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A holistic approach to climate change vulnerability and adaptation assessment: Pilot study in Thailand

Suppakorn Chinvanno

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Preface

During the last three years, the Regional Climate Change Adaptation Knowledge Platform (AKP) has worked towards building bridges between existing knowledge on adaptation to climate change and the governments, agencies and communities that need this knowledge to inform their adaptation to the impacts of climate change, while working for poverty reduction and a sustainable environment. AKP's work has been carried out following three key objectives:

1. Promoting dialogue and improving the exchange of knowledge, information and methods within and between countries on climate change adaptation, and linking existing and emerging networks and initiatives.

2. Generating new climate change adaptation knowledge, promoting understanding and providing guidance relevant to the development and implementation of national and regional climate change adaptation policy, plans and processes focused on reducing vulnerability and strengthening the resilience of the poor and women: the most vulnerable segments of society in most Asian countries.

3. Synthesizing existing and new climate change adaptation knowledge and facilitating its application in sustainable development and poverty reduction practices at the local, national and regional levels.

This publication is a result of these objectives. AKP supported thirteen countries in the Asian region in strengthening their capabilities to introduce effective adaptation measures. This includes undertaking activities at the national, sub-national and local levels to create enabling policy, regulatory, planning and budgeting environments. In each country, the platform facilitated adaptation action and strengthened adaptive capacity.

AKP is implemented by the Stockholm Environment Institute (SEI), AIT's Regional Resource Centre for Asia and the Pacific (AIT RRCAP), and the United Nations Environment Program Regional Office for Asia and the Pacific (UNEP ROAP) with funding provided by the Swedish Government through the Royal Swedish Embassy in Bangkok and the Swedish International Development Agency (Sida). The former Swedish Environmental Secretariat for Asia (SENSA) was also instrumental in setting up and supporting AKP.

Thailand is one of the thirteen countries supported by AKP. This publication highlights the insights gained from the implementation of activities in Thailand in partnership with SEA START.

AKP's publications provide insights on adaptation in the region. A consolidated initiative, known as the Asia Pacific Adaptation Network (APAN), has been established and will be fully implemented starting in 2013. Its ultimate objective is to assist the region in building the climate resilience of human systems, ecosystems and economies through the mobilization of knowledge and best practices, enhanced institutional capacity, informed decision making processes, and facilitated access to finance and technologies.

The outcomes of AKP have been made possible by the active participation of partners and various stakeholders. SEI acknowledges the editorial assistance provided by Marion Davis and Skye Turner-Walker. SEI also expresses heartfelt thanks to John Soussan, Lailai Li, Kai Kim Chiang, Lisa Schipper, Sabita Thapa, Tatirose Vijitpan, Muanpong Juntopas, Nantiya Tangwisutijit, Chanthy Sam, and Dusita Krawanchid for their contributions to AKP.

Abstract

Climate change vulnerability and adaptation planning can be taken into consideration across many sectors and at different levels and scales. Different scales of planning have different contexts and may require different approaches. In a landscape context, inter-linkages between sectors within the landscape form the context of adaptation planning, as the response of any one sector may have consequences for others. Moreover, climate change is not the only change that may affect the sector; proper adaptation will have to address future socioeconomic change as well. This calls for a new foundation for climate change adaptation assessments: a holistic view of the landscape as a complex system with multiple livelihoods or sectors under multiple pressures from climate and socioeconomic changes and their consequences. This paper points out gaps in using sectoral vulnerability and adaptation assessment for landscape adaptation planning, and proposes instead an extended framework for climate change vulnerability and adaptation with a holistic view of the landscape.

Keywords: Climate change, vulnerability, adaptation, holistic approach

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1. Gaps in ClimateChange Vulnerability and Adaptation Assessments

Over the years, there has been an increase in the number of climate change impact, vulnerability and adaptation studies undertaken in Thailand, in response to the concerns raised on climate change and the potentially serious threats to society and ecosystems (see, for example, ADB, 2009; The World Bank, 2010). However, most of the previous studies either focused on specific sectors, especially agriculture and water resources (e.g. Snidvongs et al., 2010; Snidvongs and Chidthaisong, 2011; Chula Unisearch, 2010), or were community-based assessments, focusing primarily on the main livelihoods of the community, and thus limited in their perspectives (e.g. Chula Unisearch and SEA START RC, 2011). However, social and ecological systems are complex, stretching across sectors which may have different concerns regarding climate change and may respond to climate threats differently. Such responses may have effects or consequences for other sectors in the same landscape or society. Thus, neglecting cross-sectoral impacts would be a serious gap in adaptation assessments, especially when the goal is to guide adaptation policy across a certain landscape (e.g. province or watershed).

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Another matter is that climate change is not the sole factor affecting vulnerability of and risk to social and ecological systems. Socioeconomic changes driven by development plans or private-sector initiatives can also have significant impacts and alter the risks from climate change. They may also change how resources are used, and potentially make other sectors more vulnerable to climate threats. Yet, most climate-related studies conducted in Thailand so far have not considered socioeconomic factors, so they provide only a narrow view of climate change vulnerability and adaptive capacity.

This paper presents an extended framework for climate change vulnerability and adaptation assessments, and provides a simplified example that uses a holistic view of a society under pressures from climate change as well as socioeconomic changes, and addresses the inter-linkage between key sectors from a complex system perspective.

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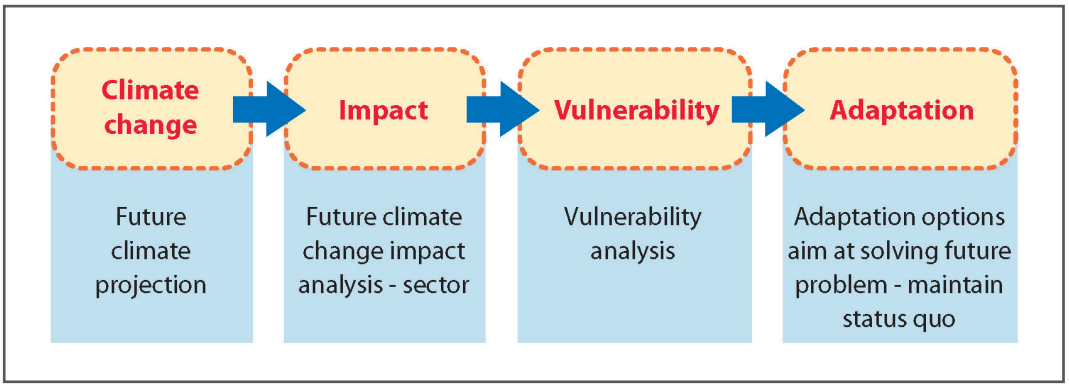
2. A new framework for Vulnerability and Adaptation Assessments

Most assessments to date have followed a conventional sequential approach, as illustrated in Figure 1 below, focusing on understanding the impacts of climate change on the sector, analyzing the vulnerability of the sector, and identifying adaptation measures.

Figure 1: Typical framework for past climate change vulnerability and adaptation assessments



However, any landscape of substantial size, such as a province or watershed, is likely to contain complex systems, both ecologically and socio-economically. People will have different livelihoods that are affected differently by climate change, and they will respond differently. Yet the choices of one sector – or sub-region – may affect others, especially those that share the same natural resources or have strong social and economic inter-linkages. Those impacts may also be unequally distributed due to economic or geographic factors. For example, in the event of a water shortage, people upstream will be better positioned to take the water they need, leaving a smaller share for people downstream.

Moreover, society is not static. Changes in social and economic conditions may lead to shifts in a sector's activities, change its need for particular resources or the way such resources would be utilized, and thus affect its vulnerability. This, in turn, may change the sector's or broader society's adaptation needs. This means that in order to provide an accurate view of the landscape in the long term, which is the time-scale of climate change, in supporting adaptation planning, a vulnerability and adaptation assessment must take a holistic view, including socioeconomic factors as well as interactions amongst sectors. The process will still begin with assessments of individual sectors, but in a critical second step, it will assemble the results of those individual assessments to create a storyline that looks at the whole landscape and its complex systems. Figure 2 illustrates that approach.

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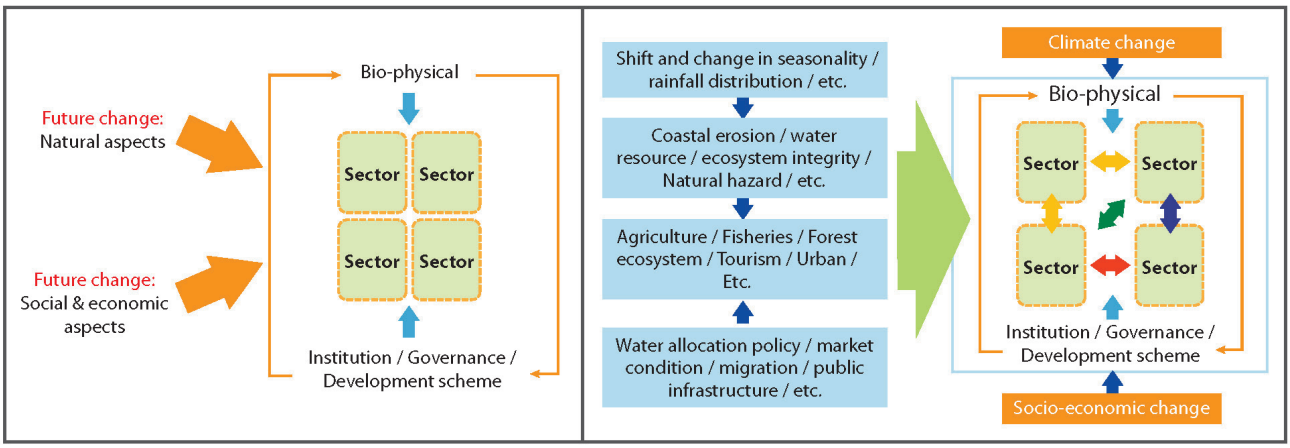
Figure 2: A holistic approach to vulnerability and adaptation assessments



The assessment process can be summarized as follows:

1. Identify key sectors in the landscape.
2. Analyze key climate concerns for each sector, including both the specific projected impacts, and their potential effects (e.g. decreased rainfall could be a major concern for agriculture; it could lead to lower crop yields and/or to increased irrigation costs).
3. Analyze key socioeconomic factors that could affect each sector, and their potential impacts.
4. Consider plausible responses each of the different sectors to the combined impacts of climate change and socioeconomic factors.
5. Assemble the results of the sector-by-sector assessments to build one or more storylines or scenarios for the landscape as a whole, as the basis for landscape-wide adaptation planning.
6. Looking at cross-sectoral impacts, identify adaptation pathways that minimize negative interactions.

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Clearly, this approach is far more complicated and time-consuming as well as more labor-intensive than the simpler methodologies used to date, but it is necessary and significantly more effective, as it will help ensure that adaptation plans reflect the realities of society and avoid conflict amongst sectors. It also reflects a growing consensus amongst scientists and environmental policy experts that integrated approaches are essential to effective planning for energy, water, land and other natural resources.[1]

[1] For a high-profile and well-developed example of such an approach, see http://www.water-energy-food.org/.

3. Case Study: Krabi Province, Thailand

A case study of the coastal province of Krabi in Thailand is used here to illustrate how this holistic approach can be used to provide a more complete climate change vulnerability and adaptation assessment. The case study builds on a study by the Southeast Asia Regional Center of the Global Change System for Analysis, Research, and Training with the WWF Greater Mekong Programme and WWF's Macroeconomics Programme (SEA START RC and WWF, 2008). The study assessed climate change vulnerability and its implications for economic development, and also aimed to build adaptive capacity and integrate climate responses into development. The team built scenarios of climate impacts on key economic sectors within 10 and 25 years, engaged local stakeholders, and made policy recommendations. However, the analysis was only done sector-by-sector, without exploring interactions between sectors.

Krabi is on the west coast of the Andaman Sea in the south of Thailand, about 814 km away from Bangkok. It covers a total area of 4708.5 square km and has a population of slightly below 500,000 people. Its economy relies primarily on agriculture and tourism. Oil palm and rubber, the principal crops, cover 95% of Krabi's cultivated areas, with many smallholder farms amid the industrial plantations. Another key livelihood is inshore fishing (Krabi Provincial Hall, n.d.).

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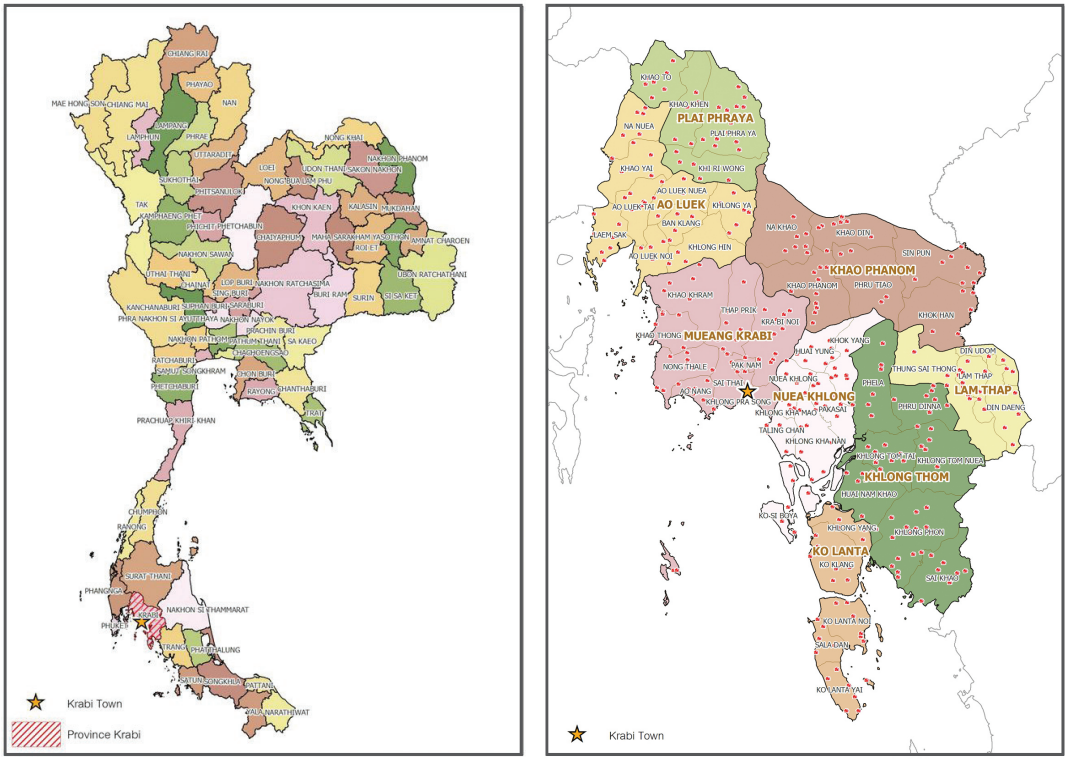
Figure 3: Location of Krabi province and district administrative units in the province



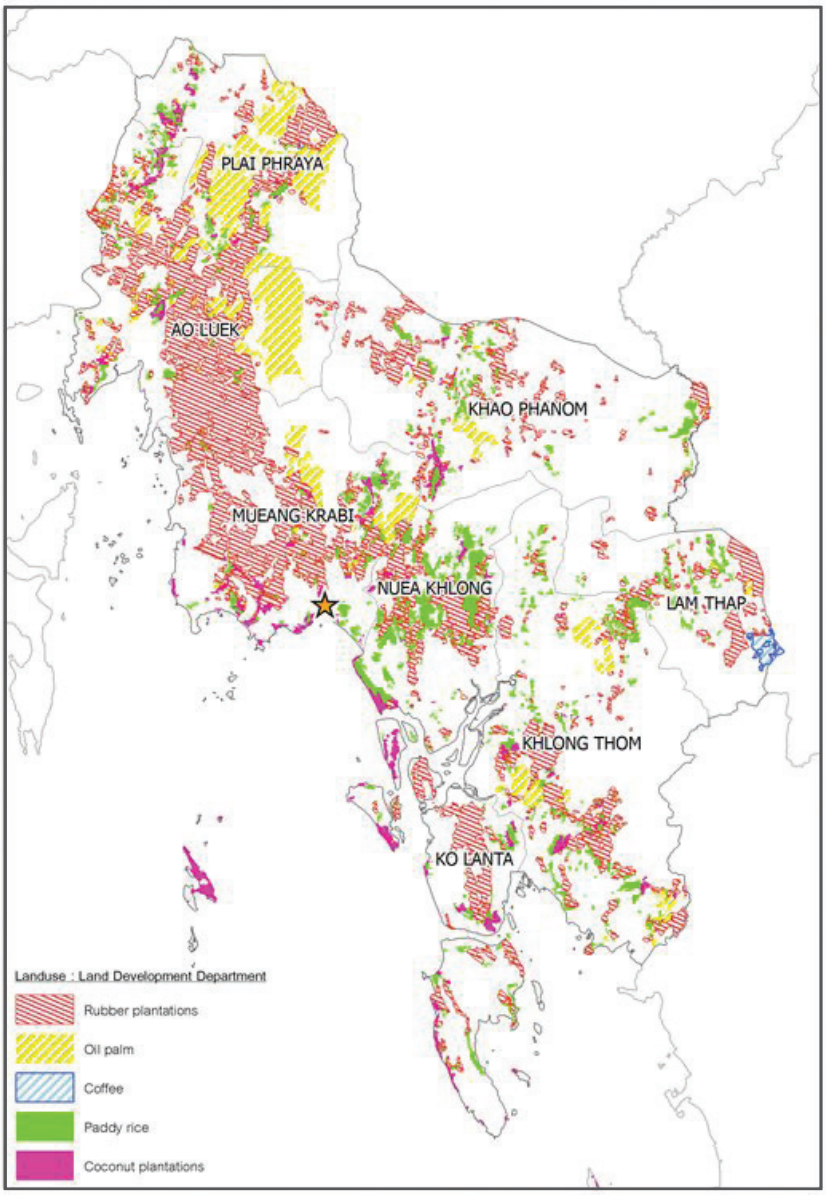
Source: SEA START RC and WWF (2008)

Key sectors in Krabi Province

Agriculture

Agriculture in Krabi is based mainly on two major crops; rubber and oil palm. Rubber is the main cash crop, with about 150,000 hectares planted – almost half of the total agricultural land. Oil palm covers another 135,000 ha, or about 45% of the province's agricultural land. Other crops include coconut, fruit trees, coffee, and paddy rice; Figure 4 shows the geographic distribution of different crops. In 2007, the province produced around 250,000 tonnes of rubber, valued at US$487 million. The total production of palm oil was 1.75 million tonnes, valued at US$140 million. Production of these two major cash crops for the province is highly dependent on weather conditions (Krabi Provincial Hall, n.d.).

Figure 4: Agricultural land use in Krabi province

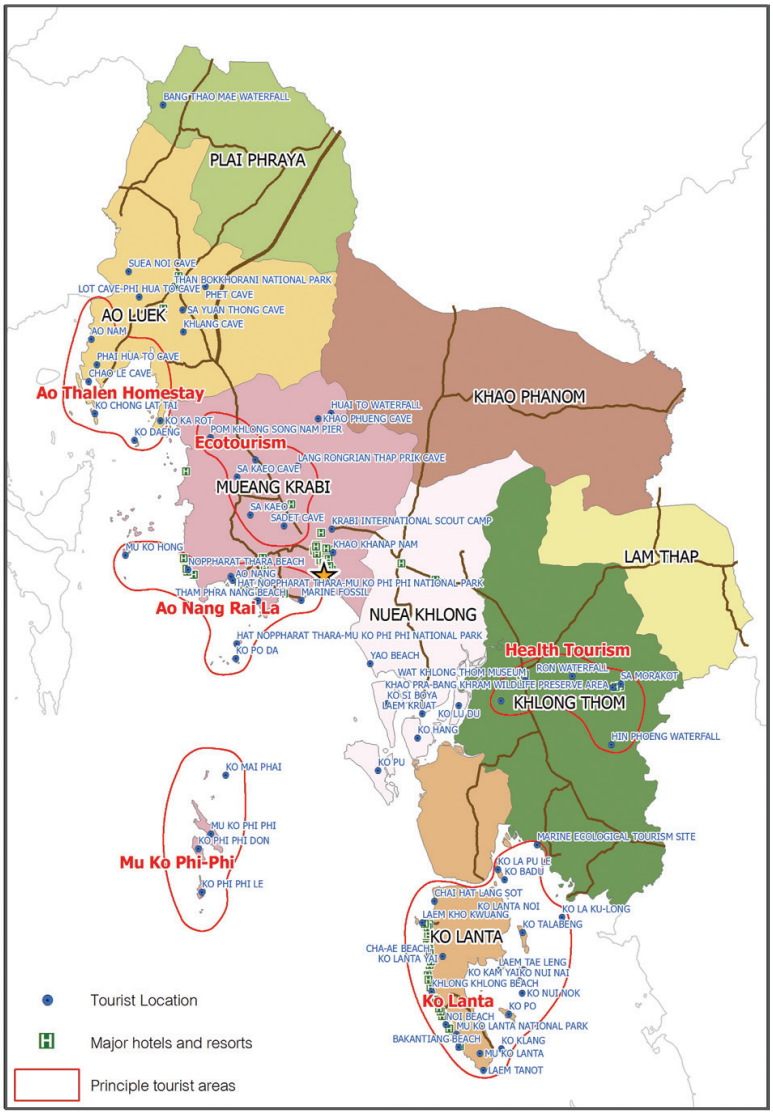


Colour code: rubber plantations (hatched red), oil palm (hatched yellow), coffee (hatched blue), paddy rice (green) and coconut plantations (pink) Source: SEA START RC and WWF (2008).

Tourism

Krabi has a strong tourism industry. In 2010, it drew more than 2.3 million tourists, which made it the second most-visited province in the Andaman cluster, after Phuket; it was ranked 15th in Thailand overall (Krabi Provincial Hall, n.d.). There are various kinds of tourist attractions, including marine, cultural and historical sites. Krabi's health services also draw visitors.

Figure 5: Major tourist areas in Krabi province



Note: Tourist centres are marked with blue dots; major hotels and resorts are marked with a green H; principal tourist areas are marked in red. Source: SEA START RC and WWF (2008).

Inshore fisheries

Another key livelihood is inshore fishing. The Provincial Fishery Office identified about 5,000 inshore fishing households in 2006; fishing is the main source of income and livelihoods in most coastal communities in the province. Fishing is done on small boats operated close to the shore. Fishing households also earn additional income by working in agriculture or in the service sector (Krabi Provincial Hall, n.d.).

Key climate concerns

Major projected climate change impacts in Krabi province by the 2030s include reduced overall rainfall, a change in precipitation patterns, stronger monsoons, and accelerated sea-level rise (SEA START RC and WWF, 2008).[2] However, these changes will not affect all sectors equally: each sector is exposed to climate change in different ways. Table 1 identifies key climate concerns for specific sectors, which are discussed in more detail below.

Table 1: Key climate impacts on major economic sectors in Krabi province

Sector	Key climate impacts	Implications
Agriculture	Reduced rainfall amounts and anomalies in rainfall distribution.	Most agriculture plantations are rain-fed; as of 2012, no agricultural irrigation systems have been set up in the area.
Tourism	Fewer rainy days and much shorter monsoon season (reduced by four weeks by the 2030s).	The rainy season is considered the low tourism season. Tourist activities are limited by rainy days. Therefore, these changes would benefit the tourism industry.
Inshore fisheries	Strong monsoons and increased sea level rise.	Coastal fisheries use small boats, which cannot withstand strong monsoon winds. Most fishing communities are located on small strips of land along the shoreline and are highly threatened by coastal erosion. Moreover, water consumption is primarily based on wells, which could be contaminated if the sea level rises, even seasonally.

Source: SEA START RC and WWF (2008).[3]

Changes in rainfall and impacts on agriculture

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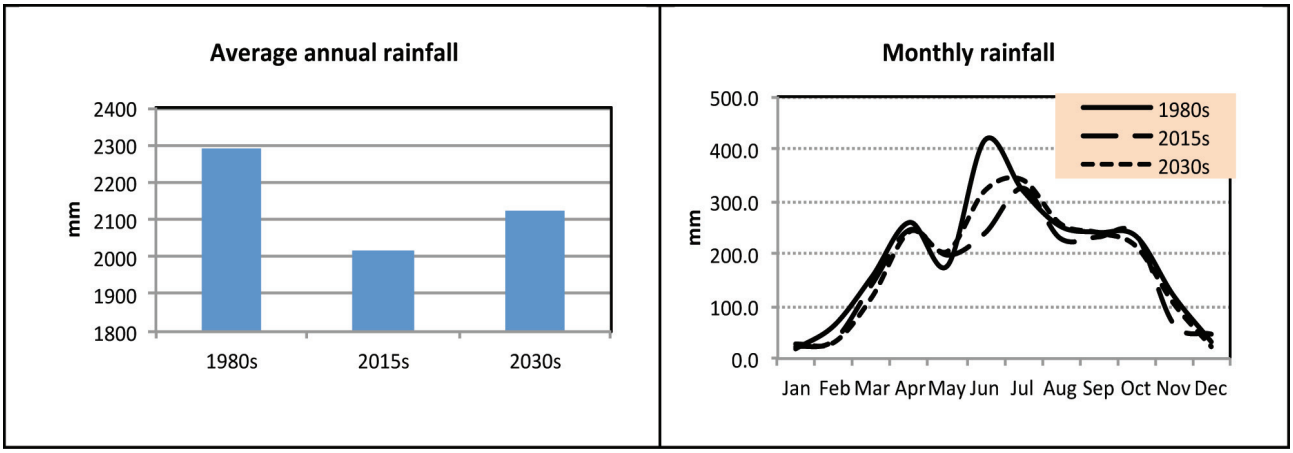
Rainfall patterns in the province vary considerably, with far more rain (and rainy days) in the inland agricultural zone and especially in the mountains, and less along the coast. As shown in Figure 6, rainfall is expected to decline by up to 300 mm per year (SEA START RC and WWF, 2008). As shown in Figure 7, most of the agricultural area in Krabi province will be affected. This raises concerns that there will be insufficient water to support agricultural activity. It could also lead farmers, especially in upstream areas, to retain more water in their plantations.

[2] For this analysis, climate patterns for three time-frames were compared: the 1980s (baseline), 2015-2024 (within roughly 10 years), and the 2030s (within roughly 25 years). The projections are based on data from the global circulation model ECHAM4, downscaled using the PRECIS regional climate model. SEA START RC did this downscaling to develop high-resolution climate projections for Southeast Asia region as part of a research project funded by the Asia-Pacific Network for Global Change Research and Thailand Research Fund with technical support from the Hadley Centre, The Met Office, UK (2007-2008).

ECHAM4 was developed by the Max-Planck-Institute for Meteorology (http://www.ipcc-data.org/is92/echam4_info.html). PRECIS is regional climate model developed by the Hadley Centre.

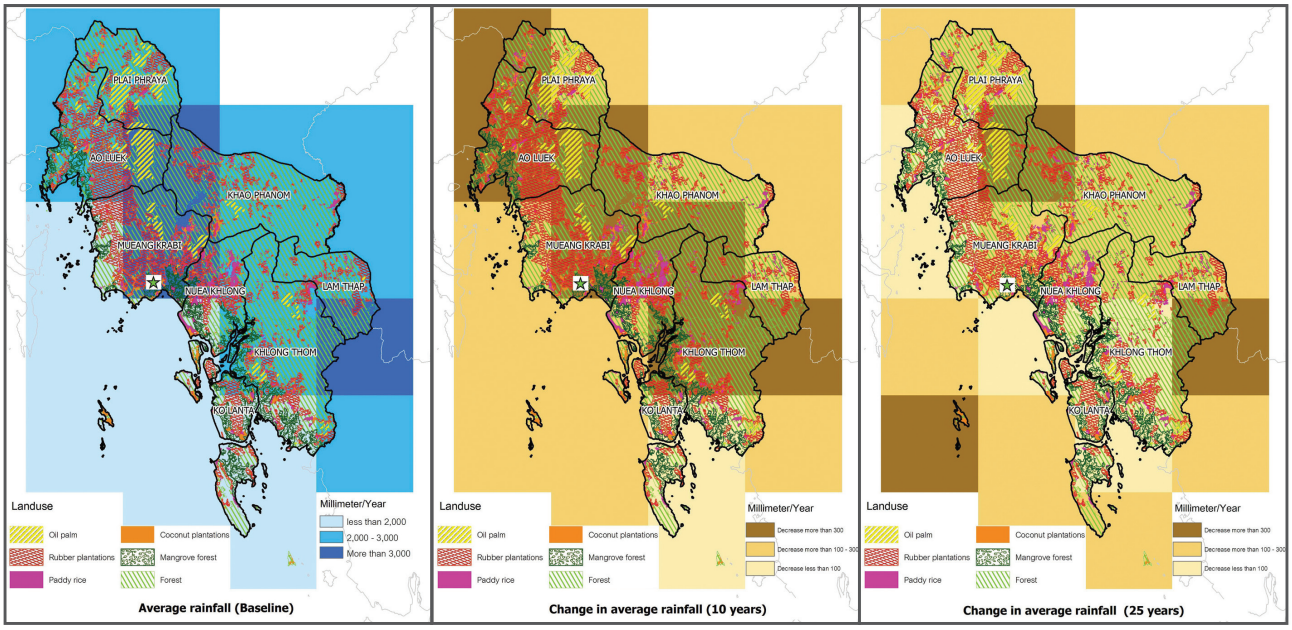
[3] This table also draws on a discussion in a multi-stakeholder workshop at the Pakasai Provincial Conference Hall in June 2008. More than 130 people participated, including national and provincial government officials and representatives of local organizations, business and professional associations, civic society and NGOs, community leaders, international organizations, and academics.

Figure 6: Changes in future rainfall and rainfall distribution over the year



Source: SEA START RC and WWF (2008).

Figure 7: Changes in average annual rainfall over Krabi province: 1980s, 2015-2024 and 2030s



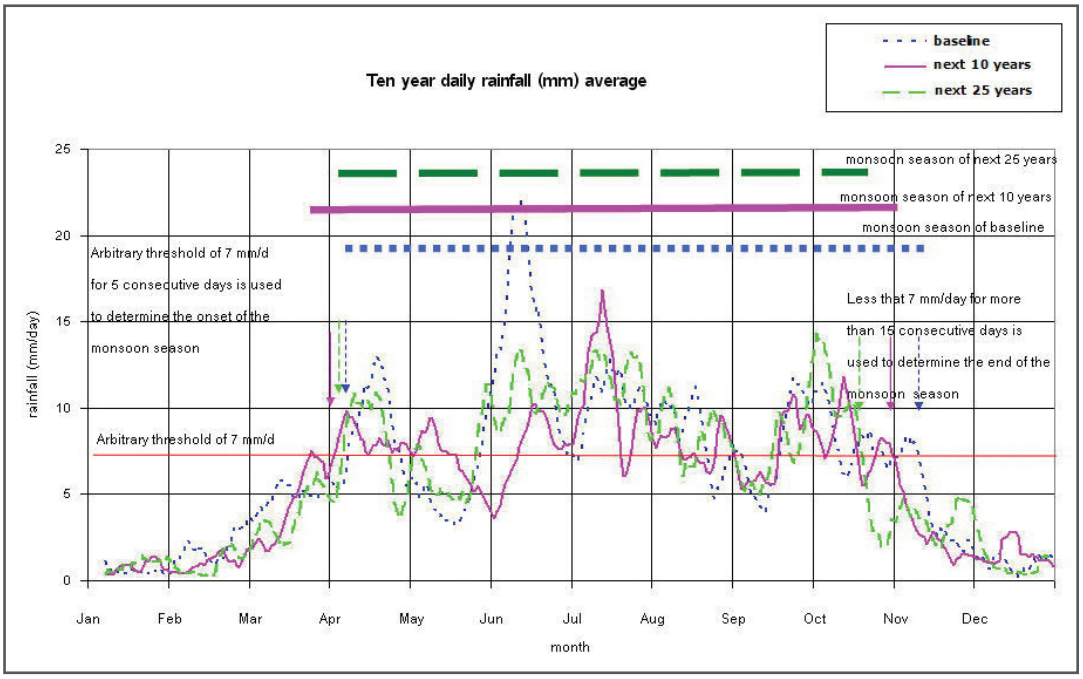
Source: SEA START RC and WWF (2008).

Change in rainy-season patterns and impacts on tourism

Climate projections show the monsoon season becoming significantly shorter, by about two weeks within a decade and by about four weeks over the next 25 years (SEA START RC and WWF, 2008). The number of rainy days and heavy-rain days will also decline (Figure 8). This trend would benefit tourism in Krabi province, as rain tends to keep visitors away and hinder tourist activities. Thus, the tourism industry in Krabi may expand, which in turn could result in higher consumption of resources, including potentially scarce water.

Photo Credit: creativecommons | Mario Ruckh

Figure 8: 10-year daily rainfall averages (mm) for Krabi province in the 1980s, 2015-2024 and 2030s

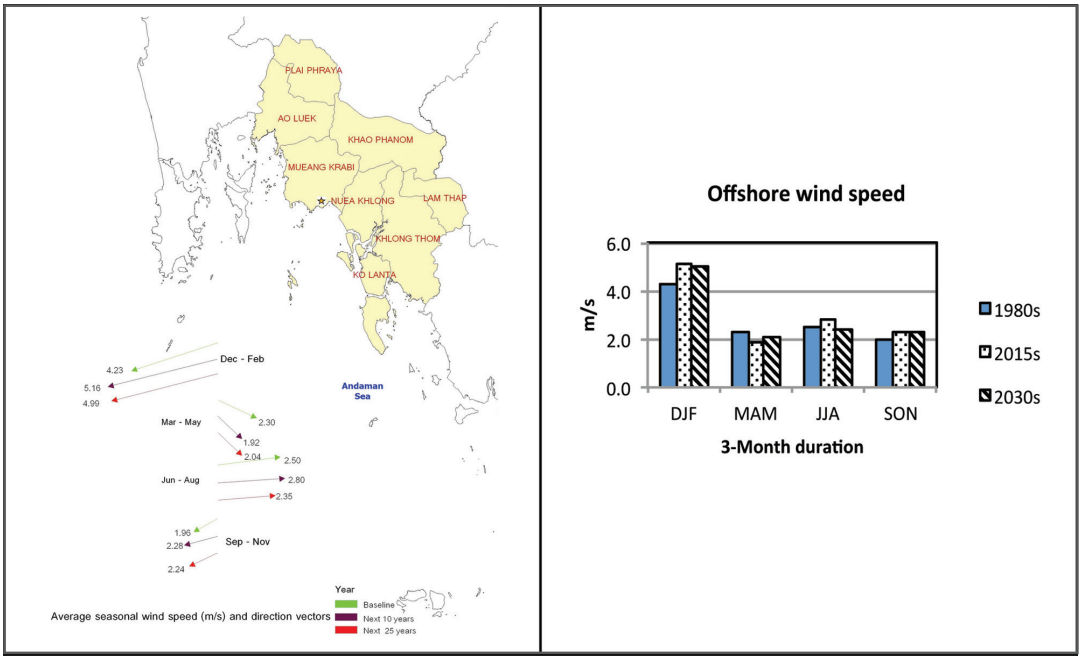


Note: An arbitrary threshold of 7 mm/day for five consecutive days is used to determine the onset of the monsoonal rainfall season and less than 7 mm/day for more than 15 consecutive days is used to determine the end of the monsoonal rainfall season. Source: SEA START RC and WWF (2008).

Stronger winds, sea-level rise and impacts on inshore fisheries

Climate change projections show stronger off-shore wind speeds almost year-round, except from March to May (Figure 9). Because local inshore fishermen use small boats that cannot withstand heavy winds, this may reduce the number of fishing days and threaten livelihoods. This could lead these communities to seek other livelihoods, such as working in other sectors or exploiting other natural resources (e.g. clam harvesting on the beach).

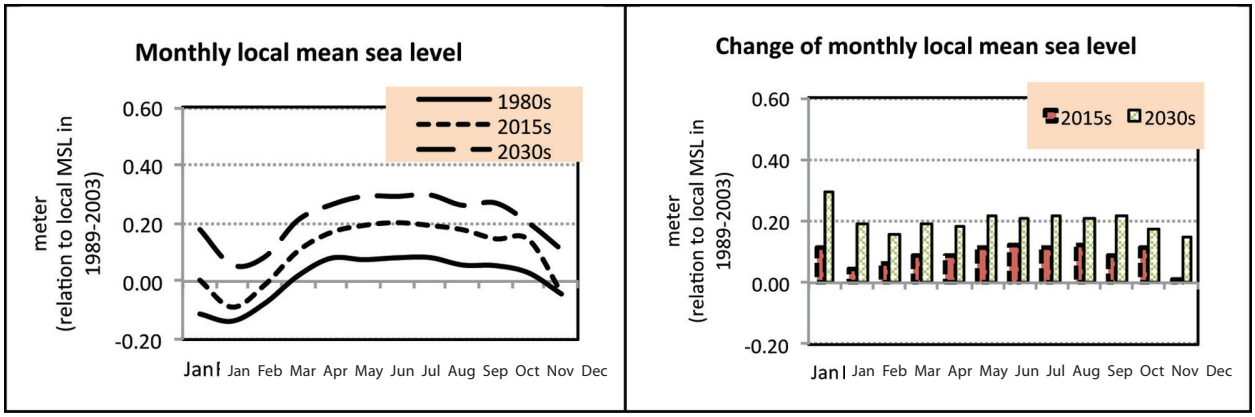
Figure 9: Change in off-shore wind speeds, Krabi province: 1980s, 2015-2024 and 2030s



Source: SEA START RC and WWF (2008) and SEA START RC.

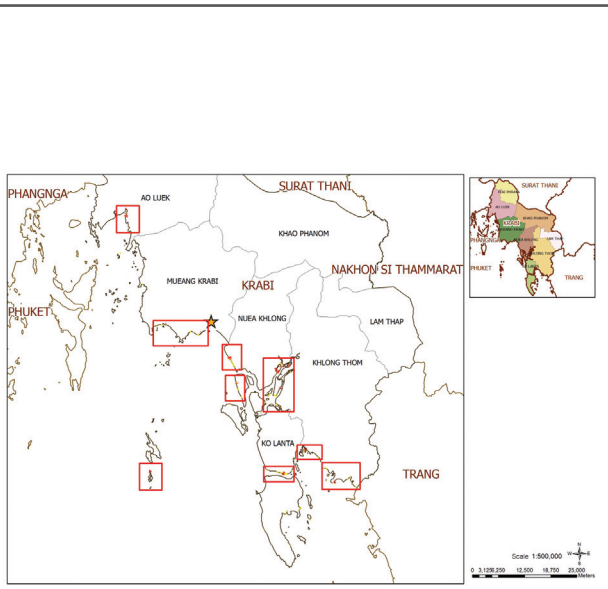
Sea-level rise, meanwhile, could pose a threat to fishing villages, most of which are located on narrow corridors along the coastline of Krabi province. Sea-level projections[4] show sea levels rising due to the impacts of global warming, as well as a stronger monsoon season (see Figure 10). This could lead to more severe coastal erosion, which would threaten village settlements and also increase the risk of saltwater contamination in the water wells that communities use as their main sources of drinking water (Figure 11). Coastal erosion has already occurred in several villages, and many villagers note that they have already lost land and asked for assistance in dealing with coastal erosion.

Figure 10: Changes in sea level, Krabi province: 1980s, 2015-2024 and 2030s

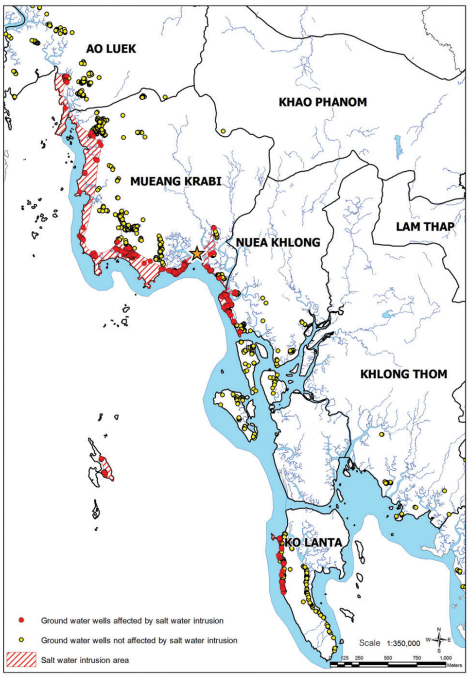


Source: SEA START RC and WWF (2008) and SEA START RC.

Figure 11: Coastal areas potentially at risk from future sea-level rise, Krabi province



Areas at high risk of coastal instability due to sea level rise



Coastal areas where beach sand aquifers are contaminated by saltwater in the dry season (red) and susceptible areas that could be affected by salt water intrusion in the future (yellow).

Source: SEA START RC and WWF (2008).

[4] Analysis of sea-level rise is based on Dynamic Interactive Vulnerability Assessment (DIVA), a tool for integrated assessment of coastal zones produced by the EU-funded DINAS-Coast consortium in 2004. Changes in wind speed from ECHAM4 – PRECIS climate scenario (see footnote 3) were incorporated into the analysis.

Socioeconomic trends

As noted in Section 2, socioeconomic changes can have very significant impacts on both social and ecological systems, affecting their vulnerability to climate change and providing a framework for each sector's adaptation choices. Socioeconomic changes can be driven by government policy as well as by private investment. This case study highlights the impact of two key national policies as examples.

Tourism promotion policy

Tourism has played a major role in Thailand's economic development for over 40 years. The number of international visitors has risen steadily, nearly doubling to 14.46 million in the period from 1998 to 2007 alone.[5] The Thai government has played a significant role in this surge through aggressive promotions led by the Tourism Authority of Thailand, from Visit Thailand Year (1987) to the Amazing Thailand campaign, the country's leading tourism campaign since 1998, and the ongoing push for 'green' tourism.

These efforts have directly affected Krabi province which benefits from diverse tourist attractions, proximity to the established tourism centre of Phuket, and an international airport that opened in July 1999. Over the decade from 2000 to 2010, the number of tourists visiting Krabi province and the number of hotel rooms almost doubled, as shown in Table 2. This trend is expected to continue into the future.

Table 2: Number of tourists and hotel rooms in Krabi province over the 2000s

Year	Number of visitors	Hotel rooms
2010	2,386,266	10,808
2009	2,212,241	12,446
2008	2,945,946	12,446
2007	2,126,107	12,442
2006	1,732,951	10,962
2005	1,027,045	9,737
2004	1,796,591	10,950
2003	1,623,217	9,088
2002	1,458,771	9,088
2001	1,356,960	6,024
2000	1,236,229	4,873

Source: Tourism Authority of Thailand and Office of Tourism Development.[6]

[5] Tourism Authority of Thailand historical data, available at http://www2.tat.or.th/stat/web/static_index.php.

[6] Data accessed online on 1 June 2012 at http://www2.tat.or.th/stat/web/static_tst.php.

Renewable energy promotion policy and consequences

Aiming to bolster Thailand's energy security amid fluctuating oil prices, the Ministry of Energy introduced policies to promote renewable energy development, with a goal of supplying 20% of energy from renewables by 2022 (Ministry of Energy, 2009). A major focus has been on alternative transportation fuels such as gasohol and biodiesel, as well as natural gas for vehicles. At the same time, the government has sponsored campaigns to boost energy efficiency through the implementation of the 15-Year Renewable Energy Development Plan (REDP).

Aiming to increase production of biofuels, the government approved the Oil Palm and Palm Oil Industry Development Plan 2008-2012, which set out to expand oil-palm plantations to 2.5 million ha. This also involved replanting another 500,000 ha of old palm plantations (for a total of 3 million ha), and increasing palm oil productivity from 3 tonnes per acre per year to 3.5 tonnes per acre per year.

These policies have considerably increased oil palm cultivation in Krabi province, which has favourable climatic conditions for this crop. Now Krabi has the largest area of oil palm plantations in Thailand, and both the planted area and productivity continue to rise (Table 3).

Table 3: Oil palm production in Krabi province

	2006	2007	2008	2009	2010
Productive area (ha)	110,948	122,221	129,075	132,390	148,603
Produce (tonnes)	2,117,375	2,049,589	2,755,306	2,308,259	2,390,651

Source: Office of Agriculture Economics.[7]

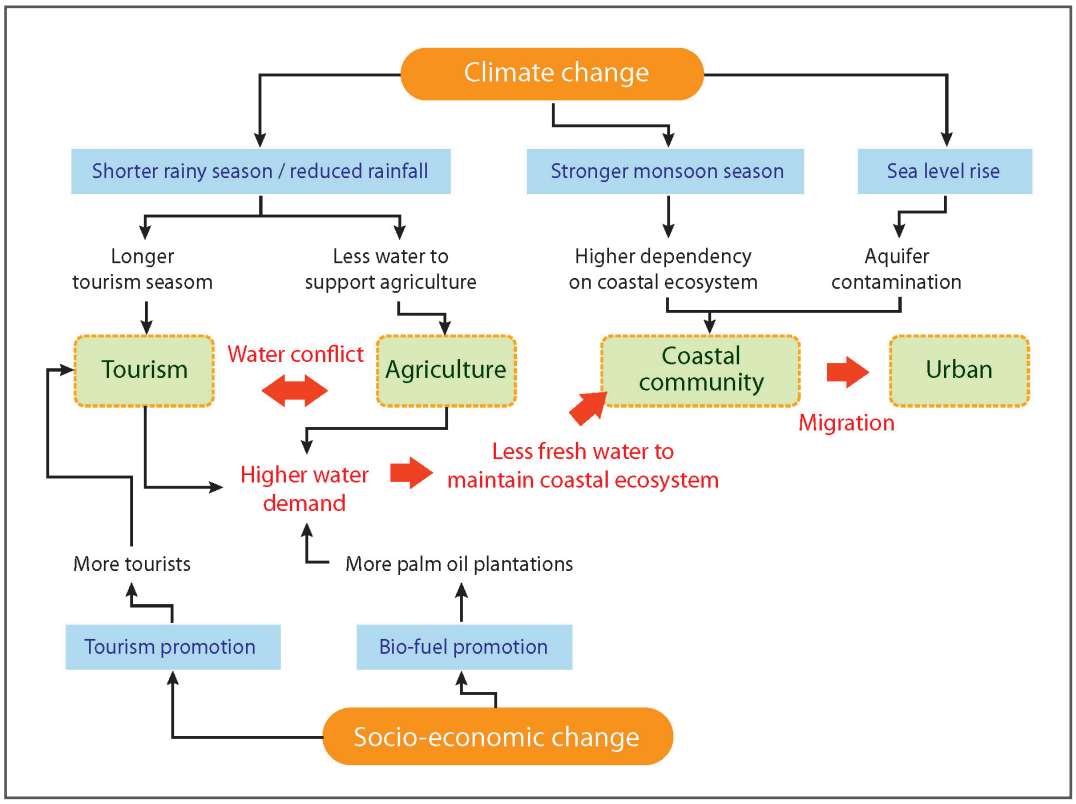
Assembling the pieces: A holistic view of Krabi province in a changing climate

As explained in Section 2, a holistic approach to vulnerability and adaptation assessments will start by looking at climate impacts on each sector, consider socioeconomic factors, and then assemble the pieces together to show interactions across sectors and between climate and socioeconomic trends. This case study has taken a simplified version of this approach, looking only at key factors affecting three major sectors: agriculture, tourism and in-shore fisheries. Figure 12 presents the results in graphic form.

[7] In Thai; http://www2.oae.go.th/zone/zone8/roae8/index.php?option=com_content&task=view&id=327&Itemid=81 (accessed 1 June 2012).

Photo Credit: creativecommons | Eric Molina

Figure 12: A holistic view of Krabi province's future under climate change



As noted above, rainfall changes are expected to benefit tourism in Krabi province, but harm the agricultural sector, which may be particularly sensitive to reduced rainfall because oil palms require substantial amounts of water throughout the year.[8] Tourism and agriculture have been continuously expanding in response to government policies, and this is likely to result in increased water demand from both sectors. At some point this could lead to direct conflicts over water between the two sectors, especially if water becomes scarce.

In-shore fisheries and coastal communities, meanwhile, tend to be under threat from both stronger monsoons that may limit their fishing activity, and from a rise in sea-levels which may exacerbate coastal erosion and increase the risk of water contamination. Moreover, in addition to direct pressure from climate change, they may also be affected by the ways in which the agriculture and tourism sectors respond to climate threats. In-shore fishermen often harvest clams from brackish ecosystems at the mouths of rivers to offset income lost from reduced fishing days. However, if more water is withdrawn from the rivers to meet agricultural and urban demands, runoff downstream would decline. Reduced rainfall due to climate change would also reduce runoff. These two factors combined could threaten brackish ecosystems, as reduced freshwater would increase the salinity of the brackish areas. For in-shore fishermen, this might mean lost livelihoods and a need to migrate to urban or agricultural areas in search of employment.

[8] One hectare of oil palm plantation may consist of approximately 140 trees and would require approximately 82.5 cubic meters of water per month. Source: Database of Management on Basically Agricultural Problem in 5 Regions of Thailand. In Thai; http://siweb.dss.go.th/qa/search search_description.asp?QA_ID=731 (accessed 1 June 2012).

4. Discussion and Conclusion

The Krabi province case study illustrates both an alternative methodology for vulnerability and adaptation assessment, and the gaps that such a methodology can expose. Sector-by-sector analyses of climate change impacts can identify important issues, but they may underestimate the vulnerability of the sector that could arise from interactions between sectors. In addition, the combined effects of climate and socioeconomic trends that may affect vulnerabilities of the sector need to be taken into consideration. Thus, a holistic view of the landscape can support more effective planning for adaptation, and prevent mal-adaptations arising from interactions that are not properly addressed.

Photo Credit: creativecommons | Ernesto Borges

This holistic approach not only addresses the needs of policy-makers and planners at the landscape level (in this case, Krabi province), but also serves as the foundation for more effective plans for individual sectors. The complex-system analysis can inform a basic adaptation plan, and when implementing this plan, each sector can be addressed separately if needed – for example, where an implementing agency's mandate covers only one sector. From a holistic view, such an approach can help ensure that the sectoral adaptation plan will minimize negative impacts on other sectors. It can also identify trade-offs that need to be negotiated at a higher level.

It should be noted that the 'landscape' used here as the unit of assessment can be defined in many different ways: it can be a geographic area, such as a watershed, an economic area, or a politically defined area, such as a province. In any case, it is appropriate for the assessment to identify, from the start, the policy platform that is to be informed, so that relevant stakeholders can be engaged in the process (in this case, the platform was the provincial development plan). Since effective adaptation involves whole societies, a holistic approach to vulnerability assessment can also help lead to dialogue across social groups and sectors, and thus help prevent conflicts and facilitate compromise.

In the case of Krabi province, the vulnerability assessment highlights the importance of adaptation measures to address potential water constraints. Basin-wide water management systems will be essential; the agriculture sector, meanwhile, could reduce risks by identifying optimal areas for oil palm plantations. Ways must be found to ensure water can be properly shared with downstream users, and that sufficient environmental flows will be maintained to support brackish ecosystems. Infrastructure engineering, including municipal water supply and storm and wastewater management, should anticipate increasing climate change impacts over a 100-year horizon. Provincial planners should engage stakeholders in a discussion of the province's capacity for tourism growth that takes into account near- and long-term climate change impacts; the best strategy may be to cap or slow growth in visitor volume while emphasizing migration to higher-value and 'greener' services for tourists.

This case study is only a demonstration of the concept of holistic vulnerability and adaptation assessments. Further research needs to be conducted to hone the methodology and, in the case of Krabi province in particular, to provide a more comprehensive perspective to support adaptation planning.

References

Asian Development Bank (2009) The Economics of Climate Change in Southeast Asia: A Regional Review. Accessed 15th August 2012. http://www.adb.org/publications/economics-climate-change-southeast-asia-regional-review

Chula Unisearch (2010) Report on Master Plan to Cope with Climate Change, Energy Price Fluctuation and World Food Crisis (in Thai). Study report to National Social and Economic Development Board, Bangkok, Thailand.

Chula Unisearch and SEA START RC. (2011) A Study on the Impact of Climate Change & Climate Variability and Adaptation of Key Sectors (in Thai). Office of Natural Resource and Environment Policy and Planning, Ministry of Natural Resources and Environment. Bangkok, Thailand.

Krabi Provincial Hall (n.d.) Krabi Provincial Data (in Thai). Accessed 1st June 2012. http://www.krabi.go.th/province_data/economic53_4.pdf.

Ministry of Energy, Thailand (2009) Thailand in the 2010s: Thailand Renewable Energy and its Energy Future: Opportunities & Challenges. Accessed 15th August 2012. http://www.dede.go.th/dede/fileadmin/upload/pictures_eng/pdffile/Section_1.pdf

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Snidvongs, A. and A. Chidthaisong A. eds. (2011) Thailand's First Assessment Report on Climate Change 2011. Working Group II: Impacts, Vulnerability and Adaptation (in Thai). THAI-GLOB, The Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi, Bangkok. Accessed 15th August 2012. http://climatechange.jgsee.org/v2/detail.php?ID=454&typeid=4

Snidvongs, A., Chinvanno, S., Sangmanee, C., Thanakitmetavut, J., Rawichchutiwan, A. and Wongthong, P. (2010) Position Paper on Plausible Climate Change Scenarios for Thailand during the Period of 2045-2065. S&T Postgraduate Education and Research Development Office (PERDO), Bangkok. Accessed 15th August 2012. http://www.perdo.or.th/downloads/Document/Book/Complete_ClimateChange.pdf.

SEA START RC and WWF (2008) Climate Change Impacts in Krabi Province, Thailand. A Study of Environmental, Social, and Economic Challenges. Southeast Asia START Regional Center and WWF Greater Mekong Programme, Bangkok. Accessed 15th August 2012. http://cc.start.or.th/climateChange/Document/Doc_eng_11.pdf.

The World Bank (2010) Climate Risks and Adaptation in Asian Coastal Megacities: A Synthesis Report. The World Bank, Asian Development Bank and Japan International Cooperation Agency, Washington, DC. Accessed 15th August 2012. http://go.worldbank.org/P8IU2IW370.

Key AKP Publications

Scoping Assessments

Date	Title	Lead Authors	Focus
October 2010	Scoping Assessment for National Implementation in Thailand - Summary	Louis Lebel	Assessment of adaptation needs
October 2010	Scoping Assessment on Climate Change Adaptation in Viet Nam - Summary	Bach Tan Sinh	Assessment of adaptation needs
October 2010	Scoping Assessment on Climate Change Knowledge Platform in Nepal: Summary	Ajaya Dixit	Assessment of adaptation needs
October 2010	Scoping Assessment for National Implementation in Cambodia - Summary	Robert W. Solar Toby Carson Marona Srey	Assessment of adaptation needs
October 2010	Scoping Assessment on Climate Change Adaptation in Bangladesh-Summary	Bangladesh Center for Advanced Studies (BCAS)	Assessment of adaptation needs
June 2011	Scoping Mission and Preliminary Assessment on Climate Change Adaptation in Sri Lanka	Serena Fortuna	Assessment of adaptation needs
October 2011	Scoping Assessment on Climate Change Adaptation in Malaysia - Summary	Robert W. Solar	Assessment of adaptation needs
June 2012	Scoping Assessment on Climate Change Adaptation in the Philippines - Summary	Jessica Dator-Bercilla	Assessment of adaptation needs

Collaborative studies

Date	Title	Lead Authors	Focus
October 2010	Adaptation Strategies for Water and Agricultural Sectors in Southeast Asia	Satya Priya	Review of adaptation priorities
February 2011	Climate Change Adaptation: Finding the Appropriate Response	Robert W. Solar Toby Carson Marona Srey	Rural livelihoods and multi-stakeholder participatory learning
February 2011	An Approach to Climate Research: Events Adaptation Change Adaptation Vents, Strategies, and Drivers	Robert W. Solar Toby Carson Marona Srey	Research methodology – sustainable livelihoods and resilience
July 2011	Desktop Study on Assessment of Capacity Gaps and Needs of Southeast Asia Countries in Addressing Impacts, Vulnerability and Adaptation to Climate Variability and Climate Change	Southeast Asia Network of Climate Change Focal Points (SEA-CC Net) Regional Climate Change Adaptation Knowledge Platform for Asia (Adaptation Knowledge Platform)	Review of adaptation priorities
March 2011	The Practitioners & Policy-makers Exchange on Climate Change Adaptation in Agriculture - Frequently Ask Questions booklet	Satya Priya Gernot Laganda Felicity Woodhams Shirley Kai Serena Fortuna Nicole Hansen Hiromi Inagaki Roopa Rakshit Kim Jihyun	Adaptation in agricultural systems
March 2012	Mainstreaming climate change adaptation into development planning	Louis Lebel Lailai Li Chayanis Krittasudthacheewa Muanpong Juntopas Tatirose Vijitpan Tomoharu Uchiyama Dusita Krawanchid	Review of experiences in mainstreaming adaptation in Asia
July 2012	Community Forestry: Responding to both Adaptation and Mitigation	RECOFTC	Importance of community forestry to adaptation and mitigation
July 2012	The Role of Community Forestry in Climate Change Adaptation and Mitigation: Case Studies from Asia	Regan Suzuki (editor) RECOFTC	Importance of community forestry to adaptation and mitigation

Policy briefs

Date	Title	Lead Authors	Focus
March 2011	Climate Change Resilience in Coastal Cambodia: Adaptive Capacity & Human Development	Robert W. Solar	Gaps in adaptive capacity
October 2010	Enhancing Adaptive Capacity in Bhutan and Nepal (Policy Brief 1)	Sabita Thapa John Soussan Satya Priya Phurba Lhendup Dusita Krawanchid	Assessment of adaptation needs
October 2011	Adaptation Knowledge (Policy Brief 2)	Louis Lebel	Role of knowledge in the adaptation to climate change
May 2012	Governance of Adaptation (Policy Brief 3)	Louis Lebel	Quality of governance as an important determinant of successful adaptation
July 2012	Institutional Responses to Local-Level Climate Change Adaptation in Nepal (Policy Brief 4)	JC Baral DR Bhuju DB Shrestha PY Shrestha	Complexity of adaptation planning

Proceedings

October 2010	Adaptation Forum 2010 Proceedings Report	AKP Secretariat	Summary of 2010 Forum
May 2012	Synthesis Report of the Second AsiaPacific Climate Change Adaptation Forum - Mainstreaming Adaptation in Development: Adaptation in Action	Louis Lebel	Summary of 2010 Forum

Design Documents

Date	Title	Lead Authors	Focus
October 2010	Inception Summary Report	AKP	Design of AKP

Partner Reports

Date	Title	Lead Authors	Focus
July 2012	Integration of climate adaptation into development and conservation planning in Bhutan: issue identification and recommendations	Phurba Lhendup	Assessment of adaptation issues and planning
August 2012	A holistic approach to climate change vulnerability and adaptation assessment: Pilot study in Thailand	Suppakorn Chinvanno	Vulnerability and adaptation assessment
August 2012	Mainstreaming Climate Change into Community Development Strategies and Plans: A Case Study in Thailand	Suppakorn Chinvanno Vichien Kerdsuk	Adaptation mainstreaming
August 2012	Scoping Assessment of Knowledge Needs in Climate Change Adaptation in China	Lailai Li Xiaojing Fei Jiayi Xu Huw Slater	Assessment of adaptation needs
August 2012	Mainstreaming adaptation into local development plans in Vietnam	Bach Tan Sinh Vu Canh Toan	Adaptation mainstreaming
September 2012	Scoping Assessment of Climate Change Adaptation Priorities in the Lao PDR	EcoLao	Assessment of adaptation needs

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