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About this Fact Sheet series

This fact sheet series aims to foster dialogue between scientists, practitioners, and the public. It focuses thematically on the complex relationship between migration, environmental change, and adaptation. It aims to disseminate scientific results, news, and other interesting information in a brief and accessible way.

It is one product of the publication portfolio of the research project "Building resilience through translocality. Climate change, migration and social resilience of rural communities in Thailand" (TransRe), which is located at the Department of Geography at the University of Bonn. To learn more visit:

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Climate Change and its impact in Thailand

A short overview on actual and potential impacts of the changing climate in Southeast Asia

by Sopon Naruchaikusol, Department of Geography, University of Bonn

Thailand is particularly vulnerable to droughts and floods and has experienced several extreme climatic events in the recent past (CHRR, 2005).

In 2011, Thailand was underwater: more than one million people were affected by severe flooding for several weeks as a result of persistent rainfall (World Bank, 2011). In 2015-16 Thailand has been experiencing one of the worst droughts in decades, leading to critical low levels of water reservoirs countrywide (NHC, 2016). Even though future climate change scenarios are still being debated, it is likely that Thailand will be disproportionately affected by the consequences of climate change.

TransRe factsheet No. 2 provides an overview of a) past climate trends, b) future climate scenarios, and c) its expected impacts.

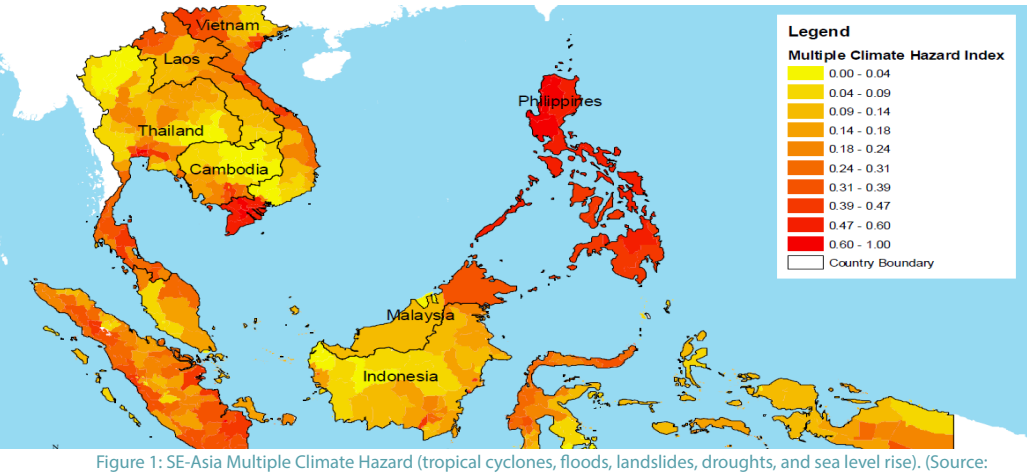

Figure 1: SE-Asia Multiple Climate Hazard (tropical cyclones, floods, landslides, droughts, and sea level rise). (Source: Yusuf and Francisco, 2009)

Background on Thailand

Thailand is located in the heart of the South-East Asian peninsula neighbouring Cambodia, Laos, Myanmar and Malaysia. With a gross national income (GNI) per capita of THB186,276 or EUR 4,657 in 2014 (NESDB, 2016), it is categorized as an upper-middle income economy by the World Bank. Thailand has an above-average human development index in East Asia and the Pacific. With an index of 0.726 it is ranked as 93 out of 187 countries (UNDP, 2015). Thailand has experienced far-reaching socio-economic transformation in the past 50 years. The Thai economy had, until the 1970s, been mainly based on agricultural production. Since the 1980s, industrial production and the service sector have greatly expanded. While the agricultural sector is contributing 11.47 percent of the gross national product in 2014, it still employs total 12.27 million people or 31.84 percent of the workforce in 2015 (Bank of Thailand, 2016). Agricultural production, which is dominated by small-scale family farms engaged in the cultivation of cash crops, has experienced continuous decline over the past 30 years due to declining access to natural resources (UNDP, 2010). Rural households therefore are seeking other off-farm income sources.

"Climate change in Thailand is expected to have severe impacts which will lead to various risks to Thailand's society and challenge the nation's development goals(...). For example: regular and severe floods in low lying areas, agriculture products loss due to climate and rainfall variability, more challenges in water resource management due to a warmer and longer dry season" (Sethasirot et al., 2015)

Past climate trends

Temperature

» **Rising temperature:** Average annual temperatures have significantly risen by about 0.95° C between 1955 and 2009 (Thailand Meteorological Department, 2011). This is well above the average world temperature increase of 0.69° C (TRF, 2011). The annual highest, average and lowest temperatures have also been increasing by about 0.86°, 0.95° and 1.45° respectively over the past 55 years. The increase has been especially significant since 1994 (Climatological Center, 2010).

» **Increasing additional number of warm days and nights:** The number of warm days and nights (>35° and >25° Celsius) has increased between 1970 – 2006, with considerable regional differences: North (12 days), Northeast (20 days), Central (27 days), East (23 days) and South (35 days) (Limsakul et al., 2011).

Precipitation

» **No significant change of rainfall volume:** The total amount of rainfall between 1955 and 2014 did not change significantly (Limsakul & Singhruck, 2016).

» **Regional diverging trends in rainfall volume:** In Central and East Thailand, decreases in total rainfall can be observed; while there has been increasing rainfall in the Northeast and Gulf region as well as the Bangkok metropolitan area. (Limsakul & Singhruck, 2016).

» **Decadal variations in rainfall volume are linked to El Niño –** Southern Oscillation (ENSO) (Limsakul & Singhruck, 2016)

» **Seasonal shifts in rainy volume:** There has been a significant increase of rainfall between November and April and a decrease between May and October (Limsakul & Singhruck 2016)

» **Decreasing number of rainy days** by 1 day per decade (Limsakul & Singhruck, 2016)

» **More intense rain:** the number of intense raining days is increasing (MOAC, 2012).

» **Changing rainfall patterns:** Normally rain falls during the monsoon season (May – September), which has been partly disrupted especially between 2006 and 2010, with longer dry spells in the middle of the rainy season and more intense precipitation (Jarupongsakul, 2011).

Sea Level Rise

» **Sea level rise:** The sea level in the gulf of Thailand has risen about 3 - 5 mm per year from 1993 – 2008 (TRF, 2011), compared to a global average of 1.7 (±0.5) mm per year (Thammasart University Research and Consultancy Institute, 2009).

» **Combined effect with land subsidence:** The effects of sea level rise overlaid with land subsidence, may mean up to 25 mm per year of net sea level rise in some areas such as the larger Bangkok metropolitan area or the river mouths in the gulf of Thailand (Naeije et al., 2012).

Diminishing water levels in Pasak Chonlasit Dam (Lopburi province), Thailand in 2015

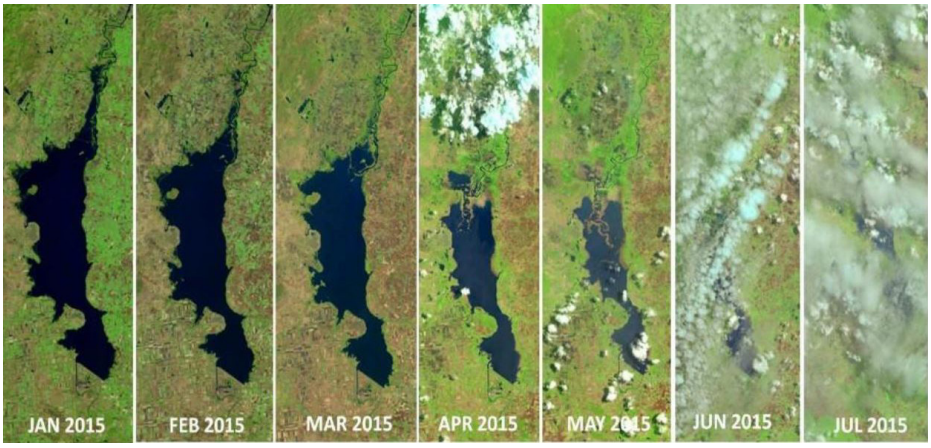

Figure 2: Diminishing water levels in Pasak Chonlasit Dam, Lopburi province, Thailand in 2015. (Source: GISTDA, 2015)

Although not necessarily labeled as internal migration, the Thai population proves to be highly mobile and a good portion engages in manifold patterns of movements within the country. Common migrant streams link for instance rural and urban areas, without domestic migration being exclusively urban-bound, though. People's movements also include rural areas as destinations and are often non-permanent anyway. In general, there is a high level of diversity regarding types of (domestic) migration in Thailand. However, exact and meaningful numbers are available to a limited extent only.

The (forthcoming) fact sheet will give an overview on the data that are available. Sources of those data will be reviewed in terms of modes of data generation and their significance in depicting realities of human mobility in Thailand. Moreover, general patterns of domestic migration as well as implications for households, for connections between migrating and non-migrating household members, and for livelihoods in rural areas will be outlined.

Extreme weather events

- **Increasing extreme precipitation events:** Long dry spells and flash flood events have become more frequent and intense (Limjirakan et al., 2010).
- **More intense tropical storms:** The frequency and intensity of tropical storms has increased, as well as the frequency of hailstorms during change of seasons (from rainy to winter and winter to summer) (Thailand Meteorological Department, 2011).
- **Unpredictable cold spells:** Between 2000 and 2010, the Northeast monsoon (cold wind) became stronger and more variate (Jarupongsakul, 2011).

"Farmers in Thailand have adopted adaptation practices as well as intercropping, diversified farming, and variation of crop rotation patterns"
(ADB 2009: 101)

Future scenarios of climate change

The Southeast Asia START Regional Center (2006) has developed a regional climate change scenario. It predicts an increase of mean annual temperature by about 1-2° C in Southeast Asia, as well as a summer season (defined as having mean daily temperatures above 33° C) lengthened by 2-3 weeks and a shorter winter season (mean daily temperatures below 15° C) under the climate conditions at CO2 concentration of 720 ppm. Chinvanno et al. (2009) created a localized model for Thailand and the neighboring countries with two different CO2 emission schemes (SRES A2 and B2 scenarios) for the future climate projection between 2010 - 2100.

Temperature

- **Increasing temperature:** Major climate models indicate a temperature rise for the whole country of Thailand, particularly the central plain and lower North-eastern region. Projections for the increase of mean temperatures vary between 0.4° and 4.0° C in the next 100 years (TRF, 2011), rising from an average of 29°-33° C in the early 21st century to 33°-35° C until the year 2100.
- **More warm days:** The number of warm days (>35° C daily mean temperature) per year is expected to increase, particularly in the Chao Phraya River basin, central plain, and lower Northern regions, meaning an extension of the summer/hot period (with maximum daily temperature > 35°C) of 2-3 months on average. The Northeastern, Central, and Southern regions are expected to have hot periods extended to 5 - 6 months, by the end of the century, while the Northern region is expected to extend to 3 - 4 months (Limsakul et al., 2011).
- **Fewer cold days:** The duration of the cold period (with cold days, temperature < 16° C) in the North and Northeast will shorten after mid-century from currently 2 - 2.5 months to 1 - 2.5 months (Limsakul et al., 2011).

In Thailand, an increase of warm days and a decrease of cold days is expected

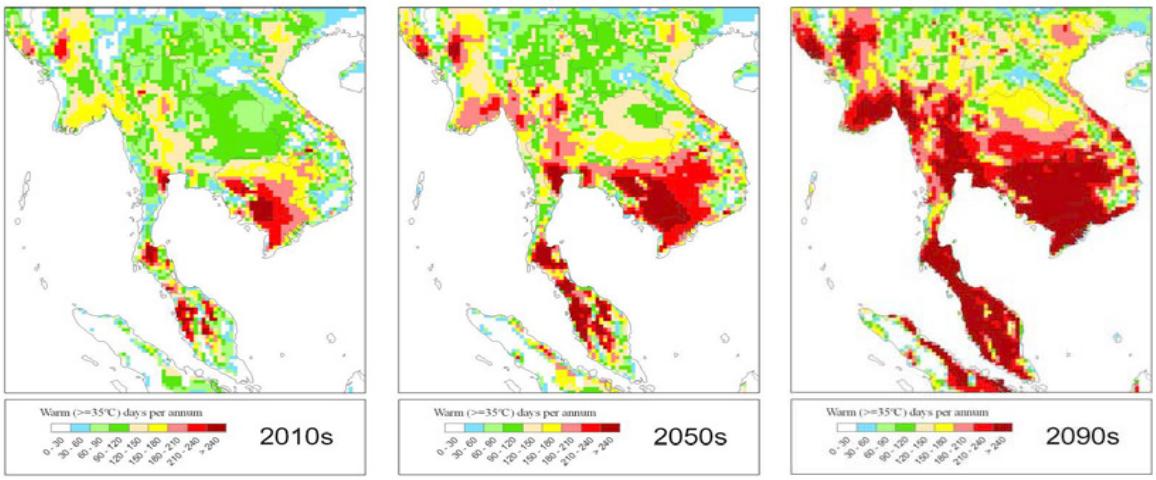

Figure 3: Expected Increase of warm days per year in 2010s, 2050s and 2090s. (Source: Chinvanno et al., 2009)

Precipitation

» **Higher rainfall variability:** Rainfall will have higher variability. In the beginning of the century (2010s), Thailand has encountered increasing rainfall variability and fluctuation. From the middle of the century (>2050s), the total annual precipitation is expected to increase, especially in the areas near the Mekong River as well as the Southern region. In Western Thailand, precipitation is expected to remain almost unchanged.

» Average temperature and humidity are expected to rise especially in the rainy season.

» The intensity (expressed in wind speed) of the Southwest monsoon (May - October) coming from the Andaman Sea is expected to increase about 3 - 5 percent by 2100s.

Sea Level Rise

» The mean sea level of the Andaman coast in Krabi province is expected to rise by about 1 cm annually over the next 25 years, with shoreline shifts between 10 - 35 m (Southeast Asia START Regional Center and World Wildlife Fund, 2008).

Socio-economic impacts of climate change

Impact on rural areas:

Around 32 percent of Thailand's population currently relies on agriculture for their livelihood, with 12.27 million people in 2015 working in the agricultural sector (Bank of Thailand, 2016). Agricultural products are highly dependent on specific climate conditions. Between 1989 and 2010 droughts and floods affected between 2 and 27 percent of total agriculture lands and resulted in crop losses ranging from THB1,000 to 17,000 million (EUR25 to 425 million) per annum (MOAC, 2012).

» The floods of 2011 highly impacted 76 out of Thailand's 77 provinces, affecting 10.56 million rais of land (1.69 million hectares). Total loss in agriculture, livestock and fishery amounted to THB 75,725 million (EUR 1.893 billion) (see case study).

» Rice productivity is expected also to be influenced by changing precipitation and temperature levels which are associated with occurrences of pests and diseases and (especially in the case of night time temperatures) declining crop yields (AIT-UNEP RRC.AP, 2010; Peng et al. 2004). For irrigated rice farming cold spells can reduce rice productivity during the germination period.

» In upland areas, an increase of heavy rain together with changing land use, particularly deforestation can cause serious landslides, flash floods as well as severe flooding in lowland areas. Roads and bridges are often blocked and cut off after heavy rain, seriously affecting rural economies.

» The 2007 drought created economic loss of about THB1,520 million (EUR38 million) from agriculture and livestock productivity loss, burnt forest biomass and livelihood impact (DDPM, 2015).

» The National Water Resources Committee reported that Thailand is experiencing the worst drought from the past 50 years in 2015/2016. In January 2016 about 60 percent of the country was affected, especially in the Central and Northeastern regions. (ONEP, 2016).

Bird eyes view: Thailand Floods in 2011 in Bangkok and surrounding areas damaged industrial estates and agricultural areas

Summary of Damage and Cost by Droughts and Floods over the past 20 Years

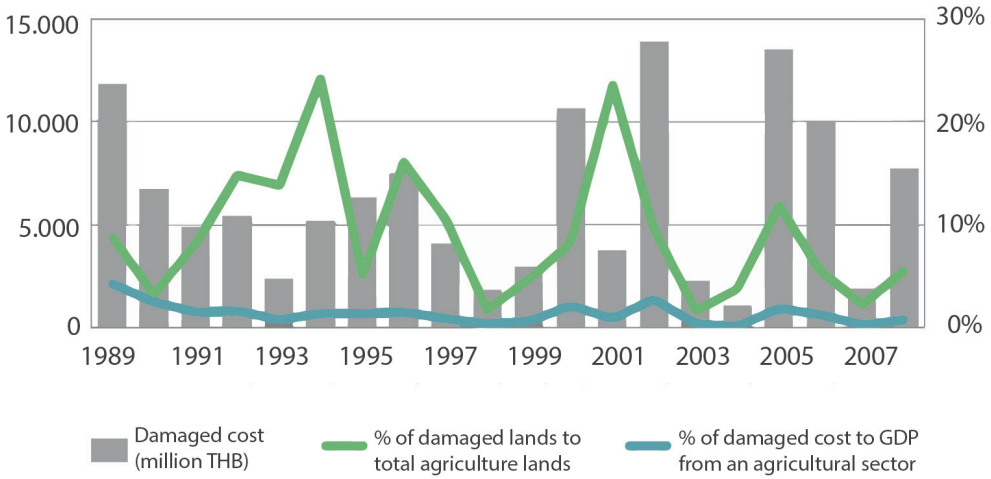

Figure 4: Summary of Damage and Cost by Droughts and Floods over the past 20 Years. (Source: Sonkranok et al., 2010)

Impact on urban areas:

» In urban areas, especially in Bangkok, severe flooding occurred in 1995 and 2011.

» Severe droughts in 2014 and 2015 posed massive challenges to Bangkok's freshwater supply. Several waterworks stations stopped their operation, due to lack of freshwater and problems with salt water intrusion (Metropolitan Waterworks Authority, 2015).

» The urban heat island effect will intensify rising temperature in large urban agglomerations such as Bangkok particularly during the dry season (Arifwidodo and Tanaka, 2015) with effects on public health, labour productivity and energy consumption (Marks, 2011).

Impact on coastal areas:

The IPCC (2007) highlights the impacts of climate change on coastal areas in Asia including Thailand, which are especially at risk due to high coastal population densities and declining ecosystem services and functions. Impacts on coastal areas are important for Thailand, with 23 out of 73 provinces covering a total of 3,148 km of coastline.

» Sea level rise increases the chance of storm surges or cyclone intensity, and river-basin flooding could have serious impact on coastal cities, including Bangkok. Also many important tourist destinations are in low-lying coastal areas (AIT-UNEP RRC.AP, 2010).

» Around 830 km of coastline are suffering from coastal erosion, especially in the upper gulf of Thailand (Krainara, 2013).

» Mangrove forests on the seaward side of Krabi's coastline may be severely damaged by about 18 m of sea level rise over the next 25 years (Southeast Asia START Regional Center and World Wildlife Fund, 2008)

» A sea level rise of 1 m would impact large parts of Thailands low lying coastal areas, affecting about 1.4 million people on more than 4,000 km2 of land (Thammasart University Research and Consultancy Institute, 2009).

"We always have more water in the rainy season. But if we don't have integrated water management, we will face this problem again next year." [...]"We've hurt nature for a long time, and right now it seems that nature wants to pay us back."
(Capt. Somsak Khaosuwan, director of the Thailand National Disaster Warning Center)

CASE STUDY | The 2011 flood in Thailand

by Anja Lamche

The Thai saying "escape a tiger, meet a crocodile" (English translation: "out of the frying pan, into the fire") came to life when in 2010 the country was hit by a severe drought (Marks, 2011) and then shattered by a massive flood between August and December 2011 (Okazumi and Nakasu, 2015).

The flood's impacts on the country were manifold, as they claimed over 740 lives, affected over 13.6 million people and caused over US$ 40 billion in loss and damages (Abe and Ye, 2013; Kaewkitipong et al., 2012; Okazumi and Nakasu, 2015). The flooding interrupted the supply chains of many economic goods, especially hitting the automobile sector and the computer industry, affecting the latter through a substantial shortage of microchips, leading to a so-called "chain reaction", which affected the whole industry (Abe and Ye, 2013; Okazumi and Nakasu, 2015). The media quickly agreed upon a sole culprit: *climate change*. This claim is partially supported by the latest IPCC report (Hijioka et al., 2014) as well as by announcements from the UN Office for Disaster Risk Reduction, stating that over 80 percent of all disaster events nowadays are climate-related (Okazumi and Nakasu, 2015). What has been less reported, however, are man-made factors that shaped the impact of the flood. Immediate flood mitigation measures were controversial. Long-term political decisions (e.g. investment policies or taxation deregulations) had led to the settlement of companies in flood-prone areas. In addition, there was a lack of investment in more water-resilient infrastructure as well as deficient forecasting and communication concerning floods and evacuation planning (Okazumi and Nakasu, 2015). Political will and increasing institutional capacity are essential in preventing disasters in this context (Marks 2011). To hold climate change alone responsible would be like the Thai proverb says: "turning the ears to the paddy field, whilst turning the eyes to the plantation" (or, as the English saying goes: "turning a blind eye").

- **Newspaper** | As Thailand Floods Spread, Experts Blame Officials, Not Rains (The New York Times) URL: http://nyti.ms/1VTqAs6
- **Blog** | Thailand's floods: complex political and geographical factors behind the crisis (iied) URL: http://bit.ly/1SmFL7K
- **Video** | Flood URL http://bit.ly/1V549j0
- **Scientific paper** | Thailand Floods 2011: Causes and Prospects from an Insurence Perspective (Meehan 2012) URL: http://stanford.io/1WXPKUX
- **Scientific poster** | The 2011 Thailand flood: climate causes and return periods (Gale & Saunders) URL: http://bit.ly/1RKMUxV
- **Pictures in a timeline** | Flooding devastates Thailand (The Washington Post) URL: http://wapo.st/21TC1j1

"With climate change it is likely that there will be more natural disasters and extreme weather events; this is not unique to Thailand and can be expected all over the world. "
(Ms. Waraporn Hirunwatsiri, Environmental Specialist)

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About the autor

Sopon Naruchaikusol is a research associate/PhD candidate at the University of Bonn, where he works for the TransRe Project. He has over ten years of professional experience on issues relating to climate change, adaptation, migration, disaster risk management, natural resources management and environmental economics. He has previously worked at the Stockholm Environment Institute, IUCN – The World Conservation Union, and Kasetsart University, among others.

EMAIL: snarucha@uni-bonn.de
HOMEPAGE: www.transre.org

About the project

Our research group "Environment. Migration. Resilience" offers a fresh perspective on the environment-migration nexus. It starts from the assumption that, regardless of the accuracy of the projections of future environmental changes, migration is already occuring and will continue to be a major dynamic of global change. We seek to interrogate how migration-induced translocal relations alter the environment and the capacity to deal with environmental changes in the places of origin of migrants.

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EDITOR IN CHIEF	Prof. Patrick Sakdapolrak
EDITOR	Harald Sterly
CONTRIBUTORS	Sopon Naruchaikusol, Anja Lamche
PHOTOGRAPHY	Prachanart Viriyaraks; L. Porst; S. Naruchaikusol; NIST School; DVIDSHUB
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