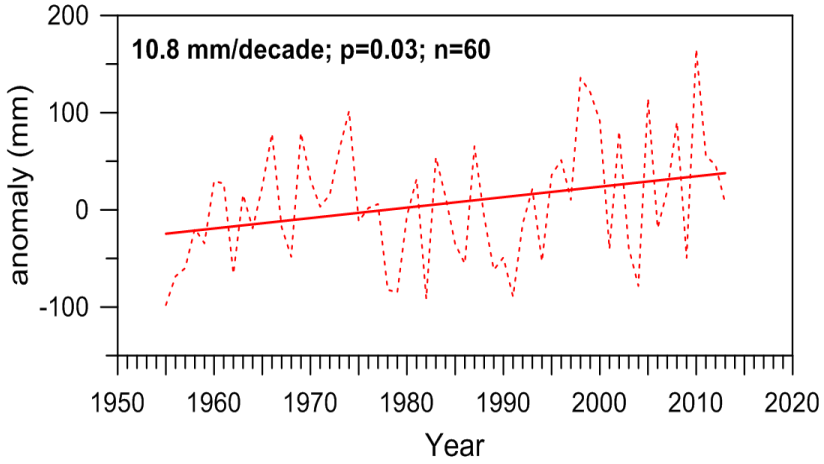
4.1 Conceptual Framework

4.1.1 Objectives and scope

The objectives of this chapter are to present (1) the climate change projections used for impact assessment; (2) the vulnerability assessment in each sector under climate change impact; (3) the risk assessment with examples of adaptation to response to future uncertainty, and (4) the status of adaptation related activities. Scenario approach is used to assess future uncertainty from both climate change and socio-economic development in the future.



(a) average temperature



(b) rainfall during November to April

Figure 4-1 Past trend of the average temperature and change of rainfall during November to April over Thailand

Source: (a) 2nd TARC, (b) Limsakul and Singhruck (2016)

4.1.2.2 Climate change in the future

To assess vulnerability to climate change, climate change projections are required along with socio-economic scenarios. The GCM selection based on observed rainfall data over Thailand was carried out to select three GCMs that have the smallest bias. The three GCMs selected under three RCPs (RCP2.6, RCP4.5, and RCP8.5) areIPSL-CM5A-MR, GFDL-CM3 andMRI-CGCM3 to represent uncertainties in climate modeling and scenarios. Daily precipitation, maximum temperature, and minimum temperature over Thailand from the three GCMs were statistically downscaled and bias corrected using the method proposed by Watanabe et al. (2014) during the two periods in the future, 2016 – 2045 and 2071 – 2100 to represent medium and long-term projections.

From recent studies, overall the maximum temperature over Thailand, after downscaling and bias correction, is projected to increase around 0.9 – 1.8°C, 1.3 – 2.3°C,and 2.0 – 3.1°C under RCP2.6, RCP4.5, and RCP8.5, respectively as shown in *Figure 4-2*. The change in the annual precipitation from the three GCMs in certain region is different as shown in *Figure 4-3*. Overall the projected annual precipitation shows decreasing trend for both time periods. The decrease in annual precipitation ranges between 66 – 193, 46 – 229, and 19 – 191 mm/year under RCP2.6, RCP4.5, and RCP8.5, respectively.

4.1.2.2 Climate change in the future

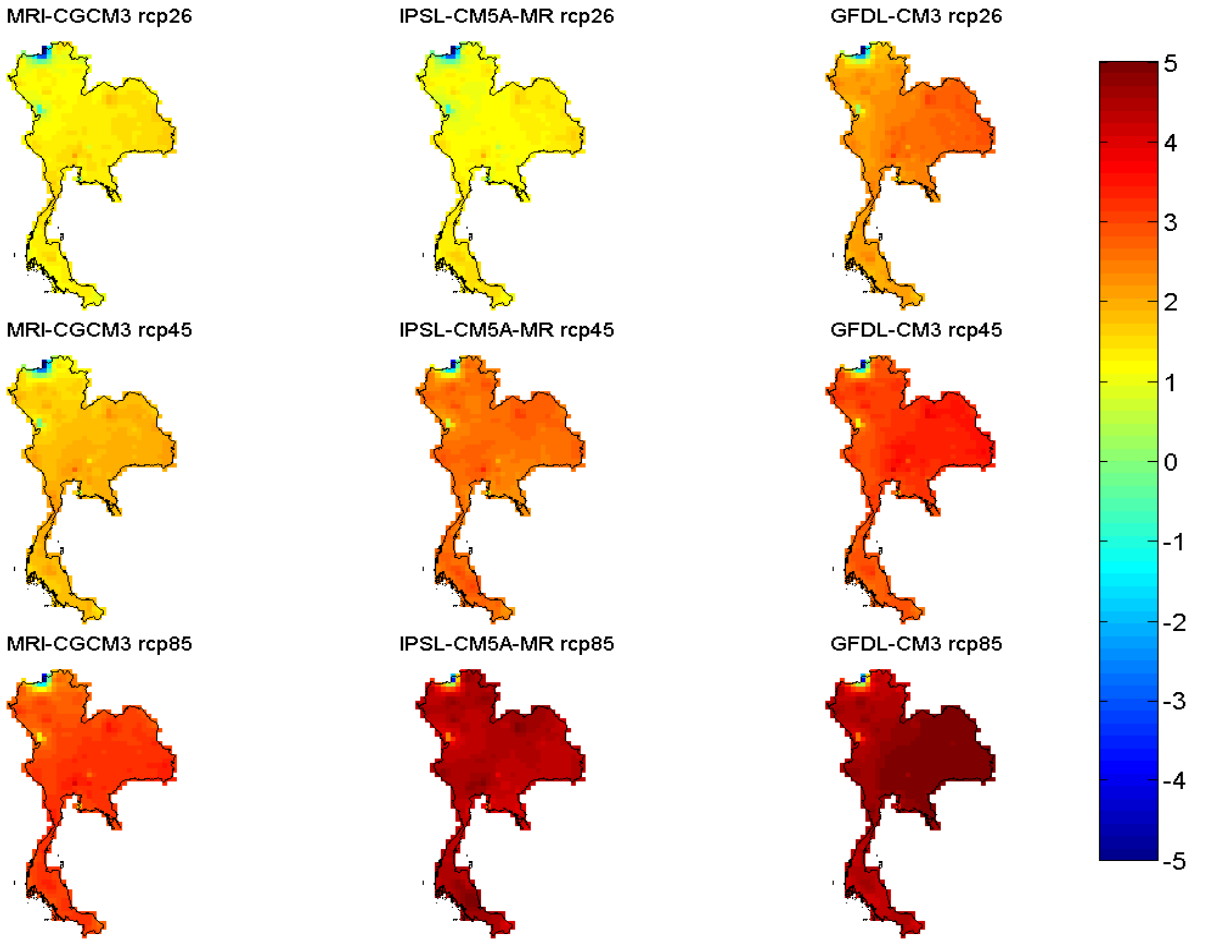


Figure 4-2

Change in daily maximum temperature in 2071-2100 from the reference period 1976-2005

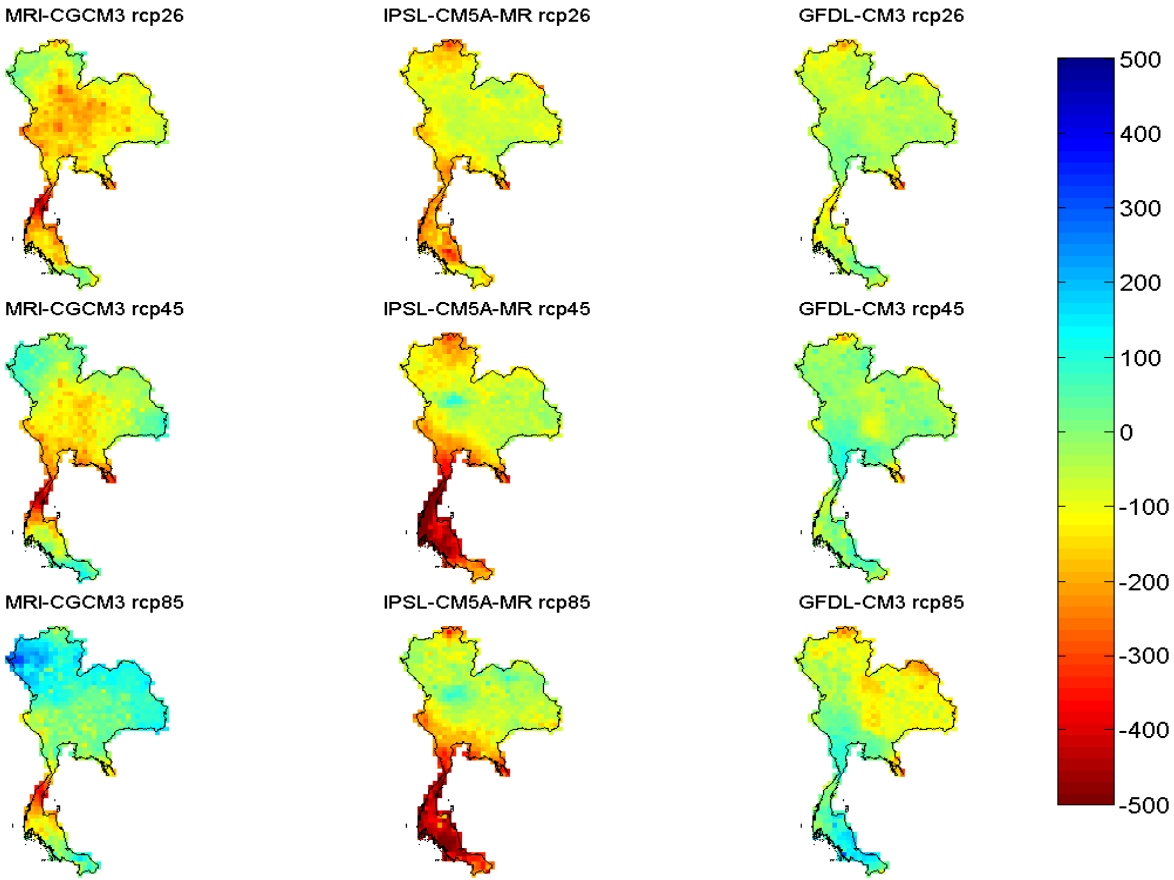


Figure 4-3

Change in annual precipitation in 2071-2100 from the reference period 1976-2005

4.1.3 Baseline socio-economic scenarios

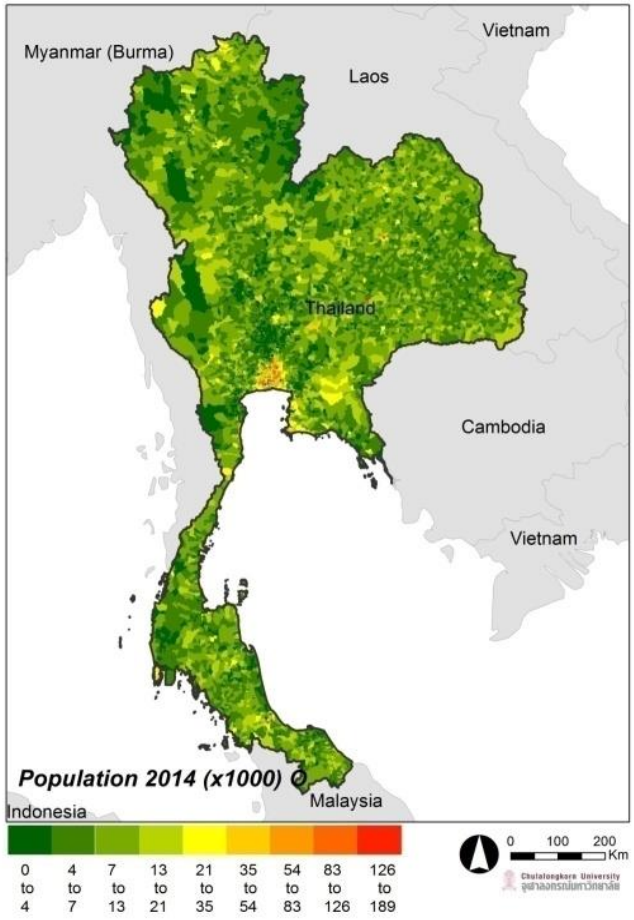
4.1.3.1 Socio-economic development from the past

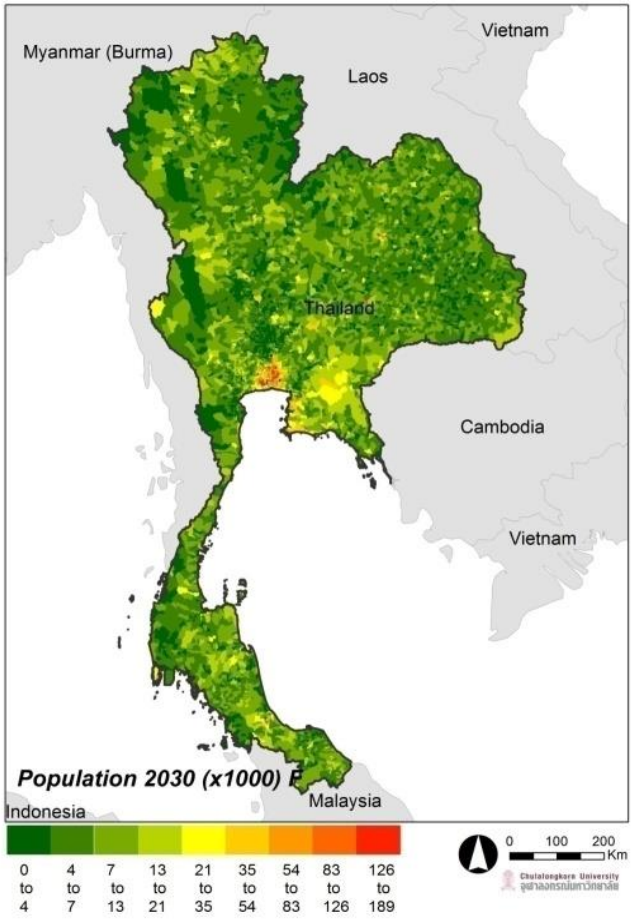
Based on information from NESDB, Thailand has experienced three major economic crises in its modern history: (1) Asian Financial Crisis in 1997; (2) Subprime Mortgage Crisis in 2009; (3) Thailand Flood in 2011. The third crisis was flood, which is one of the climate-related disasters that affect all economic sectors

4.1.3.2 Socio-economic development in the future

a) Social issues

First, social issue is analyzed via number and distribution of population in the future. For future population, the result presents maximum number of population is approximately 66.4 million heads in 2025, (*Figure 4-4*).





a) Observed number of population in 2014*

b) Projected number of population in 2030**

Source *Department of Provincial Administration, **Office of the National Economic and Social Development Board

Figure 4-4 Change of number of population in each sub-district level of Thailand

b) Economic issue

Office of the National Economic and Social Development Board or NESDB concluded past, present situations and trends on national development that "The Thai economic has gradually continuously grown until presently. Thailand is grouped in the medium-level countries in term of income earners and could position herself possessing the important role in international trade in the fierce competition in the world scenario." Based on the philosophy of Stability, Prosperity and Sustainability, escaping from the middle-income trap is one of the main targets. Innovation is defined to ensure sustainable long-term economic growth. *Figure 4-5* shows GDP per capita in each scenario. The main difference between these scenarios is labor-intensive products in the 1st scenario and high technology ones in the 2nd scenario.

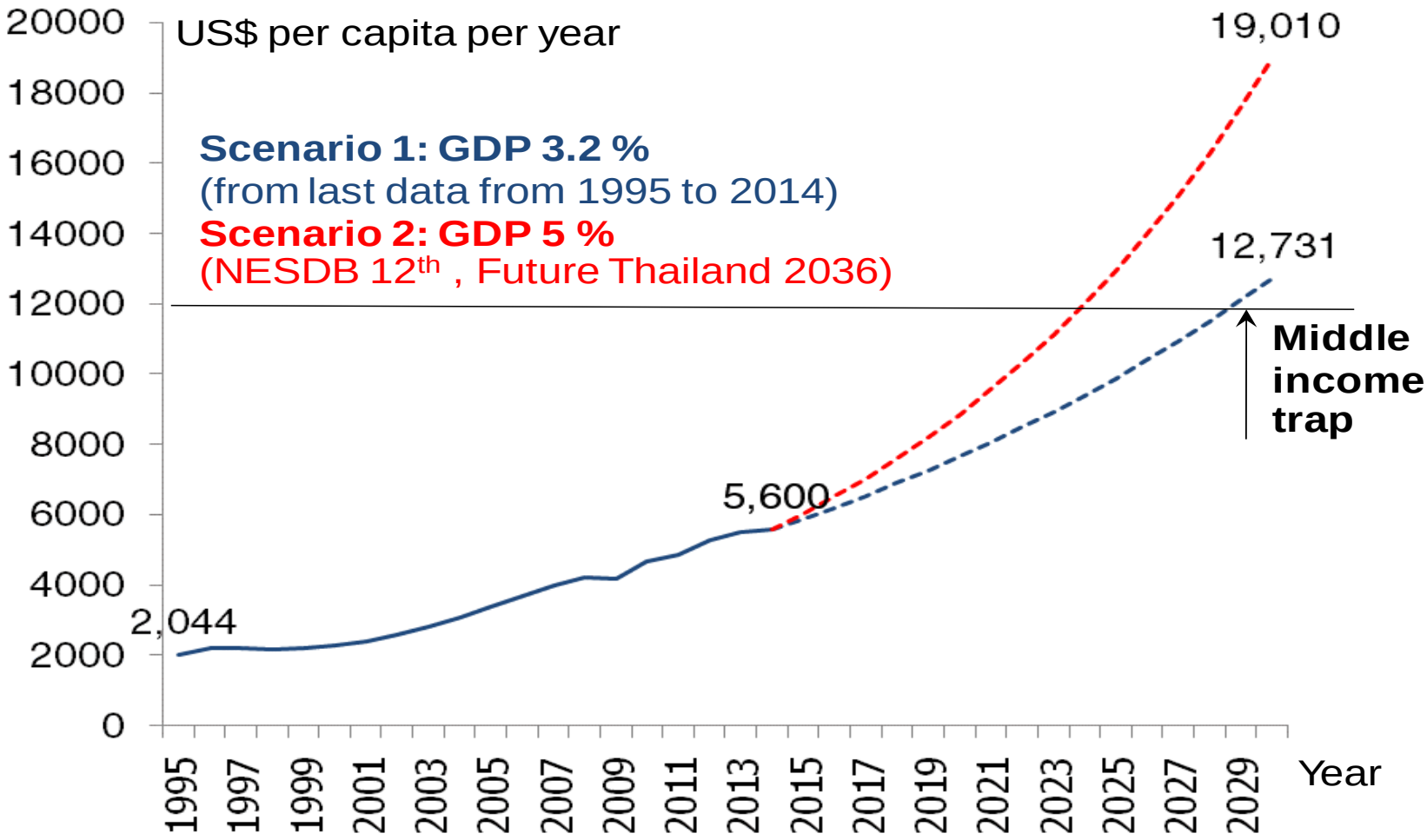
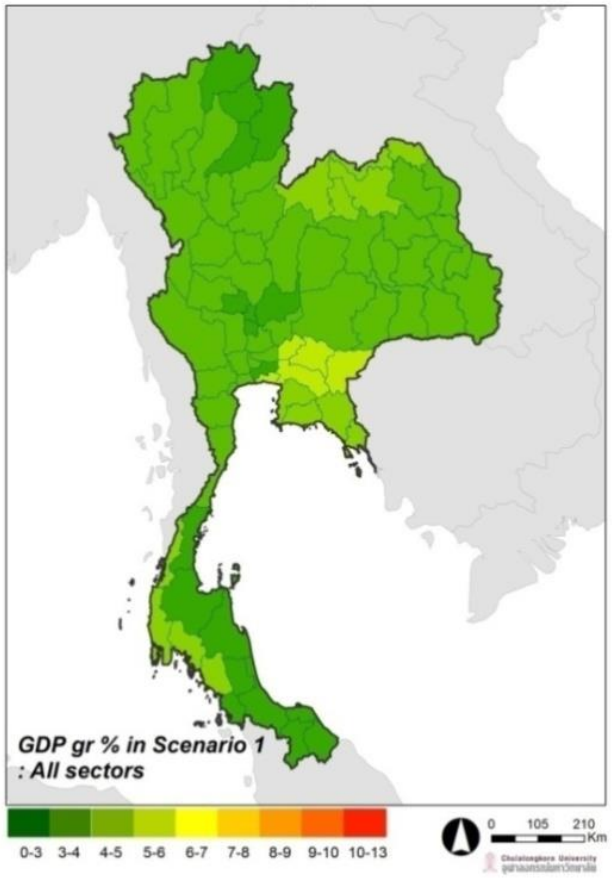
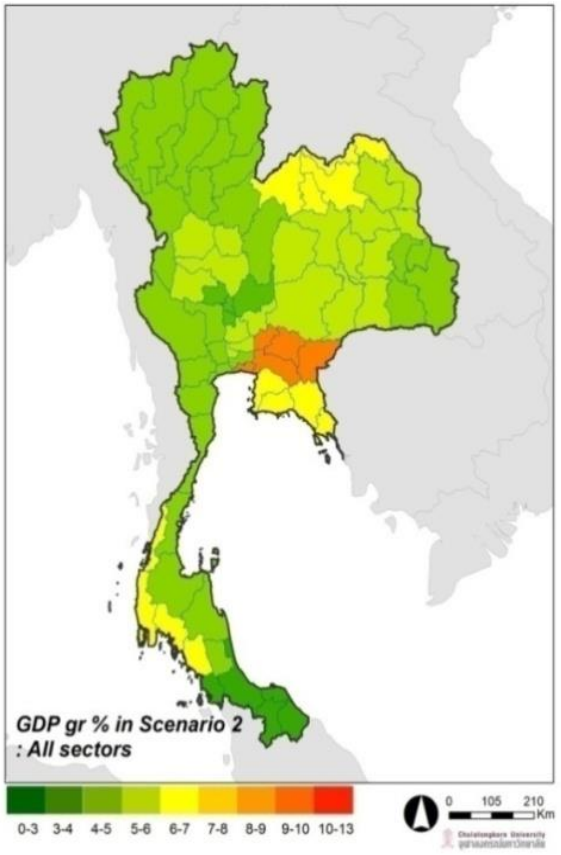


Figure 4-5 GDP per capita in each scenario (NESDB)

c) Spatial development issue

Figure 4-6 shows GDP growth rate in each provincial cluster under two scenarios. This represents one main difference in term of spatial development. The 2nd scenario concentrates in development of new economic areas to increase competitiveness of the country. As can be seen in *Figure 4-6*, Thailand's *Eastern Economic Corridor* (*EEC*) is the main development area in the future with greater GDP growth rate comparing with the rest of Thailand.





a) 1st Scenario, GDP gr for all sector = 3.2 %

b) 2nd Scenario, GDP gr for all sector = 5.0 %

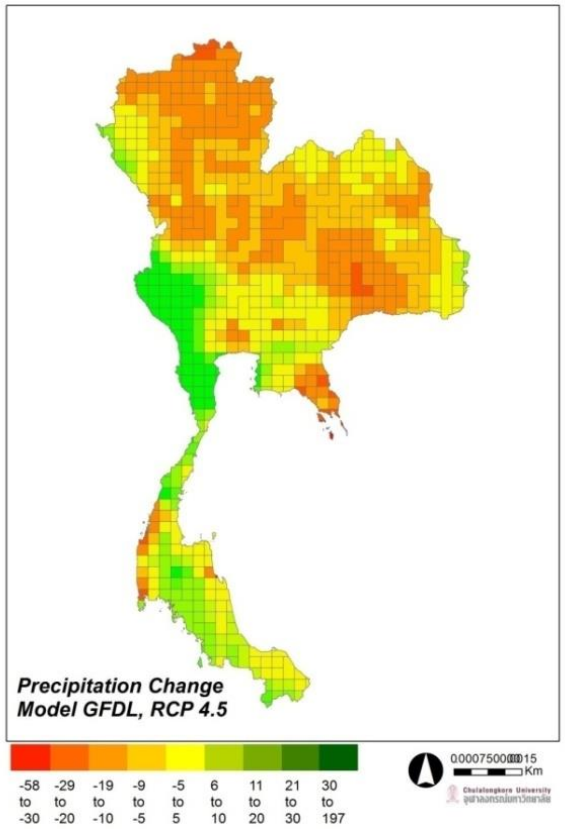
Source edit from Office of the National Economic and Social Development Board

Figure 4-6 *GDP growth rate (gr) in each provincial cluster and scenario from 2015-2030*

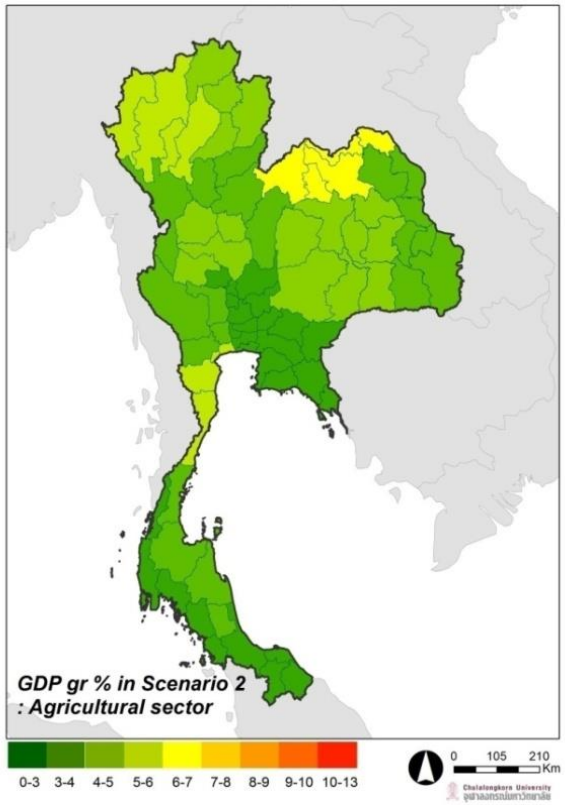
d) Key results

The results from the previous sections (climate change scenario and socio-economic scenario) are developed to present the risk of future development under climate change impacts. Policy maker can make decision on mitigation and adaptation measures by understating both uncertainties. For example, *Figure 4-7* shows example of a combination of scenarios of climate change and socio-economic matrix. This means some targeted area of agricultural production especially in northern part will affect from less precipitation caused by climate change impacts. The target of escaping middle-income trap in some agricultural community may not reach because of this water shortage. Policy makers and stakeholders should carefully consider and make decisions how to mitigate and adapt from this issue. Vulnerability of each sector and area including risk management with adaptation will be shown in the next section.

4.2 Vulnerability assessment



a) a scenario of climate change impact



b) a scenario of socio-economic development

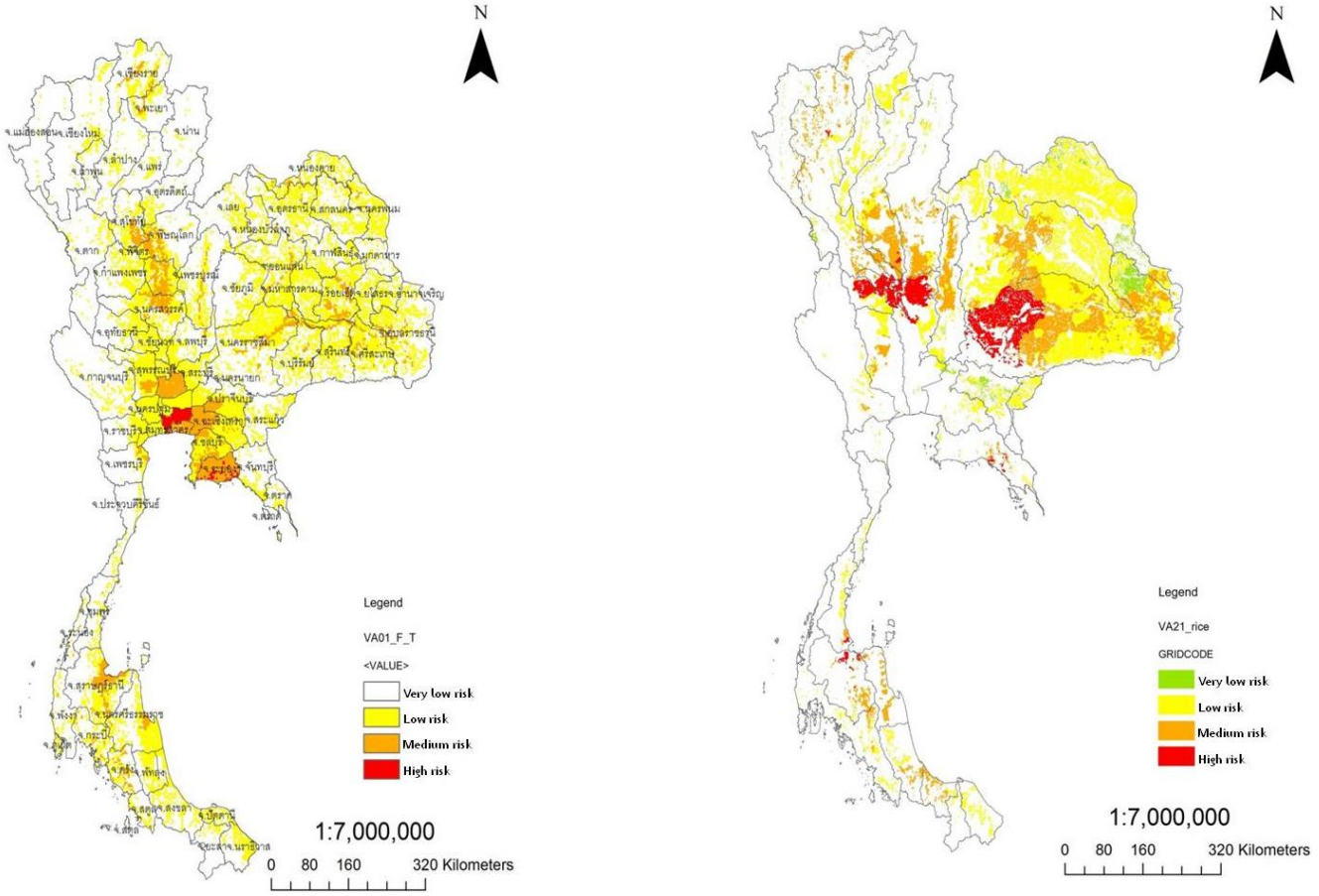
Figure 4-7 *example of a combination of scenarios of climate change and socio-economic matrix in 2030*

Vulnerability maps

Vulnerability maps were divided into 4 sectors: (1) water resources; (2) agriculture; (3) human settlement; and (4) health. *Figure 4-8* presents vulnerability map of water resources, agricultural, human settlement and health sectors, respectively. In conclusion, vulnerability level is mainly based on sector (water resources, agriculture, human settlement and health), area (region, province), time (past, present, future).

It is noted that Policy makers should carefully make decisions for each context. The option for mitigation and adaptation to climate change impacts may be different based on dimensions of sector, area and time.

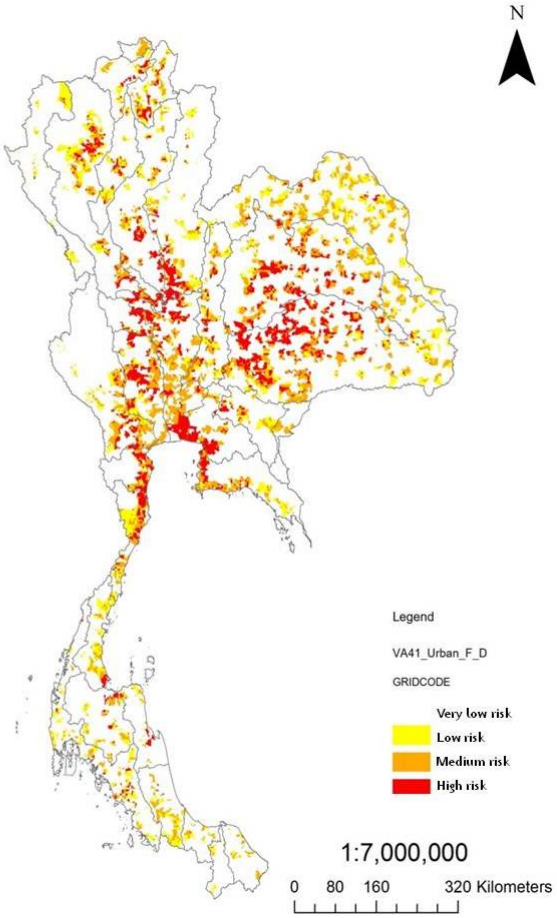
Table 4-1 to Table 4-4 conclude the vulnerability hotspots of water resources, agricultural, human settlement and health sectors, respectively.



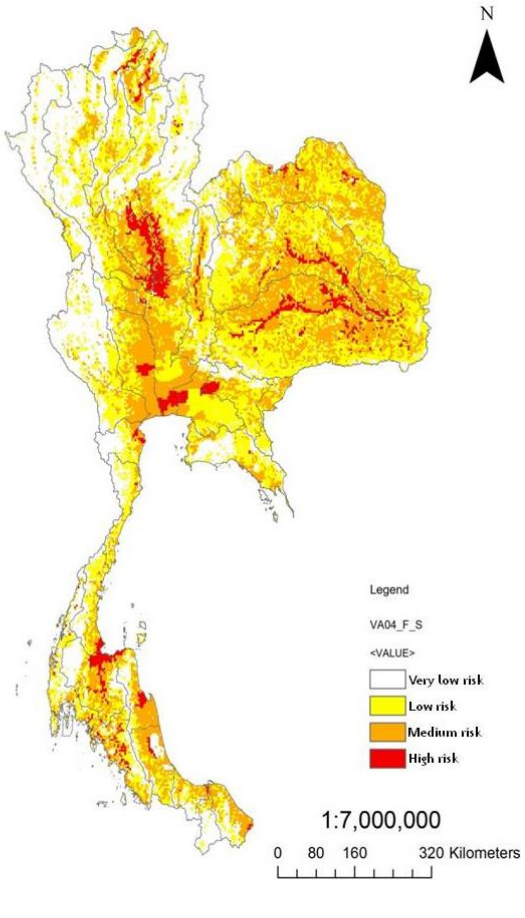
a) case of flood in all sectors of water sector

b) case of rice of agricultural sector

Figure 4-8 *Vulnerability map in case of flood and drought in each economic sector (red means high, orange means medium, yellow means low level of vulnerability)*



c) case of urban area under flood and drought



d) case of health with flood

Figure 4-8 *Vulnerability map in case of flood and drought in each economic sector (red means high, orange means medium, yellow means low level of vulnerability)*

4.3 Adaptation opportunities in key sectors

4.3.1 Disaster risk management and Adaptation

From risk assessment analysis results conducted from the impacts of the uncertainty analysis of climate change and the development of the area, counter measures can be prioritized in each sector by the severity of climate change and the level of economic development. The management approach can be divided into 4 parts. First, in case of high intensity of climate change and high economic development level, government should prioritize this area as the first priority by taking urgent measures such as structural measures, which requires investment. Second, policy makers should use structural measures that focus on protection, such as reservoirs or retention ponds that require planning in case of high levels of economic development with low impact of climate change. Third, in case of high impact of climate change and low economic development, policy makers should manage this area by non-structural measures such as system alarms, insurance systems. This areas need adaptation. Finally, in case of low impact of climate change and low economic development level, the government should use non-structural measures such as database preparation, education which requires monitoring system. All details can be shown in *Figure 4-9* ~~and Table 4-5~~.

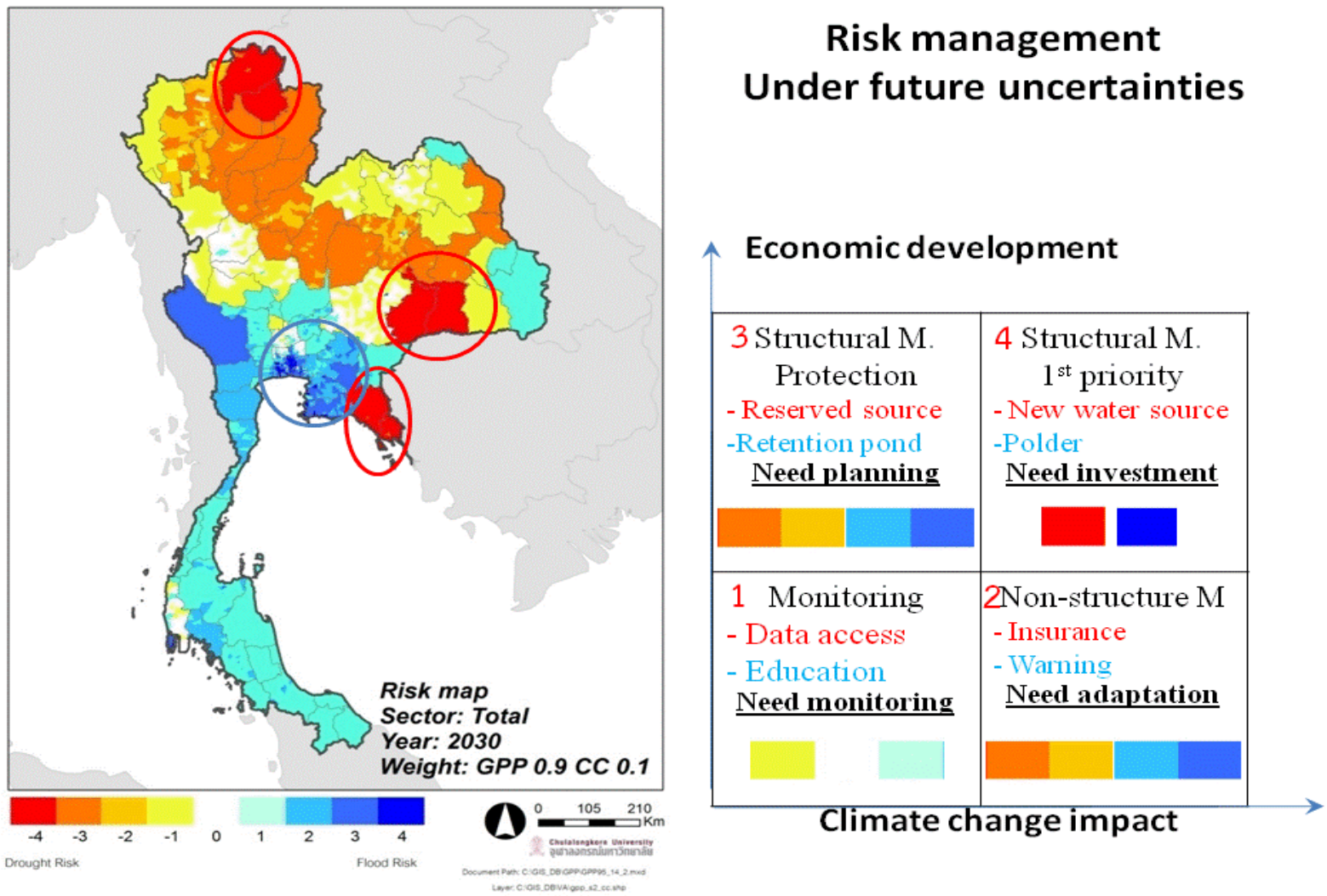


Figure 4-9 Risk management under uncertainty in the future

4.3.2 Adaptation measures implemented

In the budget year 2015, ONEP conducted the National Adaptation Plan (Phase 1) to study and assess vulnerability from climate change on six sectors (as in CC Master Plan) in Thailand as in regional and provincial levels shown in vulnerability/risk. In the budget year 2016, ONEP conducted the National Adaptation Plan (Phase 2) to collect and set the data base of the best practices in adaptation from climate change impact from both local (municipal and sub district level) and national (department and ministry) levels.

4.3.3 Samples of adaptation study cases

a) Planned cases

Sample of planned adaptation cases can be introduced via the Project GIZ-ECOSWAT, under cooperation between the Department of Water Resources and GIZ, has studied on vulnerability and adaptation measures. It has been conducted in 3pilot areas(Hubert Lohr 2015): Luab Sub-basin, HuaiSai Bat basin And the Tha Dee River basin.

The results of the Ecosystem-based adaptation are as follows (1) Luab Sub-basin: The adaptation measures are bank stabilization, forested buffer strip and forest riparian buffers, terracing and Infiltration Basin, (Figure 4-10); (2) Huai Sai Bat sub-basin: The adaptation measures are wetland restoration and Sedimentation trap, water Management, sedimentation trap at confluence of tributaries, riparian zone development and Flood plain, (Figure 4-11); (3) Tha Dee sub-basin: The adaptation measures are bank erosion control, riparian zone development, river bed enhancement, constructed wetland and Flood control with wetland, Water spreading weir with connected wetland development, (Figure 4-12).

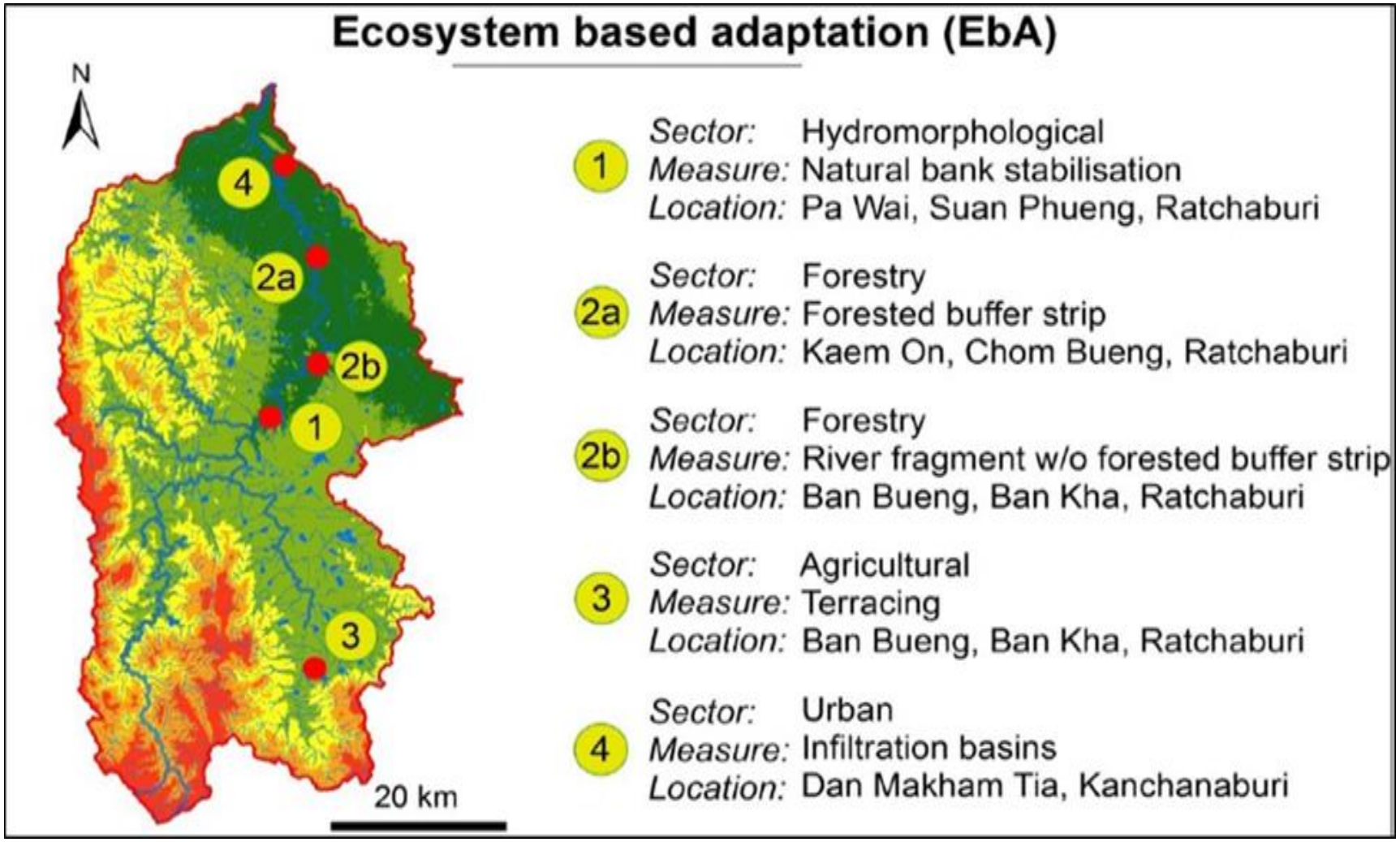


Figure 4-10 Ecosystem-based adaptation of Luab Sub-basin (Hubert Lohr 2015)

b) Unplanned case (Community Survey on Drought Adaptation)

To explore the unplanned adaptation for rice cultivation at farm level, field surveys were conducted in the Plaichumpol Irrigation Project (in the central area as a wet case) and the Lam Pao Irrigation Project (in the northeast area as a dry case) during July 2016 which is at the end of critical drought period. The questionnaires were distributed to 40 farmers in each irrigation project area and in nearby rainfed area for comparison. The interviews of irrigation engineers were also conducted to explore the adaptation scheme and decision factors at the project level.

Self adaptation in central and NE areas

4.3.6 Research and cooperation activities

Study and research activities

TRF issued the report on Thailand assessment report on climate change in 2015 and 2017 to demonstrate the existing research and knowledge on climate data, mitigation and adaptation in various sectors.

Department of Mineral Resources studied the sea level rise in past 60 years to forecast the future pattern. The results show that the past sea level was raising approximately 0.4 mm. per year. Based on this result, Bangkok and vicinities have the greater risk from (1) sea level rise affected from climate change and (2) land subsidence. This causes Government of Thailand declared this sea level rise effect to be an issue in the 20 year National Strategy.

Regional cooperation

ASEAN academic network for water, disaster management and climate change was created in 2015 under UNESCO support and there were two international conferences organized (THA 2015 and THA2017 on “Climate Change and Water & Environment Management in Monsoon Asia” in Bangkok, Thailand) to facilitate collaboration among academics in ASEAN for water, disaster management and climate change and to provide platform for networking among academics and government executives to coordinate disaster management, policies and technologies.

4.4 Conclusions and recommendations

4.4.1 Conclusions

The VA study was conducted under three scenarios of national socio-economical development, i.e., SSP1, SSP2 andSSP3. The analysis of climate change was based on daily max and min temperature and precipitation during 2016 - 2100 from three GCMs (IPSL-CM5A-MR, GFDL-CM3, and MRI-CGCM3) under RCP2.6 RCP4.5 andRCP8.5. The risk assessment was conducted from the dominant factors, i.e. climate change at present and future and socio-economic development scenarios. The coping capacity assessment used the spatial analysis techniques in four selected sectors, i.e., water, agriculture, human settlement and health. The vulnerability assessment was conducted in the selected sectors using GIS and overlapping techniques from three main parameters, i.e., damage, vulnerability and coping capacity. The disaster risk management was proposed based on the impact and risk assessment results with proposed measures to adapt with the climate change impact and possible measures in each sectors based on structural and nonstructural measures of the functions and community coping capacity.

4.4.2 Recommendations

There are constraints and gaps to cope with full assessment in vulnerability to properly cope and adapt with climate change. Thailand still need more data monitoring, research and training for young scholars with the international/regional collaboration to find joint and co benefit measures. The main issue to address gaps and constraints is to mainstream the CC planning into the normal budget planning especially in the extreme events, hot spot areas and prioritized sector as water resources, agriculture, human settlement and health as shown in previous vulnerability map. Data monitoring system for sea level rise, water and the other related sectors are required to prepare for appropriate counter measures. The climate change management tools related to financial, technical and capacity building will still be in needs.

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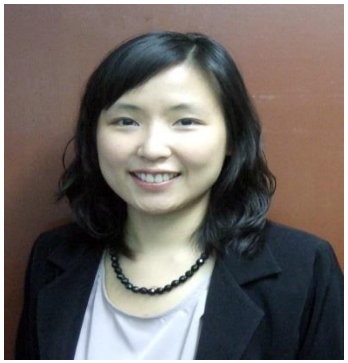

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