

Belinda Yuen and Leon Kong

## Climate Change and Urban Planning in Southeast Asia

---

### Warning

The contents of this site is subject to the French law on intellectual property and is the exclusive property of the publisher.

The works on this site can be accessed and reproduced on paper or digital media, provided that they are strictly used for personal, scientific or educational purposes excluding any commercial exploitation. Reproduction must necessarily mention the editor, the journal name, the author and the document reference.

Any other reproduction is strictly forbidden without permission of the publisher, except in cases provided by legislation in force in France.

**revues.org**

Revues.org is a platform for journals in the humanities and social sciences run by the CLEO, Centre for open electronic publishing (CNRS, EHESS, UP, UAPV).

---

### Electronic reference

Belinda Yuen and Leon Kong, « Climate Change and Urban Planning in Southeast Asia », *S.A.P.I.E.N.S* [Online], 2.3 | 2009, Online since 18 December 2009, Connection on 11 October 2012. URL : <http://sapiens.revues.org/881>

Publisher: Institut Veolia Environnement

<http://sapiens.revues.org>

<http://www.revues.org>

Document available online on: <http://sapiens.revues.org/881>

This document is a facsimile of the print edition.

Licence Creative Commons

## Surveys

# Climate Change and Urban Planning in Southeast Asia

Belinda Yuen<sup>1</sup> and Leon Kong<sup>1</sup>

1. National University of Singapore

2. AKO Knowledge Solutions

This article is a revised version of a paper that was first presented at the World Bank 5<sup>th</sup> Urban Research Symposium, June 2009, Marseille, France. The other version is available in the Symposium Proceedings.

Correspondence to: rstbyuen@nus.edu.sg

### Abstract

*Southeast Asia is one of the world's fastest growing regions in terms of population and urban growth. Scientific assessment indicates that the coastlines of Southeast Asia are highly vulnerable to the effects of climate change. Climate change challenge is real and urgent in Southeast Asia. This paper presents a desktop review of the state of climate change research and policy in Southeast Asia. It identifies important challenges, knowledge gaps as well as promising practices, with specific focus on urban planning interventions that will be relevant for future urban policy and research priorities in Southeast Asian cities.*

**Keywords:** Climate change research and policy, urban planning, Southeast Asia

### TABLE OF CONTENTS

1. Introduction
2. Southeast Asia and its Climate Challenge
3. Urban Planning revisited
4. Conclusion

## 1. INTRODUCTION

Southeast Asia is a sub-region of Asia. It is located south of China and east of India, extending more than 3,300 km from north to south and 5,600 km from east to west. Much of Southeast Asia is within the tropical climatic zone with temperatures above 25°C throughout the year. The region is strongly influenced by the Asian monsoons, which bring significant amount of rainfall to parts of Southeast Asia. There are 11 countries in Southeast Asia, of which 10 are members of the regional economic organization, the Association of Southeast Asian Nations (ASEAN).<sup>1</sup> Timor-Leste is expected to join ASEAN in the near future. Economic cooperation and socio-cultural exchange aside, ASEAN offers a regional framework to discuss major issues faced by Southeast Asia, including climate change.

As with the rest of Asia-Pacific, Southeast Asia has witnessed strong population, urban and economic growth in recent decades. Its population has more than trebled from 178 million in 1950 to

580 million in 2009. Accounting for 8.7 per cent of the world’s population, Southeast Asia has a land area (5 million square kilometers) that is about 3 per cent of the world’s land area. It has a combined gross domestic product (GDP) of more than US\$1.5 trillion and a total trade of about US\$1.7 trillion (2008). There are huge variations between countries, in terms of land and population size, economic performance, governance practices, cultural traditions, ethnic groups, religions and languages. Indonesia is the largest country, both in terms of land area (1.89 million square kilometers) and population (236 million). It ranks 5<sup>th</sup> in world population.

Southeast Asia also contains several post-conflict states (for example, Cambodia and Timor-Leste) and some of the world’s poorest countries (for example, Myanmar and Lao PDR). Much of Southeast Asia is low-income despite economic growth in recent decades. Only two countries, Brunei Darussalam and Singapore, are high-income economies. A third (38.6 per cent) of Southeast Asian population lives with less than US\$2 a day while 7.4 per cent lives with less than US\$1 per day. The Gini coefficient, a common indicator of income inequality, has increased in some economies, for example, from 30.4 in 1992 to 34.6 in 2002 in Lao PDR, from 42.9 in 1994 to 46.1 in 2000 in the Philippines and from 35.7 in 1993 to 37.5 in 2002 in Vietnam. These socioeconomic circumstances often spill over to the environment and impact on the climate, for example, land use changes, pollution and problems of fire (such as when the poor uses fire as part of their land management), haze and biodiversity damage from unsustainable resource use.

This paper presents a desktop review of the state of climate change research and policy in Southeast Asia. The next section (Section 2) will review the climate challenges of rapidly developing Southeast Asia. Section 3 will examine the state of climate change research and policy in Southeast Asia. It will identify knowledge gaps as well as promising practices, with specific focus on urban planning interventions to increase the cities’ resilience to climate change. Section 4 will seek to reflect on how urban form and planning can support people’s sustainable choices in terms of transportation, housing and leisure activities, and convey the drivers and

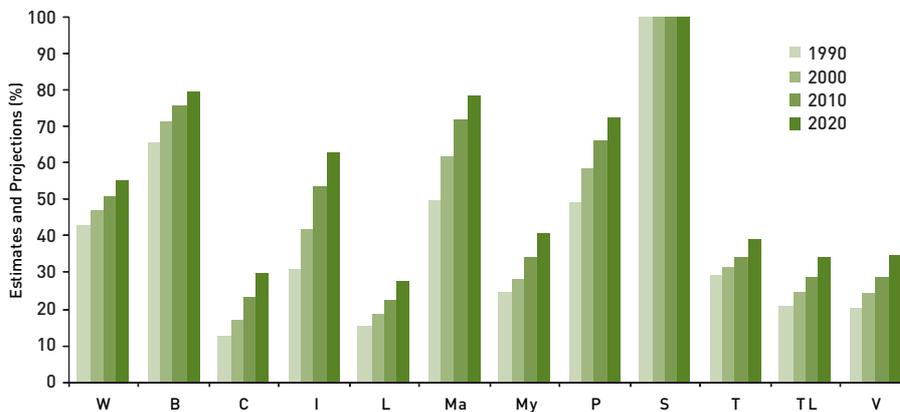


Figure 1a: Southeast Asia Urbanization : Estimates and projections  
Source: UN-HABITAT (2007a), p 352.  
Notes: W: World, B: Brunei, C: Cambodia, I: Indonesia, L: Lao PDR, Ma: Malaysia, My: Myanmar, P: Philippines, S: Singapore, T: Thailand, TL: Timor-Leste, V: Vietnam.

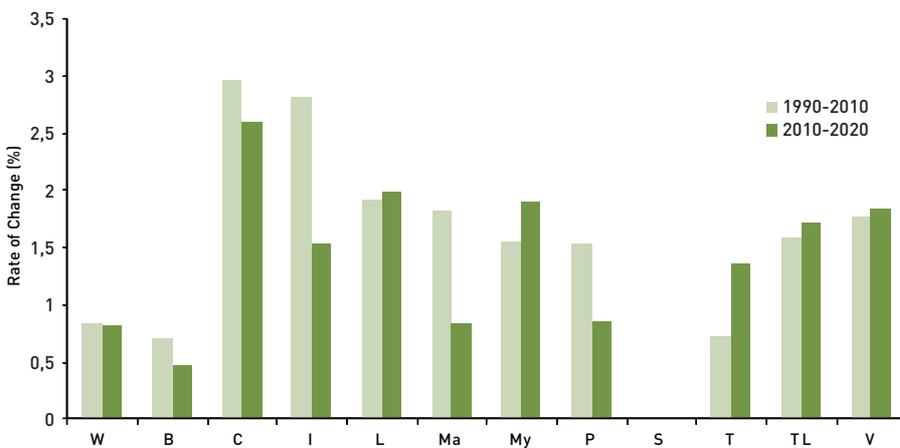


Figure 1b: Southeast Asia Urbanization: Rate of change (%)  
Source: UN-HABITAT (2007a), p 352.  
Notes: W: World, B: Brunei, C: Cambodia, I: Indonesia, L: Lao PDR, Ma: Malaysia, My: Myanmar, P: Philippines, S: Singapore, T: Thailand, TL: Timor-Leste, V: Vietnam.

<sup>1</sup> ASEAN was established on 8 August 1967 in Bangkok by the five original Member Countries, namely, Indonesia, Malaysia, Philippines, Singapore, and Thailand. Brunei Darussalam joined on 8 January 1984, Vietnam on 28 July 1995, Lao PDR and Myanmar on 23 July 1997, and Cambodia on 30 April 1999.

barriers to urban planning as a strategy of climate proofing. Issues that can be addressed through appropriate urban policy, planning, design and governance will also be highlighted.

## 2. SOUTHEAST ASIA AND ITS CLIMATE CHALLENGE

While Southeast Asia is one of the world’s least urbanized regions, its urban population is growing at unprecedented rates, 1.75 times faster than the world’s urban population (Figure 1). Human settlements and the pressure from human activities and economic growth have expanded with urbanization. On a local basis, these factors have the potential to increase the vulnerability of ecosystems and communities to climate change. In 2008, more than 45 per cent of people in Southeast Asia lived in urban areas. By 2030, this proportion is projected to increase to 56.5 per cent (United Nations, 2004). In some countries, for example, Brunei, Indonesia, Malaysia and the Philippines, the urban proportion may rise beyond 60 per cent. Singapore is 100 per cent urbanized. In the process, villages have become towns and in some cases, mega-cities<sup>2</sup>, expanding rapidly often without proper planning.

Rapid urbanization strains a municipality’s capacity to meet infrastructure and other urban service demands. Some 28 per cent (57 million) of the region’s urban population is living in slums. In some large cities such as Phnom Penh, Jakarta and Manila, it is not uncommon to find a quarter or more of the population living in informal settlements. In metro Manila, for instance, 61 per cent of its people are squatters. These informal settlements are often located in unsafe areas, which generate further risks to life, health and property, leaving them vulnerable to climate change. The region faces a range of urban environmental challenges, from rapidly expanding but poorly planned cities to forest fires, polluted air and water, inadequate water supply, sanitation and energy, deficient drains and flooding fears.

Increasingly, as much as 80 per cent of national gross domestic product is generated within urban areas, usually through industrialization and foreign direct investment. Southeast Asia, like the rest of developing Asia, until the recent global economic slowdown, has been rapidly expanding its economy, leading to tremendous environmental changes. The economic growth pioneered in Singapore—one of 4 Asian tigers—through industrialization and increases in foreign direct investment, is now occurring in the ‘second tier’ countries of Thailand, Indonesia, Philippines, Malaysia, and more recently, Vietnam. In many cases, the industrialization-led economic growth based on the development approach of ‘grow first, clean up later’ has been synchronous with rapid urban population growth, land use change and major environmental problems, including pollution and contamination of inland and coastal waters, deforestation and overexploitation of water resources and biodiversity, eroding the region’s environmental sustainability. The United Nations Environment Program (UNEP) has ranked Jakarta, Indonesia and Bangkok, Thailand, among the world’s most polluted mega-cities.

Environmental degradation is a major challenge in the region. Institutional responsibilities for urban environmental management are often unclear and weak, especially over problems of cross-boundary pollution (UN-HABITAT, 2003; von Einsiedel, 2004). Besides weak governance, other contributing factors include economic development and new lifestyles, which have seen an explosion in the demand for private cars and energy use. Rising energy demands are currently being met by the burning of fossil fuels that pollute and generate increasing volume of greenhouse gases (GHG) emission. Energy production and consumption in Southeast Asia remain largely ‘business as usual’, generating enormous quantities of wastes into the environment. In 2006, the greater proportion, 71.4 per cent of electricity and 92.4 per cent of heat production in Southeast Asia, is from coal (Figure 2). At the same time, many people (59.2 per cent) in Southeast Asia still have no access to electricity, especially in the rural areas (International Energy Agency, 2002). Much of Cambodia, for example, has no electricity. Phnom Penh, the capital, uses about 85 per cent of the country’s electricity production, leaving the rest of the country with the remaining 15 per cent. Blackouts are a regular feature in many of its towns.

Southeast Asia as a whole has a low per capita emission of carbon dioxide when compared with the developed world based on medium term forecasts. Its emission by 2030 is expected to be 4.2 tons per capita compared with 6.7 in China, 10.8 in Japan,

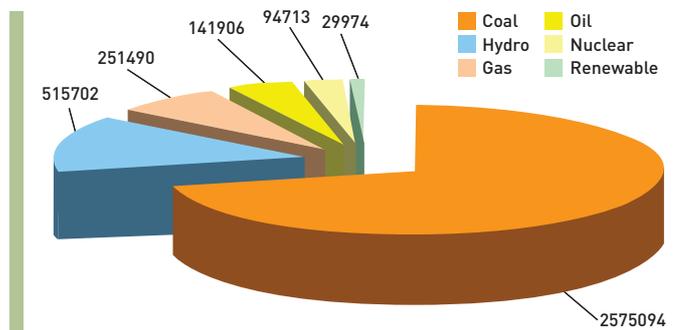


Figure 2a: Electricity Production in Southeast Asia (GWh), 2006  
Source: International Energy Agency Statistics, <http://www.iea.org/Textbase/stats/electricitydata.asp>.  
Notes: Hydro includes production from pumped storage plants.

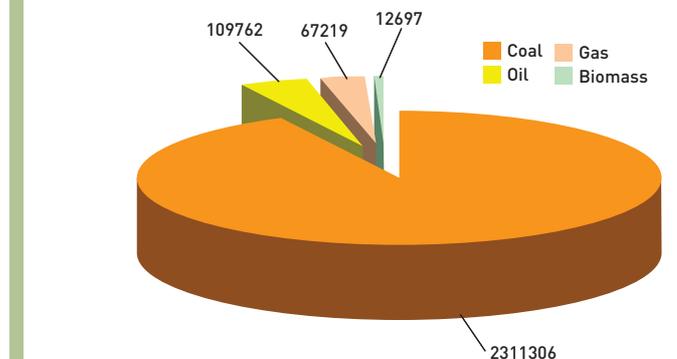


Figure 2b: Heat Production in Southeast Asia (TJ), 2006  
Source: International Energy Agency Statistics, <http://www.iea.org/Textbase/stats/electricitydata.asp>.  
Notes: Hydro includes production from pumped storage plants.

<sup>2</sup> Jones (2002) has estimated that 11 per cent of Southeast Asian population lives in mega-urban regions. The population of Greater Jakarta, Manila and Bangkok each exceeds 10 million and growing.

21.9 in Australia and 23.0 in the United States (APERC, 2006). The low per capita emission is consistent with its low per capita income level. However, the per capita emission on a regional basis masks national variation. Two of its 11 countries, namely, Indonesia (0.48 per cent) and Thailand (0.24 per cent) are among the world's top 10 countries of historical responsibility for global carbon dioxide emissions (1850-2000).<sup>3</sup> Their emissions are comparatively small against that of the United States (29.6 per cent) and European Union (27.1 per cent). In 2002, Singapore's per capita carbon dioxide emission was 12.2 tons and expected to reach 18.8 tons by 2030.

Energy production and consumption in Southeast Asia are projected to produce a fourfold increase in total carbon dioxide emissions from 2002 to 2030, assuming the status quo in energy production and consumption pattern. The emission figure will be twice that of Japan, almost a third that of USA and a quarter that of China in 2030. Control of GHG emissions is crucial for Southeast Asia. Additionally, wet rice agriculture produces methane, which contributes to GHG emissions. Forest fires related to the 1997-98 El Nino event have released approximately 1.2 billion tons of carbon to the atmosphere (Van der Werf *et al*, 2004). According to the United Nations Environment Program, these forest fires are among the most damaging in recorded history. The loss of natural forest and tropical forest dieback will vastly increase global carbon emissions. Typically, clearance of 1 hectare of tropical forest will release about 500 m3 of carbon into the atmosphere (Jones *et al*, 2003).

The region contains some of the world's major areas of biodiversity such as the lowland rainforest of the Indo-Malayan archipelago. Forests are commonly converted to cropland, paddy and pasture to respond to growing population and urbanization needs or lost through illegal logging. Areas affected include Kalimantan and Sumatra of Indonesia, Sarawak and Sabah of Malaysia and the mountainous areas of Mekong region in Vietnam, Cambodia, Laos, Myanmar and Thailand. Indonesia, for example, has lost 60 per cent of its total forest (64 million hectares) over a period of 50 years, from 1950 to 2000, and the loss is continuing at the rate of 2 million hectares per year. Biodiversity is under threat. Hundreds of mammal and bird

species have been declared threatened (UNEP, 1999). Widespread bleaching of coral reefs has been reported in Indonesia, Thailand, Cambodia and Malaysia (Preston *et al*, 2006). Forest under legal protection is not safe; some 56 per cent of protected lowland forest in Kalimantan, Indonesia, has been wiped out in recent years, from 1985 to 2001.

Without effective management, rapid urban growth is expected to exacerbate existing problems of poverty, slums, pollution, water, sanitation, etc. With few exceptions, most municipalities cannot cope with the challenges of rapid urbanization. All the countries in Southeast Asia, except Singapore, are developing countries with little capacity to manage urbanization and climate impacts. Many are struggling to cope with the current climate-related hazards to which they are exposed, including cyclone, rainfall extremes, floods and droughts with severe damage and loss of life (Table 1). Take the Nargis cyclone (2 May 2008). Its winds exceeding 190 kilometers per hour swept through Myanmar's biggest city, Yangon, for more than ten hours, flattening homes, uprooting trees, destroying power lines and creating a disaster of a scale that the country has not dealt with before. In Indonesia, some 75 to 80 percent of all natural disasters during the period of 2003-06 were linked to climatic change (*The Brunei Times*, 2008). Elsewhere, heavy rainfall and typhoon in 2008 have led to flooding in many Southeast Asian countries, including the Philippines, Indonesia, Lao PDR and Vietnam. In addition, scientists are predicting that climate change may trigger more frequent and violent seismic activities (Reuters, 17 Sep 2009).

Global climate change scenarios predict that the region's annual temperature will increase in the order of 0.4-1.3°C by 2030 and 0.9-4.0 deg C by 2070 while winter rainfall is projected to decrease (less than 10 per cent by 2030 and approximately 20-30 per cent by 2070). The effect of a rise in global sea level on the region may be as much as 3-16 cm by 2030 and 7-50 cm by 2070. The region's coastal communities would experience climate damages in the decades ahead (Table 2). Several of the Southeast Asian countries are island-states or in low-lying river deltas. The Mekong river delta of Vietnam and many small islands in Southeast Asia are most at risk. The cost for protecting Southeast Asia against sea-level rise of more than half a meter is estimated

	Cyclones			Droughts			Floods		
	Number of events		Loss of lives	Number of events		Loss of lives	Number of events		Loss of lives
	Annual average	Annual average	Per million	Annual average	Annual average	Per million	Annual average	Annual average	Per million
Cambodia	—	—	—	—	—	—	0.29	48.52	4.08
Indonesia	—	—	—	0.29	60.29	0.34	2.48	120.29	0.67
Lao PDR	0.19	2.67	0.6	—	—	—	0.43	3.29	0.75
Malaysia	0.1	12.86	0.6	—	—	—	0.43	4.43	0.24
Myanmar	—	—	—	—	—	—	0.29	9.05	0.20
Philippines	5.57	863.19	14.35	0.24	0.38	0.01	1.76	75.71	1.22
Thailand	0.71	30.24	0.54	—	—	—	1.33	78.52	1.37
Vietnam	2.24	435.24	6.4	—	—	—	1.00	137.90	1.98

Table 1: Some Major Disasters, 1980-2000, in Selected Countries  
Source: UN-HABITAT (2007a), p 369.

<sup>3</sup> Data obtained from the Climate Analysis Indicators Tool of the World Resources Institute. Available at: <http://cait.wri.org/>.



to be US\$300 billion (Preston *et al*, 2006). According to the *Asia Times*, 26 May 2007, Southeast Asia is possibly one of the most vulnerable areas in the global climate-change scenarios. Extreme climate events are expected to occur more frequently. The Philippines, Vietnam, Cambodia, Lao PDR, Thailand and Indonesia are among the countries identified as climate change 'hotspots' (Yusuf and Francisco, 2009). They are particularly vulnerable to some of the worst manifestations of climate change expected in the coming decades.

Climate change, major drought and flooding are refocusing attention on the environment and sustainable development. Increasingly, more initiatives have been taken, particularly post-Agenda 21 and with international aid, for example, the International Council for Local Government Initiatives (ICLEI) Cities for Climate Protection in Southeast Asia and UN-HABITAT Sustainable Cities Program to make Southeast Asian cities more sustainable. Grants (technical assistance) and loans (for example, GEF funds) are the dominant type of project funding. Many cities in Southeast Asia, including medium-sized cities such as Penang in Malaysia now have a sustainable development initiative. This is an encouraging development, especially as Roberts and Kanaley (2006, p437) pointed out, "Asia's future is urban. It is in developing sustainable cities." In this regard, ASEAN provides an important inter-governmental framework for regional cooperation on climate change and sustainable development. A milestone is the ASEAN Declaration on Environmental Sustainability signed by the country leaders at ASEAN 40<sup>th</sup> anniversary and 13th ASEAN Summit (Nov 2007) in Singapore. The Declaration recognizes the need to encourage the development of an ASEAN Climate Change Initiative and support the development of environmentally sustainable cities.<sup>4</sup> In the area of climate change, the following are stated in the Declaration:

- To work closely with the international community to better understand and adapt to the adverse impacts of climate change, including, in particular, the related issues of greenhouse gas emissions and carbon sinks;
- To agree that the pursuit of climate change and energy security policies should avoid introducing barriers to trade and investment;
- To intensify cooperation on the joint research, development and deployment of low emission technologies for the cleaner use of fossil fuels, recognizing that fossil fuels will continue to play a major role in our energy mix;
- To take concrete measures to promote the use of renewable and alternative energy sources such as solar, hydro, wind, tide, biomass, bio-fuels and geothermal energy, as well as, for interested parties, civilian nuclear power, while ensuring safety and safeguards that are of current international standards, and environmental sustainability throughout the full life cycle of production and use;
- To improve energy efficiency in key sectors of energy use through capacity building and information sharing of best practices in managing energy use and the adoption of appropriate technologies and practices;

Climate Change Impact	Sea Level Rise	Temperature Rise
Brunei		
Cambodia		7
Indonesia	3	8, 9
Lao PDR		7
Malaysia	5	
Myanmar		7
Philippines		10
Singapore		
Thailand		7, 11
Timor-Leste		9
Vietnam	1, 4, 6	7

**Caption**

Sea Level Rise  Affected by a sea level rise < 30 am  
 Affected by a sea level rise > 30 am  
 Not affected even for a sea level rise > 50 am  
Temperature Rise  Affected by a temperature rise of 2°C  
N References

Table 2: Estimated Impact of Climate Change to Southeast Asia  
Sea level rise (<30cm): 1. About 69 – 91 per cent of land area in Mekong Delta, Vietnam affected by sea-level rise during flood season (Wassmann *et al*, 2004).  
Sea level rise (30-50cm): 2. About 29,808 km of shoreline affected in Southeast Asia with direct costs of US\$226 million per year (Darwin, 2001). 3. About 34,000 km<sup>2</sup> of land area lost in Indonesia affecting 3.1 million people (UNEP, 2006). 4. About 86 – 100 per cent of land area in Mekong Delta, Vietnam affected by sea-level rise during flood season (Wassmann *et al*, 2004).  
Sea level rise (→50cm): 5. About 7,000 km<sup>2</sup> of land area lost in Malaysia affecting about 500,000 people (IPCC, 2001). 6. About 40,000 km<sup>2</sup> of land area lost in Vietnam affecting 26.9 million people (UNEP, 2006). About 15 per cent of dry land lost in Vietnam and 8 per cent of GDP (Tol, 2004).  
Temperature rise (<2°C): Large-scale damages to coral reef ecosystems in the region (Hoegh-Guldberg, 1999). Coastal southeastern Asia becomes suitable for malaria transmission (Rogers and Randolph, 2000). Epidemic potential for malaria, and dengue in Southeast Asia changes by +7 – +45 per cent, and +24 – +47 per cent, respectively (Martens *et al*, 1997). Temperature rise (2-4°C): About 4 – 8 per cent of species extinct in tropical woodlands and forests (global estimate) (Tol, 2004). Population at risk for malaria in Southeast Asia declines by 1 million (van Lieshout *et al*, 2004). Number of people experiencing increase in water stress in Southeast Asia increases by 0 – 10 million (Arnell, 2004). 7. Number of people experiencing increase in water stress in Greater Mekong increases by 0 – 105 million (Arnell, 2004). 8. US\$64.5 billion in cumulative health costs associated with treatment of infectious disease in Indonesia; total climate change losses equivalent to US\$766 billion in Indonesia (Asia Development Bank, 1994). 9. Vegetation biomass in southern Southeast Asia (Hadley Centre, 1999). 10. Change in runoff of -12 – +7 in Lake Lanao Reservoir and -12 – +32 in Angat Reservoir, Philippines (Jose and Cruz, 1999). 11. About 1.1 – 3.5 per cent decline in Thailand's GDP (Mendelsohn *et al*, 1998).

- To undertake effective measures towards open and competitive regional and international markets geared towards providing affordable energy at all economic levels to facilitate the adoption of energy-efficient and low-emission technologies.

While progress is being made, especially among countries with higher income, the state of sustainable urban development and climate knowledge in Southeast Asia remains patchy. There are major differences within and across countries. The countries with relatively low adaptive capacity include the poorer countries of Cambodia and Lao PDR while Thailand, Malaysia and Vietnam are

<sup>4</sup> <http://www.aseansec.org/21060.htm>.

countries with relatively high adaptive capacity (Yusuf and Francisco, 2009). International development agency project/program-based activities provide an important source of initiatives. Many of these activities relate to capacity building, data gathering and policy development in specific project/program interest areas. They generally reflect specific project/program scope and are designed to improve project management and implementation rather than capacity development per se. Capacity development is absolutely essential in bringing change to Southeast Asian cities. Improving the effectiveness and cooperation between organizations in setting priorities and developing capacity that is less donor-driven and more demand responsive is needed. The knowledge gap is real.

Of the 28 planning schools in Southeast Asia, apparently none has a teaching program on climate change. Education on planning for climate change is urgently required. Very few are undertaking research on sustainable urban development. Much of the existing climate research is oriented around technologies, for example, air quality, water and energy, such as fuel cells, bio-energy and bio-fuels. A focus on technology though common is too narrow for Southeast Asia. There are signs of change. In the face of rapid urbanization and global warming, the case for sustainable city research is strong and fast emerging as an important agenda. As Blakely (2007, p9) argues in the wider urban planning literature, "Sustainability is now firmly part of the lexicon of planning and is the best grounding for climate change research."

Several regional networks (for example, the Partnerships for Disaster Reduction Southeast Asia, the Asian Cities Climate Change Resilience Network) and research centers have been set up. More funding is being put into research on the environment, climate change and city including at the national level. Knowledge has become urgent as more and more Southeast Asian cities seek the development of a sustainable city for future urban living. LESTARI at the Universiti Kebangsaan Bahasa and National Hydraulic Research Institute of Malaysia (NAHRIM) Research Centre for Water Resources, Government of Malaysia, the latest regional water knowledge hub for climate change adaptation, and the National Environment Research Institute set up in 2007 at National University of Singapore, Singapore, are some examples of the new kind of interdisciplinary research institutions that are emerging in Southeast Asia to research the issues of sustainable city.

The private sector has joined the arena. For example, Siemens Singapore in April 2009 has set up a Siemens city of the future exhibition and solutions center to profile innovative solutions and technologies for city management of future smart, safe and mobile cities. New holistic and interdisciplinary research results on Southeast Asian sustainable urban development can be expected in the years ahead as actors get into doing the interdisciplinarity and disseminate their findings. In the frontline of dynamic and unprecedented growth, urban research needs to break new ground, refocus on the interdisciplinary economic, social, technological/environmental issues of sustainable city, and seek holistic, integrated, multi-disciplinary solutions to the

urban and climate challenges of Southeast Asian cities. The conventional 'business as usual' mode will not work; 'business unusual' suggests thinking outside the box—thinking, approaching, organizing and also funding sustainable urban development research in new ways.

Even as individual countries and the regional body, ASEAN, have declared the need for improving energy efficiency, use of clean energy technologies and renewable and research, only one country, Singapore, presently seems to have more activities on climate change and lead the region in seeking more regional efforts over this issue. Singapore has started to promote climate change-related research and development after signing the Kyoto Accord in late 2006. It is master planning and developing an eco-city in China in partnership with the Chinese government. It is promoting water technology and renewable energy by investing in R&D, including the establishment of research institutes, provision of funding and test-bedding platforms to improve their performance and cost-effectiveness. It has set up an Energy Efficiency Singapore Program Office (E2PO) comprising members from the relevant government and research institutions. E2PO has developed a national plan to promote energy efficiency, comprising actions in several areas:

- Promoting the adoption of energy efficient technology and measures by addressing the market barriers to energy efficiency;
- Raising awareness to reach out to the public and businesses so as to stimulate energy efficient behavior and practices;
- Building capability to drive and sustain energy efficiency efforts and to develop the local knowledge base and expertise in energy management;
- Promoting research and development to enhance Singapore's capability in energy efficient technologies.

Energy production is a major consideration. Several other countries have also started to converge on renewable energy. Malaysia, the Philippines and Thailand have all established renewable energy strategies and targets. Malaysia, for example, has a Five Fuel Diversification Policy since 2000, a small renewable energy power program, Biogen program with a target (2005) of 5 per cent or 500 mw of power capacity. The Philippines renewable energy policy framework 2003 includes a target (2003-2013) of 100 per cent increase of renewable energy power capacity while Thailand's strategic plan for renewable energy development 2003 sets a target by 2011 of 9 per cent renewable energy share in primary energy and 4 per cent renewable energy power capacity.

Energy efficiency policy in Thailand appears one of the most advanced in ASEAN. The driver is the Thai government's vision to establish Thailand as the Regional Energy Centre for Southeast Asia. It has implemented a Strategic Plan for Renewable Energy Development. Solar, wind, biomass, biogas, hydro, bio-fuels, geothermal and fuel cells are included in the Strategic Plan as well as energy efficiency (Australian Business Council for



Sustainable Energy, 2005). Its Department of Energy Development and Promotion and Energy Policy Office are pursuing activities such as consumer education, industrial energy audits, thermal/electricity energy efficiency demonstration projects and end-use studies. In the Philippines, integrating GHG emission reduction and avoidance strategies into the city's operations of waste management, land use planning, transport improvement and building retrofits such as in the Cagayan de Oro, Philippines ICLEI project could serve as a promising practice for other cities (ICLEI, 2009). Cagayan de Oro is greening its energy supply and making demand-side improvements with the target to reduce GHG emissions by 10 per cent against forecasted emissions growth.

There are increasing efforts, both commercially and promoted by government, to develop and expand bio-fuel production; bio-diesel from palm oil is especially favored. Although bio-fuel is often pitched as a sustainable energy source, there is concern that the rush to develop it may result in more destruction of old forests to clear the way for oil-palm plantations, contributing to the problem of slash and burn as well as resultant haze pollution in adjoining urban areas. There is also a regional shift towards more natural gas, which is desirable in terms of its lower carbon-dioxide emissions. By 2006, 78 per cent of Singapore's electricity was generated by natural gas using highly efficient combined cycled technology, one of the most advanced in the world. But, natural gas has its obstacles, including delays in constructing pipelines and issue with upstream production, which often releases carbon dioxide unless engineering measures are taken to re-inject the gas.

More hydropower is likely to be used, especially in the Mekong region. But, again there are environmental concerns as to the impact of the river damming on downstream river life and communities vulnerable to drought. Vietnam, in particular, is finding this a major problem, with its exceptionally dry seasons during the past two to three years, leading to low water levels in the reservoirs behind hydro-dams and competition in supply for farmers down river for rice irrigation and for power generation. Nuclear power has also emerged as a serious possibility in several countries, including Vietnam, Indonesia, Thailand and Myanmar. Again, there are many issues here, ranging from economic feasibility to safety and weapons-proliferation concerns that require research and policy development to address. Policies and mechanisms conducive to knowledge dissemination and technology transfer among countries including between advanced developed countries and Southeast Asia are clearly required.

### 3. URBAN PLANNING REVISITED

Even though global climate change awareness has been around for some time, it is only in recent years that cities and urban planners in the region appear to consider the environment in their planning of competitive and livable cities. Many countries have begun to address climate change issues in different ministries. Some have formulated national climate change policy with

measures for adaptation and mitigation (see Table 3). Increasingly, environmental sustainability is mentioned in development plans. In 2008, ASEAN presented the first ASEAN Environmentally Sustainable City award to 10 cities/townships/districts in ASEAN that have made exemplary effort towards environmental sustainability. These 10 cities are: Brunei Darussalam: Temburong District, Cambodia: Municipality of Phnom Penh, Indonesia: Palembang City, Lao PDR: Luang Prabang District, Malaysia: North Kuching City Hall, Myanmar: Taungyi City, Philippines: Puerto Princesa City, Singapore: South West Community Development Council, Thailand: Bangkok City, Vietnam: Ha Long City. By and large, climate change is not mainstreamed in development plans.

Mainstreaming of climate change in development planning is critical. UN-HABITAT (2007b) has reiterated that urban planning is important in managing climate change because well-planned cities provide a better foundation for sustainable development than unplanned cities. Both adaptation and mitigation actions of environmental change require urban planning. Among others, urban planning and development control could help to mitigate the urban heat island effect by creating open spaces and parks as heat sinks in urban areas, reduce the urban ecological footprint by planning for more efficient, compact and mixed use city forms and a shift to public transport-based movement. In the urban and planning literature, there is a gradual shift of focus on mitigation actions to a concern with longer term adaptation measures of, for example, preventing flooding and landslides, protecting or relocating vulnerable settlements, improving drainage and preventing new developments in areas likely to be affected by sea level rise or floods, among others. The integrative planning of a future climate regime has significant implications for Southeast Asian urbanization, especially in mega-cities and vulnerable areas. Raising the policy profile of climate change within the context of sustainable development is crucial in realizing the vision of a sustainable Southeast Asia.

Land use change has impact on the carbon balance of ecosystems. Practices that detract from environmental sustainability cannot be promoted. At its simplest, the common planning typology of land use zoning determines land cover types. Land cover types affect energy and water consumption as well as waste and traffic production and GHG emissions (Pauleit and Duhme, 2000). In many developing countries, local authorities lack the mandate and human capacity to handle urban planning and its enforcement mechanisms. As the Asian Development Bank (2008) concluded in its review of managing Asian cities, capacities are deficient in key areas of urban management, economic and social planning and environmental management in many Asian cities, Southeast Asian cities included. The comparative newness and unprecedented scale of urbanization has accentuated the problem. Improved technical competence in urban planning is required at all levels of government.

Beyond the demand for professional urban planning education, most developing countries in the region are facing the problem of

Climate change actions	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Timor-Leste	Vietnam
Ratification of the 1997 Kyoto Accord to the 1992 United Nation Framework Convention on Climate Change		•	•	•	•	•	•	•	•	•	•
National climate change strategy or actions plan		• <sup>1</sup>	• <sup>2</sup>	•	•		• <sup>3</sup>	•	•		
National climate change committee or inter-agency task force	•	• <sup>4</sup>	•	• <sup>5</sup>	•		•	•	•		
Development plan mentions climate change		•	•				•	•	•		•
Green building movement	•		•		•		•	•	•		•
Green Neighborhood								•			
Eco-city planning					•			•			
Study of vulnerability to climate change		•	•				• <sup>6</sup>	•			
Implementation of CDM		•	•	•	•	•	•		•		•
Urban planning policy for climate change				• <sup>7</sup>	•		•				
Clean air policy	• <sup>8</sup>		•		•		•	•	•		
Energy efficiency policy			•		•		• <sup>9</sup>	•	•		•
Building control act for climate change			•		•			•			
Promotion of renewable energy		• <sup>10</sup>	•	• <sup>11</sup>	•		•	•	•		•
Clean & renewable energy research and development			•					•			
Develop resilient water resource			• <sup>12</sup>				•	•	•		•

Table 3 - Climate Change Actions

1. The Ministry of Environment (2001) has developed the National Action Plan on Climate Change. In August 2003, CCCO started implementation of a new project, the National Adaptation Program of Action to Climate Change with financial support from GEF through UNDP.
2. Indonesia released the National Action Plan for Climate Change Mitigation and Adaptation at the end of 2007. The document still demands revision by related sectors, academics and experts. See The Brunei Times, 10 July 2008 [http://www.bt.com.bn/en/opinion/2008/07/10/tackling\\_climate\\_change\\_the\\_finetest\\_way](http://www.bt.com.bn/en/opinion/2008/07/10/tackling_climate_change_the_finetest_way).
3. Funded by USAID.
4. The Ministry of Environment has set up a separate office called Cambodia Climate Change Office (CCCO) in June 2003.
5. Science, Technology and Environment Agency has a key role to coordinate across all ministries and local authorities to manage the overall environment throughout Lao PDR.
6. An ADB climate change project in 1991 assessed Philippines' vulnerable sectors and areas to climate change including agriculture, water resources and coastal areas.
7. Pragmatic integrated transport plans for the main urban centre and the formulation of an overall urban transport policy including the possibility of mass public transport are high priority of Lao PDR government facing rapidly increasing volumes of motorized traffic in urban centers.
8. Brunei has national programs include improvements of transportation infrastructure to reduce traffic congestion, cogeneration power station to reduce emissions of pollutant gases, and full use of unleaded gasoline to reduce air pollution. <http://www.wpro.who.int/NR/rdonlyres/64F00DEF-F568-4A03-8855-13C2958D0B4B/0/BRU.pdf>.
9. Energy efficiency programs in the Philippines are directed by the Department of Energy and guided by an Energy Plan that currently covers the period from 2002 to 2011. See Renewable Energy and Energy Efficiency Partnership <http://www.reeep.org/index.php?id=9353&text=policy-db&special=viewitem&cid=72>.
10. Renewable Electricity Action Plan 2002–2012. See Renewable Energy and Energy Efficiency Partnership <http://www.reeep.org/index.php?id=9353&text=policy-database&special=viewitem&cid=30>.
11. A World Bank-assisted project in 1997 has demonstrated renewable energy technologies as off-grid electrification options to reduce inefficient use of fossil fuels in diesel generators in rural areas.
12. Solar energy desalination project in North Jakarta district.

weak capacity of local or municipal government. Visions are lacking. Planning is generally short-term, physically oriented and unable to respond effectively to change. Newer and more innovative planning approaches are in order. There is also the issue of plan implementation. Plans that reflect sustainable development principles carry no meaning if they are not implemented. There is an urgent need to strengthen the institutional capabilities that are prerequisite to effective plan implementation. More attention has to be given to the functioning of the planning system and as such, to legislation, regulations and processes that are out of date or are insufficiently reformed to be able to deal with the major challenges of the 21<sup>st</sup> century. Strong government leadership is indispensable, particularly where there is a need to create inclusive policy conditions and a

multi-stakeholder process for plan implementation. Proper modalities should also be developed to monitor plan implementation and ensure its continued relevance to changing conditions and dynamics.

Well-planned cities are not only efficient but also make sustainable use of resources including space, energy and water. Take Singapore. The strong state commitment to planning has transformed the city from 'third world to first world' (Lee, 2000; Yuen 2004). Its comprehensive, strategic, integrated urban development planning has led to the efficient use of space, clustering many people in a relatively smaller land area, often through high-rise high-density settlements. Research has indicated that denser urban areas emit less radiant heat energy

per parcel than do more expansive developed areas (Stone and Rodgers, 2001). The co-location of high-rise, high-density urban form, services and employment is purposefully designed to configure a hierarchy and location of community facilities that reduce or minimize travel by private car and enhance walking and usage of public transportation while enhancing quality of life. Its deliberate greening policy at the building, neighborhood and city levels gives careful consideration to the relationship between the built and natural environments, creating a garden city and increasing the cooling potential of its built-up areas. Additionally, since 2007, green buildings have been encouraged. These buildings adopt various energy efficiency ways and designs to minimize impact on climate change, including the use of recycled or recyclable materials for construction.

Singapore is building its first eco-friendly precinct of 700 public housing flats, expected to complete by 2011, to promote sustainable green living. There will be more greenery provision, which is expected to lower the surrounding temperature by as much as 4°C. Solar panels on the roof of buildings will power the common corridors, improving energy resource utilization and saving 80 percent of the energy used. On the industrial front, it has built an industrial park on Jurong Island planned on the principle of industrial symbiosis where the waste or by-product of one enterprise becomes the resource or input of another. While Singapore may have its unique characteristics, its strong commitment to planning bears testimony to planning in action. In the era of climate change, cities must be planned to develop sustainably from the start. However, planning is not static. The environmental dimension of urban planning is increasingly also about enabling and adapting cities to meet the dynamics of climate change.

More than ever, sustainable urban development is now the key theme of urban planning and is fundamental for climate change policy. Energy efficient buildings and built form, renewable energy sources, climate responsive design and standards together with open space and green areas are important to ensure a sustainable neighborhood. Cities can take proactive measures to reduce emissions from vehicles. Motor vehicles—a major source of carbon dioxide emissions—are set to increase in Southeast Asian cities. In per capita terms, car ownership is still low. But, in large urban areas, growing car ownership continues to congest cities, pollute the atmosphere and endanger community health through vehicle exhaust. Alternative urban form aside, better public-transport systems from buses to rail and sustainable transport options are clearly critical. Bangkok, Thailand, long notorious for traffic jams and air pollution, is now benefiting from its light rail and underground rail system as well as stricter standards and controls on gasoline quality. In a similar vein, there are plans for mass-transit systems for the large and fast-growing cities of Hanoi and Ho Chi Minh in Vietnam, the fastest-growing economy in the region.

Urban planning, though essential is not sufficient, in addressing climate change. Population, economic development, technology

advancement and government policies on energy and environment are key drivers of GHG emissions and interlinked in a complex web of interactions. Energy production and use, for example, are sensitive to changes in the climate. The climate change effects on energy supply and demand will depend not only on climatic factors but also on the patterns of economic growth, land use, population growth and distribution, technological change and social and cultural trends that shape individual and institutional actions. Understanding these major driving forces will enable the setting of corresponding adaptation strategies and policies to overcome entrenched lifestyle preferences that significantly contribute to climate change. To succeed, climate proofing requires concerted action across all sectors. This includes cooperation and joint programming on population, economic growth, GHG emissions control, R&D, application of clean technologies, renewable energy and eco-city policies to ameliorate GHG emissions, among others.

Collaboration across planning, enforcement and compliance regimes can strengthen the integration of environmental concerns into the wider development agenda. As demonstrated by the Singapore experience, the government plays a critical role in the coordination approach and creating policies, incentives and disincentives and plans that encourage sustainable urban development, in environmental education and training, and enforcement of policies and regulations. To improve the resilience of Southeast Asian cities to climate change, it is imperative to also implement institutional strengthening and capacity building to ensure that the institutions and human capital have the knowledge on climate change and are able to make effective decision, allocate resources and manage risk and implementation.

## CONCLUSION

The challenge of climate change in Southeast Asia is real and urgent. Climate change is likely to amplify some of the existing urban and environmental stresses and vulnerabilities of its urban communities, many of which are living in coastal and low-lying areas and rapidly expanding mega-cities. A business-as-usual scenario is unlikely to support a sustainable Southeast Asia. Measured against this situation, Southeast Asian responses to date have been largely inadequate even though several important steps have been taken and a number of essential foundations, both at country and regional levels, have been established for further action. For example, ASEAN leaders have recently signed the Declaration on Environmental Sustainability and the ASEAN cooperation in environment has established a common agenda and forged consensus on some policy goals for sustainable development as well as action to address trans-boundary haze pollution, nature conservation and biodiversity, marine and coastal environment problems. Another milestone is the establishment of the ASEAN sub-regional climate review meeting in 2000 to closely monitor the weather condition especially during the dry seasons to prevent and mitigate the damages from recurrent fires and haze. Yet, its urban land, forests and rivers remain environmentally vulnerable.

While there is no standard model solution and sustainable development may be more complicated than the commonly acknowledged economic, social and environmental dimensions in practice, the importance of sustainable development as the guiding principle to climate proofing cannot be neglected. The mainstreaming of climate issues into national strategies and development planning is crucial. In all cases, urban planning offers an important entry point, shaping urban form in very particular ways with implications on climate change. The proactive development of newer and innovative planning is essential for better environmental management and sustainable development in this vein. The emergence of urban planning's central role has reinforced the need for truly cross-sectoral integration to be in place as well as capacity development so as not to overburden the already weak implementation capacity.

## REFERENCES

- Arnell N. (2004). "Climate change and global water resources: SRES emissions and socioeconomic scenarios." *Global Environmental Change*, 14, 31-52.
- Asian Development Bank (ADB) (1994). *Climate Change in Asia: Executive Summary*, Manila, ADB.
- Asian Development Bank (ADB) (2008). *Managing Asian Cities*, Manila, ADB.
- Asia-Pacific Energy Research Centre (APERC) (2006). *APERC Energy Demand and Supply Outlook 2006*.
- Australian Business Council for Sustainable Energy (2005). *Renewable Energy in Asia: The Thailand Report*, August.
- Blakely E. J. (2007). "Urban planning for climate change." Lincoln Institute of Land Policy Working Paper.
- Darwin R. F. & Tol R. (2001). "Estimates of the economic effects of sea-level rise." *Environmental and Resource Economics*, 19, 113-129.
- Hadley Centre (1999). "Climate change and its impacts: stabilisation of CO<sub>2</sub> in the atmosphere." Hadley Centre for Climate Prediction and Research, Met Office, UK, [http://www.met-office.gov.uk/research/hadleycentre/pubs/brochures/B1999/climate\\_web.pdf](http://www.met-office.gov.uk/research/hadleycentre/pubs/brochures/B1999/climate_web.pdf)
- Hoegh-Guldberg O. (1999). "Climate change, coral bleaching and the future of the world's coral reefs." *Marine and Freshwater Ecology*, 50, 839-866.
- ICLEI (2009). *International Council for Local Environmental Initiatives: Cities for Climate Protection in Southeast Asia*, <http://www.epa.gov/usctcgat/file/toolmanager/086C299F62935.pdf>
- International Energy Agency (2002). *World Energy Outlook 2002*, IEA/OECD, Paris.
- IPCC (2001). *Climate Change 2001: Impacts, Adaptation and Vulnerability*. McCarthy J. *et al.* (editors) Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, World Meteorological Organisation and United Nations Environment Programme. Cambridge University Press.
- Jones G. W. (2002). "Southeast Asian urbanization and the growth of mega-urban regions." *Journal of Population Research*, 19(2), 119-136.
- Jones C. D., *et al.* (2003). "Strong carbon cycle feedbacks CO<sub>2</sub> and sulphate aerosols." *Geophysical Research Letters*, 30, doi:10.1029/2003GL01686.
- Jose A. M. & Cruz N. A. (1999). "Climate change impacts and responses in the Philippines: Water Resources." *Climate Research*, 12, 77-84.
- Lee K. Y. (2000). *From Third World to First: The Singapore Story, 1965-2000*. New York: HarperCollins.
- Martens W. J. M., Jetten T. H., & Focks A. D. (1997). "Sensitivity of malaria, schistosomiasis and dengue to global warming." *Climatic Change*, 35, 145-156.
- Mendelsohn R., Morrison W., Schlesinger M. E., and Andronova N. E. (1998). "Country-specific market impacts of climate change." Proc., IPCC Asia-Pacific Workshop on Integrated Assessment Models, 10-12 March, 1997, Tokyo, Japan. [http://crga.atmos.uiuc.edu/publications/market\\_impact/MarketImp.PDF#search=%22Country-specific%20market%20impacts%20of%20climate%20change%22](http://crga.atmos.uiuc.edu/publications/market_impact/MarketImp.PDF#search=%22Country-specific%20market%20impacts%20of%20climate%20change%22)
- Pauleit S. & Duhme F. (2000). "Assessing the environmental performance of land cover types for urban planning." *Landscape and Urban Planning*, 52(1), 1-20.
- Preston L. B. *et al.* (2006). *Climate Change in the Asia/Pacific Region, Consultancy Report Prepared for the Climate Change and Development Roundtable*, CSIRO Marine and Atmospheric Research.
- Roberts, B. & Kanaley, T. (2006). *Urbanisation and Sustainability in Asia*, Manila: ADB.
- Rogers D. J. & Randolph S. E. (2000). "The global spread of malaria in a future warmer world." *Science*, 289, 1763-1766.
- Stone J. B. & Rodgers M. O. (2001). "Urban form and thermal efficiency: How the design of cities influences the urban heat island effect." *Journal of the American Planning Association*, Spring, 186-198.

The Brunei Times (2008). from the country report presented by the Department of Public Works of Indonesia during the COP Conference of 13 Parties in Bali in November 2007, [http://www.bt.com.bn/en/opinion/2008/07/10/tackling\\_climate\\_change\\_the\\_finetest\\_way](http://www.bt.com.bn/en/opinion/2008/07/10/tackling_climate_change_the_finetest_way)

Tol R. S. J. (2004). "The Double Trade-Off Between Adaptation and Mitigation for Sea-Level Rise: An Application of FUND." Working Paper FNU-48, Research Unit Sustainability and Global Change, Hamburg University and Centre for Marine and Atmospheric Sciences, Hamburg, Germany, <http://www.uni-hamburg.de/Wiss/FB/15/Sustainability/slradaptmitigatewp.pdf>

UNEP (1999). Global Environment Outlook 2000. London: Earthscan.

UNEP (2006). Geo Year Book 2006: An Overview of Our Changing Environment. Early Warning and Assessment, United Nations Environment Programme, Nairobi, Kenya, [http://www.unep.org/geo/yearbook/yb2006/PDF/Complete\\_pdf\\_GYB\\_2006.pdf](http://www.unep.org/geo/yearbook/yb2006/PDF/Complete_pdf_GYB_2006.pdf)

United Nations (2004). World Urbanization Prospects: The 2003 Revision, United Nations, Department of Economic and Social Affairs, New York.

UN-HABITAT (2003). Water and Sanitation in the World's Cities: Local Action for Global Goals, London: Earthscan.

UN-HABITAT (2007a). Enhancing Urban Safety and Security: Global Report on Human Settlements 2007, London: Earthscan.

UN-HABITAT (2007b). UN-HABITAT pitches for urban planning, Bonn, <http://www.unhabitat.org/content.asp?cid=4836&catid=550&typeid=6&subMenuId=0>

Van der Werf G. R. *et al.* (2004). "Continental-scale partitioning of fire emissions during the 1997 to 2001 El Niño/La Niña period." *Science*, 303, 73-76.

Van Lieshout M. *et al.* (2004). "Climate change and malaria: Analysis of the SRES climate and socio-economic scenarios." *Global Environmental Change*, 14, 87-99.

Von Einsiedel N. (2004). "Strengthening local government capacities in urban planning and finance: Lessons from the East Asian city development strategies," in Freire, M., and Yuen, B., editors, *Enhancing Urban Management in East Asia*, Ashgate: Aldershot, p 159-169.

Wassmann R., *et al.* (2004). "Sea level rise affecting the Vietnamese Mekong Delta: Water elevation in the flood season and implications for rice production." *Climatic Change*, 66, 89-107.

Williamson L. (2007). BBC News, 2 May 2007, <http://news.bbc.co.uk/2/hi/asia-pacific/6610973.stm>

Yuen B. (2004). "Planning Singapore growth for better living" in Freire M., and Yuen B., editors, *Enhancing Urban Management in East Asia*, Ashgate: Aldershot, p 55-70.

Yusuf A. A. & Francisco, H. (2009). *Climate Change Vulnerability Mapping for Southeast Asia*, IDRC.