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Mekong ARCC Adaptation & Resilience to Climate Change

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THAILAND CLIMATE CHANGE VULNERABILITY PROFILE

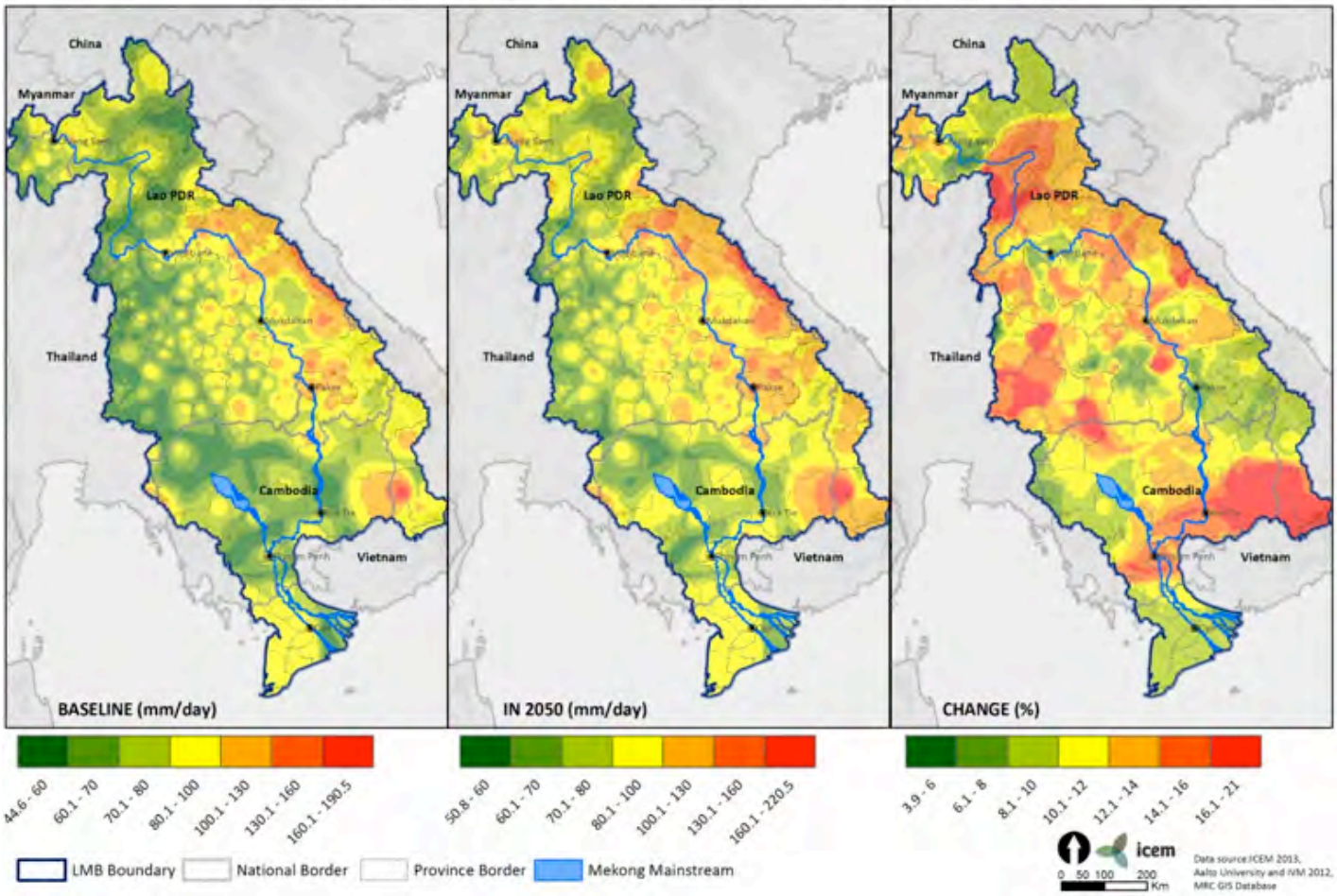
BASED ON THE USAID MEKONG ARCC CLIMATE CHANGE IMPACT AND ADAPTATION STUDY

The Thailand portion of the Lower Mekong Basin includes the northern highlands region of Chiang Rai Province and vicinity; and the northeastern region of Isan encompassing the Khorat Plateau and draining the significant Mekong tributary system of the Chi-Mun Rivers. *The results of the USAID Mekong ARCC Climate Change Impact and Adaptation Study indicate these regions will experience significant changes in rainfall patterns, and increasing temperatures throughout the year.*

Key findings include the following:

- Wet season rainfall will increase significantly in both Chiang Rai and the northeastern Isan provinces (Figure 1); increased precipitation during the traditional growing season will impact crops through increased flooding, waterlogging of soils, and higher incidence of fungal disease and pests.

Figure 1: Projected increases in peak daily precipitation in the wet season for the Lower Mekong Basin.



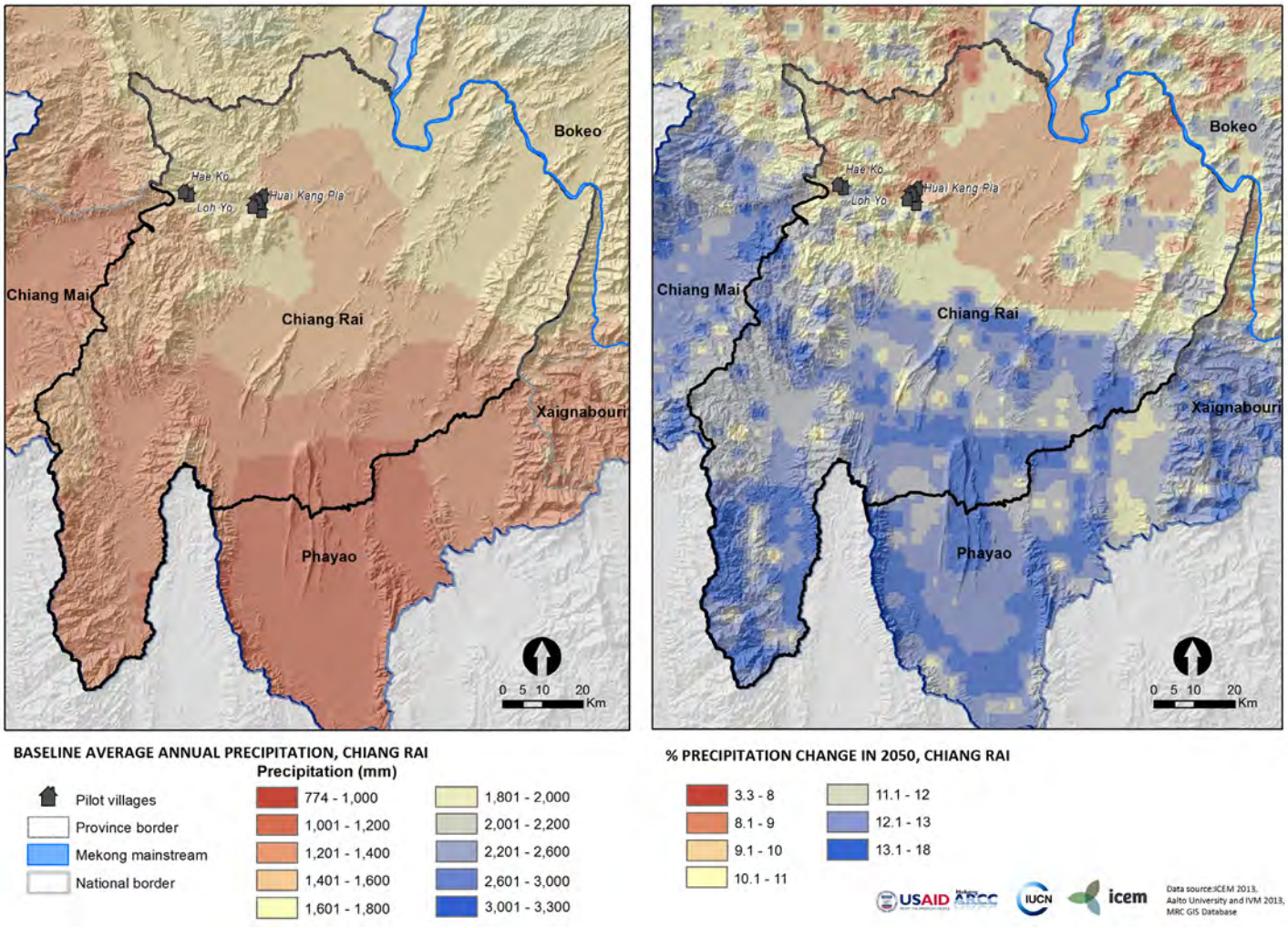
- **Large rainfall events (i.e., greater than 100 mm/day) will occur more frequently** in Thailand and throughout the LMB; in **Chiang Rai**, for example, they will occur twice as often compared to baseline conditions, resulting in more frequent flash floods and higher incidence of landslides on steeply sloped terrain throughout the province.

- **Daily maximum temperature will rise by 2°C** in the Thailand portion of the LMB; in **Sakon Nakhon** the average daily maximum temperature will rise from roughly 33°C to 35°C with much higher temperatures occurring during the more extreme years. This increase in both average and extreme temperatures will have potentially serious impacts on crops, livestock, and human health.

NORTHERN THAILAND

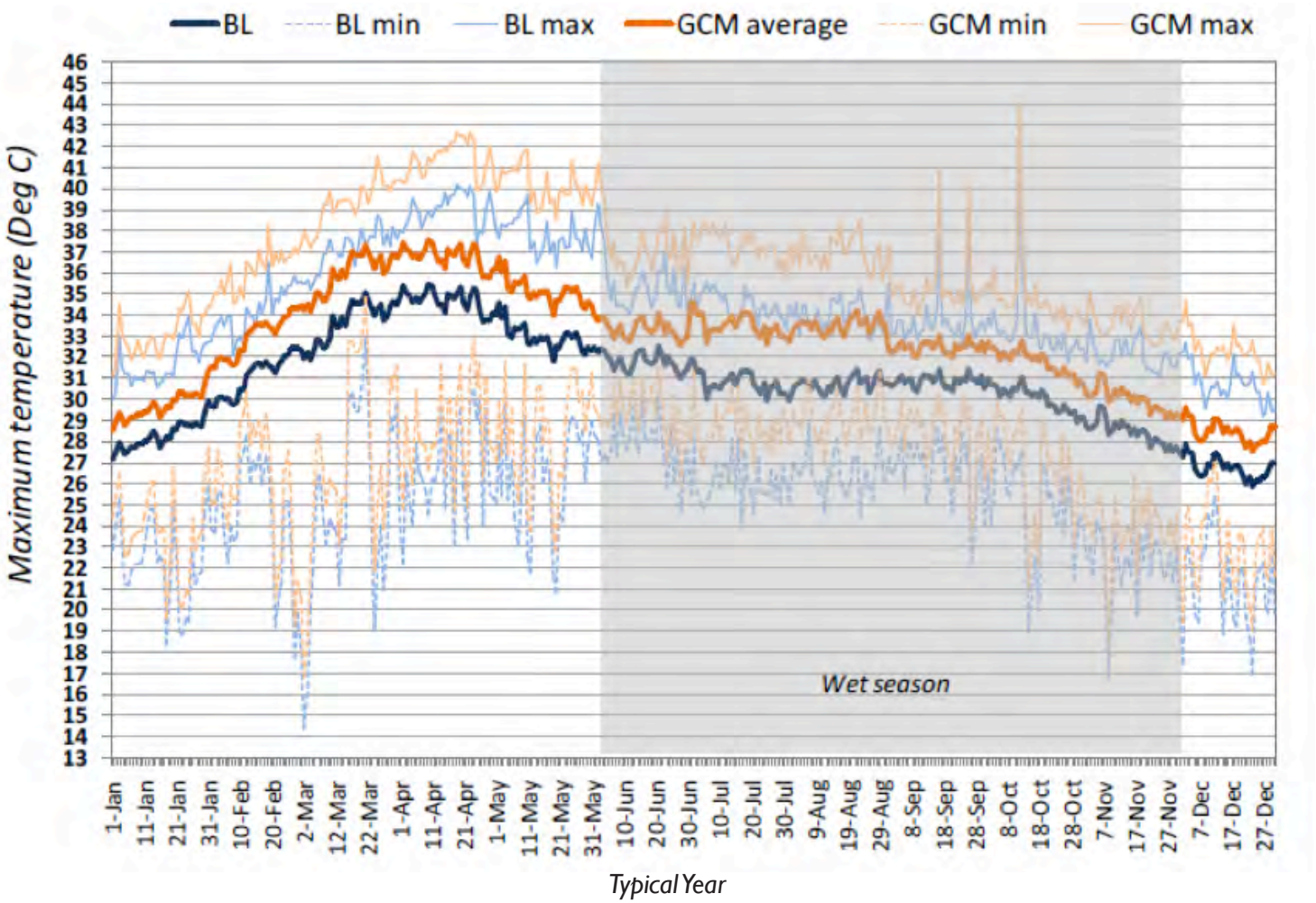
Chiang Rai Province in northern Thailand is projected to experience some of the largest relative increases in precipitation within the LMB with annual precipitation increasing by 9 to 18% (Figure 2). The greatest relative increase in precipitation is projected to occur in December with a close to 50% increase in precipitation from 11 to 16 mm/month. The greatest absolute increase will occur during the wet season month of September with over 30 mm of additional rainfall projected for that month (11% increase).

Figure 2: Chiang Rai projected change in annual average precipitation.



Daily maximum temperatures are projected to increase generally by 2°C throughout the year and up to 3°C during the wet season (Figure 3). During the growing season months of July and August, for example, daily maximum temperatures for a typical year are projected to hover around 34°C under climate change compared to 31°C under baseline conditions. During extreme years, temperatures will reach 38°C during this same period in the growing season.

Figure 3: Maximum temperature typical year time series for a lowland area in Chiang Rai. Solid lines represent average daily maximum temperatures over a 25 year period for baseline (blue) conditions and projected climate change (orange) conditions.



Climate Change Threats and Sectoral Vulnerabilities in Northern Thailand

Farming systems in northern Thailand will be affected by changes and shifts in regular climate. Specific crops that are likely to be negatively affected by climate change include lowland rice culture, lychee, and rubber due to an increase in temperature (Table 1).

Table 1: Main threats and vulnerabilities in Chiang Rai Province, Thailand

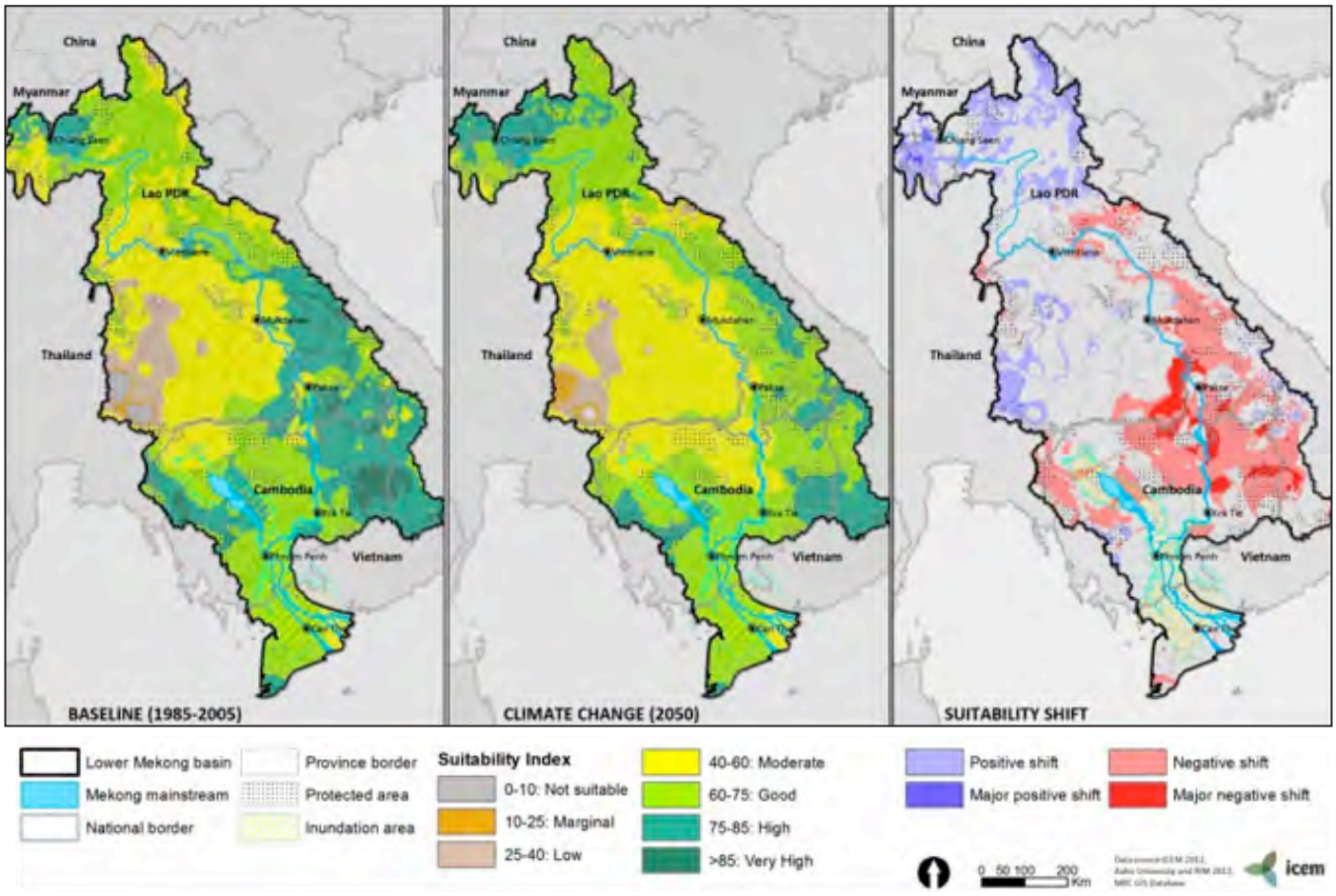
Vulnerable Crop	Threat	Impact Summary	Vulnerability
Lowland rice	Increased temperature	10 to 12% of the days will be above 35°C. Temperature above 35°C induces sterility and reduces the number of grains. High temperatures in October will affect the ripening stage when the crop has a lower temperature tolerance.	High
Lychee	Increased temperature	Lychee trees requiring temperatures below 15°C for at least 100 hours to flower during the winter months from November to December. Relative minimum temperature will increase by 20% in December by 2050.	High
Rubber	Increased temperature	Daily maximum temperature will be over the optimum of 29°C in both dry and wet seasons.	High

- The crop yield modeling conducted by the USAID Mekong ARCC project estimates a drop of 4.8% of rainfed rice yield in Chiang Rai Province. Projections based on 2006 yields estimate that ***a reduction of 4.8% in rice yield will decrease rice production by about 30,000 tonnes at the Chiang Rai province level.***

- Lychee production is one of the key products generated by the agriculture sector in northern Thailand. ***Increased temperature will affect the flowering of the lychee tree reducing productivity.*** For example, in December 2009 an average minimum temperature over 20°C, during the lychee flowering stage affected more than 50% of the crop's productivity.

- Projected effects on rubber production are variable in northern Thailand with lowland areas likely to experience decreased suitability and upland areas becoming more suitable. Rubber production will suffer, particularly in lowland areas, from increased temperature, with more days above the optimum temperature of 29°C. In the meantime, ***new areas of up to 1,000 km^2 in higher altitudes will become more suitable for rubber plantations as a result of increasing temperatures*** (Figure 4).

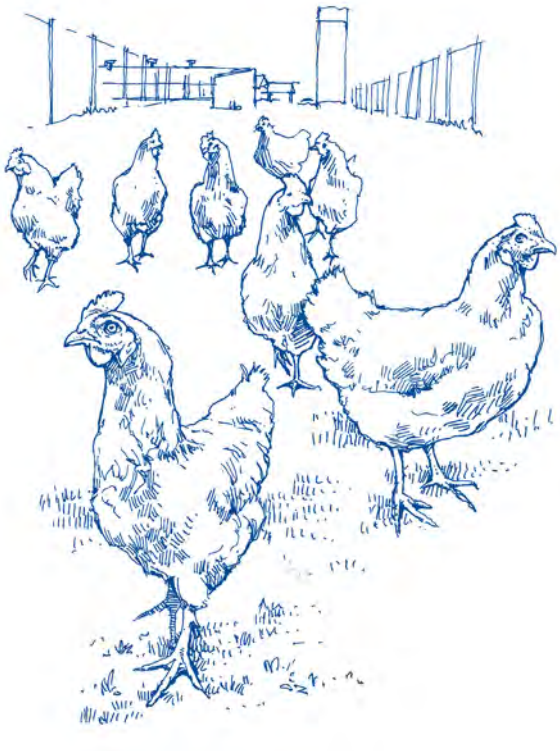
Figure 4: Baseline and 2050 land suitability for rubber in the Lower Mekong Basin.



- Northern Thailand will be increasingly affected by flash flooding and associated landslides with more days of precipitation levels above 160 mm projected. ***Flash floods will affect mostly lowland culture such as rice, maize, and soybean.*** Maize will be more negatively affected by the expected increase in temperature, as will other crops such as soybean, coffee, pineapple, and rubber.

- ***Fisheries in northern Thailand will be affected by increased temperatures and changes in rainfall patterns.*** Upland forest stream fish will be impacted by higher temperatures in the spawning season (Nov-Dec), reducing reproduction and limiting habitat suitability. Migratory white fish may be impacted by the loss of suitable refuge pools due to higher temperatures and decreased precipitation during a portion of the dry season. ***Higher temperatures will affect the water quality of aquaculture ponds while increased flash flood events will decrease stocks and impact pond infrastructure.***

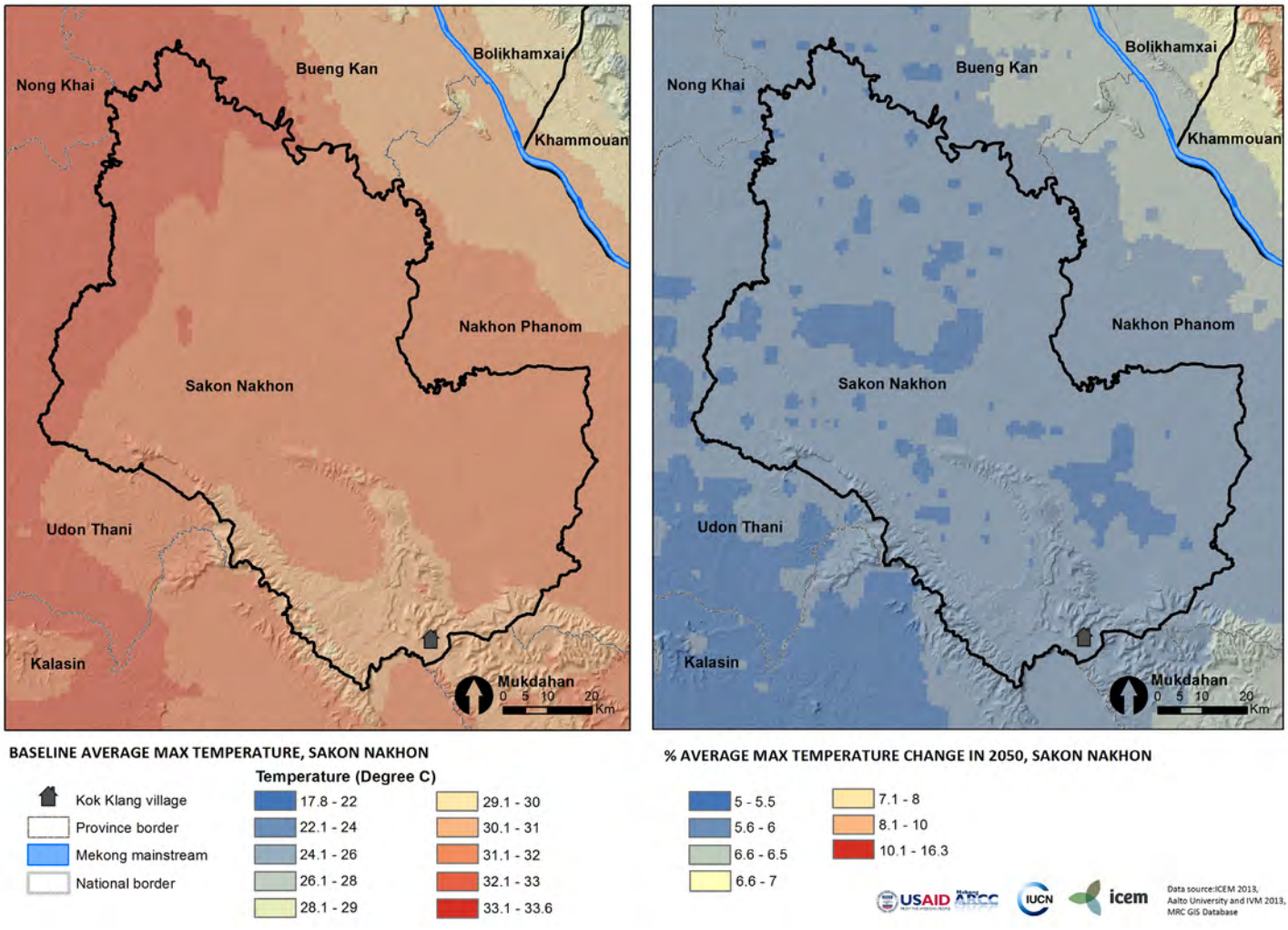
- *Livestock impacts include reduced reproduction and immunity* due to heat stress, and secondary impacts related to decreased fodder availability. ***Increasing flood events will accelerate the spread of disease and herd loss.*** Projected impacts to systems include small-scale commercial chicken and pig operations as well as smallholder cattle/buffalo systems.



NORTHEASTERN THAILAND

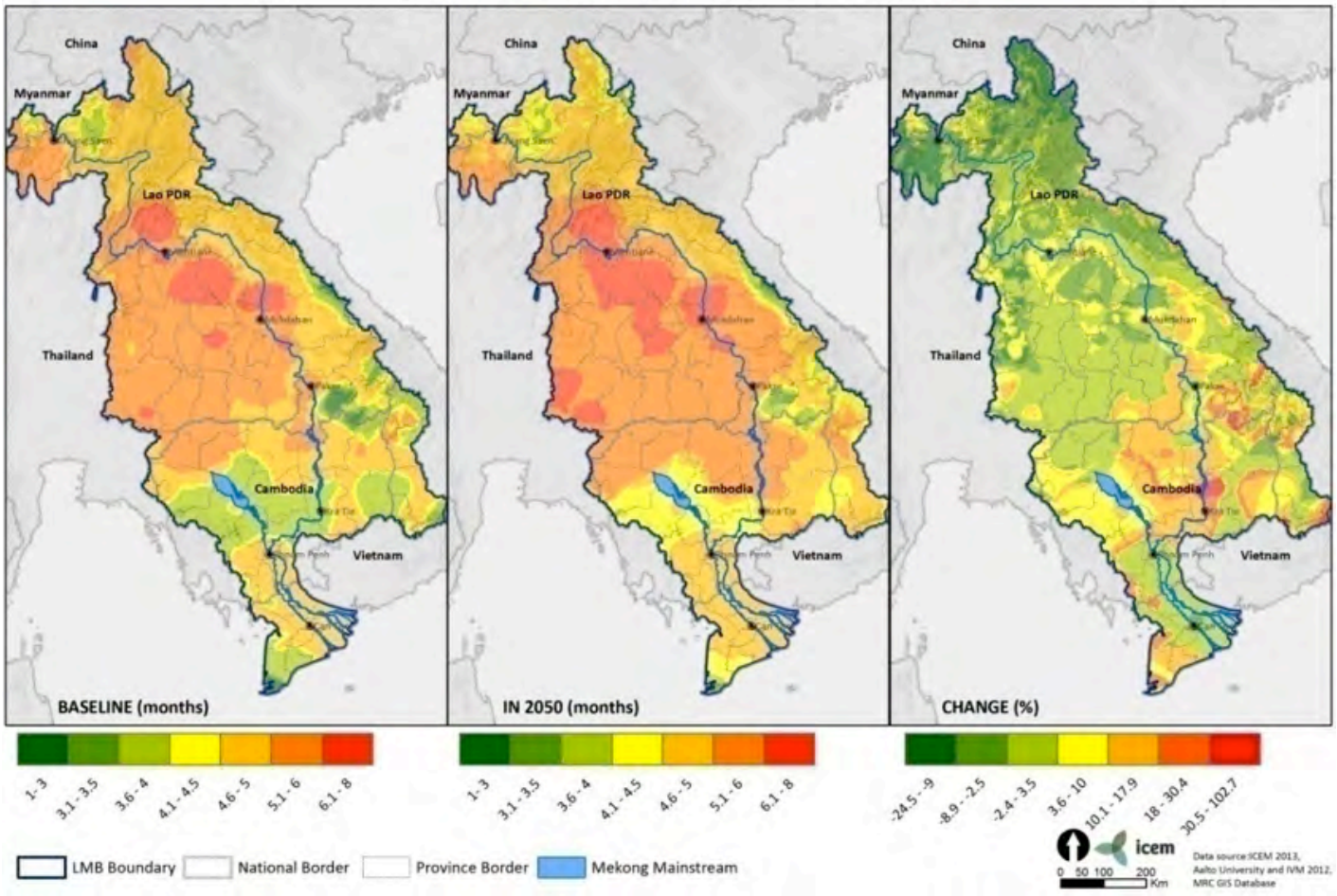
The northeastern region of Thailand historically experiences high temperatures; the average maximum temperature in Sakon Nakhon, for example, ranges from roughly 30°C in the south to roughly 34°C in the north under baseline conditions. As a result, a relatively moderate temperature increase of 5 to 6% within this province translates to about a ***2°C increase in temperatures for this area, which will result in significant stress on agricultural crops and other livelihood systems*** (Figure 5).

Figure 5: Baseline annual average maximum temperatures in Sakon Nakhon and projected percent change by 2050.



Annual rainfall will also increase dramatically in northeastern Thailand, as shown in Figure 1, resulting in both negative and positive effects for this area depending on the local landscape and microclimatic conditions. For example, some reduction in drought period may occur (Figure 6).

Figure 6: Climate change impacts on agricultural drought.



Climate Change Threats and Sectoral Vulnerabilities in Northeastern Thailand

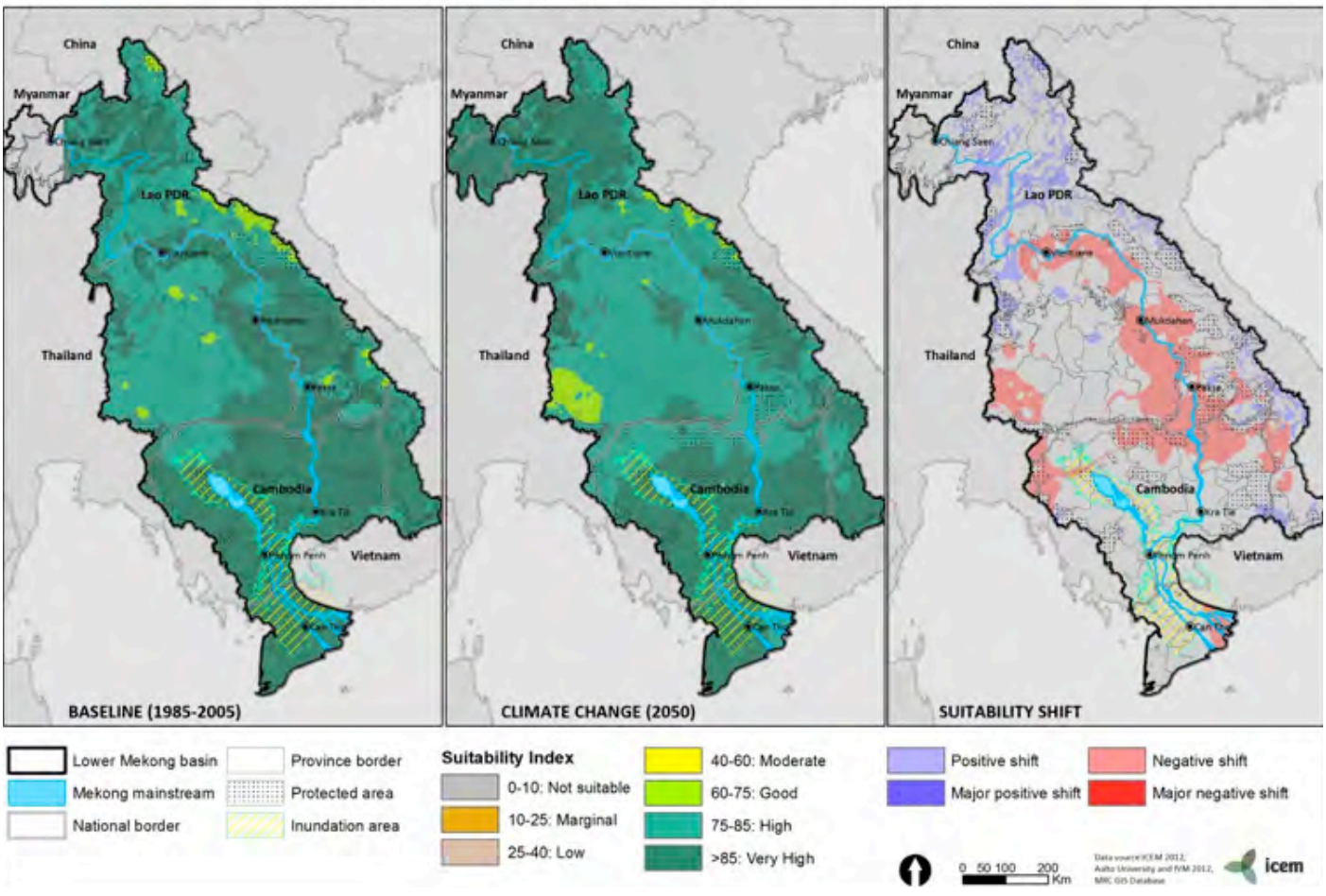
- *Increased temperature and rainfall will affect lowland rainfed rice, cassava, and rubber in northeastern Thailand* (Table 2).
- Increased precipitation may result in ***higher rainfed rice yield in the province;*** however, changes in the timing and extent of rainfall could be detrimental. For example, increased precipitation during the typically wettest month of August in Sakon Nakhon may negatively impact rice culture if it reaches above the crop's upper limit of tolerance. As lowland rainfed rice is the second largest crop in the province after sugarcane – with more than 280,000 ha cultivated – ***a decrease in rainfed rice productivity has the potential to significantly affect the food security of farmers throughout the province.***
- Rainfed crops in general are expected to be subjected to an increasing number of days with abundant precipitation. ***Excess rainfall, especially at the harvest time of rice, maize, or soybean, may affect yields and the occurrence of pests and diseases.***
- An increase in rainfall is projected to ***reduce the suitability of cassava.*** Waterlogging and the increased presence of pests and fungal disease will lead to lower rates of production. Cassava has a low tolerance to waterlogging and the increase in rainfall in the region will affect the crop's productivity, as projected in the climate suitability model (Figure 7). The vulnerability of the crop will also depend on the location of the plots (lowlands, plains, or hills) and the soil type present because these factors will determine waterlogging duration.
- *Increased temperatures will be a threat to rubber plantations in northeastern Thailand* with daily maximum temperatures frequently exceeding the maximum optimal temperature for growth from March to May in Sakon Nakhon, for example.

Table 2: Main threats and vulnerability for crops in Sakon Nakhon, Thailand

Vulnerable Crop	Threat	Impact Summary	Vulnerability
Lowland rice	Increased temperature	Increasing frequency of temperatures above 35°C will impact the productivity of lowland rice.	High
Cassava	Increased precipitation	Total precipitation during the growth cycle will approach the upper limit for optimal growing conditions; this may decrease suitability within the province.	High
	Flooding	Increased rainfall from May to November may increase flood intensity and frequency.	High
Rubber	Increased temperature	Average maximum temperature will be above the optimum of 27°C and 28°C for rubber.	High

- *Sugarcane is relatively resistant to high temperatures and is considered a less vulnerable crop compared to rice or cassava*. Sugarcane can endure waterlogging. However, since the exposure level for both threats will be high, productivity may be affected. Increased water consumption due to higher temperatures in the late dry season or during droughts may be an issue that generates conflict between different water users.
- Livestock may see *reduced reproduction rates and immunity due to heat stress, and increased spread of disease and herd loss due to increased flood events*.

Figure 7: Baseline and 2050 land suitability of cassava in the Lower Mekong Basin.



POTENTIAL ADAPTATION OPTIONS

Agriculture

Adapting the agriculture sector to climate change in both the northern and northeastern regions of Thailand will involve a mix of strategies, possibly including:

- Strengthening the resilience of both rainfed and irrigated rice-based systems through adoption of improved varieties and better management practices and reducing vulnerability to extreme climate events. This could include the use of specific varieties to mitigate the impact of flooding and extreme heat, as well as the shifting of cropping calendars to avoid harvest during periods of high rainfall as is projected for August.
- Improving soil fertility and soil management of both cash and subsistence systems such as improved erosion control techniques and intercropping.
- Promoting agricultural diversification and integrated farming systems to mitigate current trends of reliance on monocultures.

Livestock

The improvement of livestock development and resilience to climate change falls into five broad strategies:

- **Nutrition:** The quality and quantity of feed production, storage, and the nutritional balance of diets needs to be increased to reduce undernourishment.
- **Disease resistance:** Internal resistance needs to increase to reduce the threat of disease through improvement of nutritional status, body condition, and vaccination levels. It also requires improved biosecurity to prevent the movement of diseases onto and off farms and to reduce the risk of pathogens entering the herd or flock.
- **Housing:** Location and design should maximize natural ventilation and minimize exposure to extreme events.
- **Production planning and offtake:** Reducing inbreeding, earlier weaning, and strategic offtake plans can increase resilience of livestock systems.
- **Access to markets:** Improved access to input and output markets and producer organizations would reduce input costs, increase prices received, and reduce price volatility.

Fisheries

Due to its diversity of systems, scales of production, inherent manageability, and control of environments, **aquaculture** potentially offers more scope for adaptation to climate change than capture fisheries. The creation of **small on-farm ponds**, as promoted by Thailand's King Bhumibol for several decades, can be viewed as an excellent local climate change adaptation strategy for a wide range of farming activities that are reliant on rainfall. These multi-use ponds will benefit small-scale aquaculture and allow the trapping of wild fish from the local capture fisheries, thereby helping rural households meet their food security requirements. Other strategies for the fisheries sector include:

- Pond aeration to mitigate the effects of increased temperature;
- On-site water storage to reduce the risks of reduced water availability during the dry season;
- Strengthening of embankments to protect against flooding will be necessary for ponds in many areas; *and*
- Diversion canals may also have to be dug to channel water away from vulnerable pond areas.

Regardless of the livelihood sector, successful adaptation will require flexibility and a diversity of approaches to adapt to shifting conditions.

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