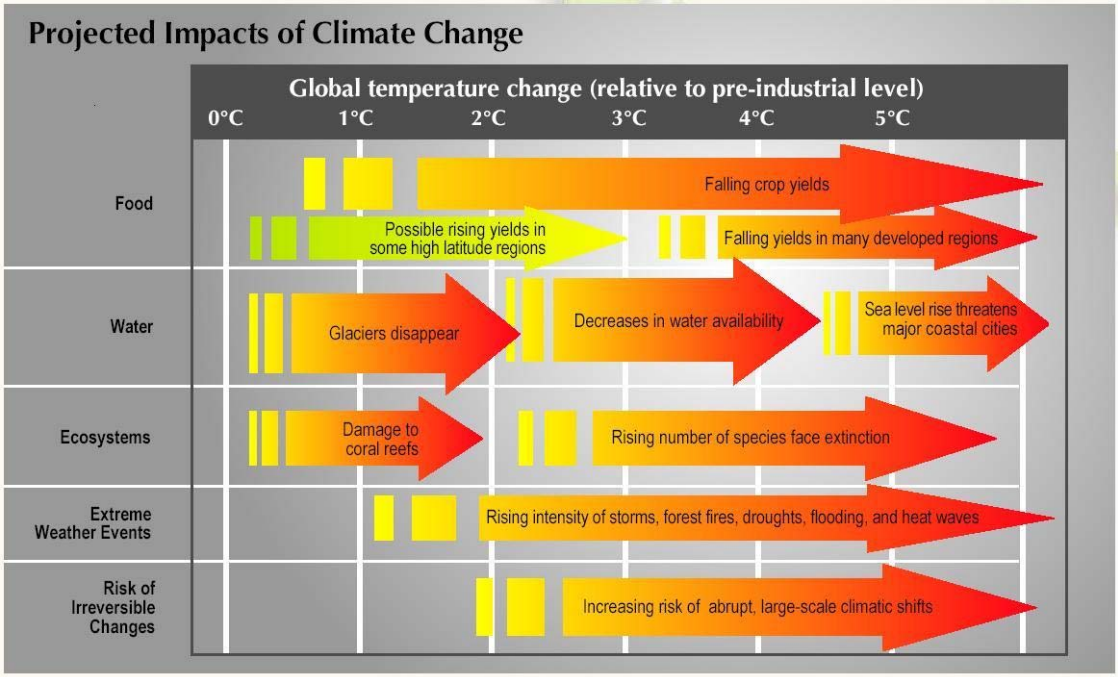
CLIMATE CHANGE IN ASIA

Mrs Quach Thi Nhan is a subsistence farmer living in An Phu Commune, about 100km from Hanoi, the capital of Vietnam. National economic growth of about 8% per year has contributed to many improvements in the life of her family during the last 5 to 10 years. But she says the environment around her is getting worse, and the weather is changing. She believes the cause of the deteriorating environmental conditions and the changing weather to be the local brick kilns, which have multiplied all around An Phu Commune in recent years, to supply the booming suburban construction industry. These hundreds of small kilns burn coal and rice husks, and produce (in addition to bricks) smoke, dust, and ash. Mrs Nhan says that in recent years there are more droughts, and more floods in An Phu. And the winters are colder, and the summers are hotter. This last winter, several buffalo died in her village because villagers didn't know how to care for them in the cold. Apart from the family house, a buffalo can be a family's most valuable physical asset. This spring farmers in An Phu had to plant their spring rice crop late, because of the long cold winter.

The poor in the developing world – those who have contributed the least to causing Climate Change – are the people who experience its effects most severely. There are three broad reasons for this. First, the livelihoods of the poor in the developing world are most directly dependent on agriculture, which is dependent on climate. Second, a large proportion of developing countries already have warmer climates than developed countries, therefore the effects of further warming are more extreme. Finally, the poor are the least able to afford to pay for any inputs or resources which could help them adapt their livelihoods to Climate Change.

The projected impacts of Climate Change are depicted below, (adapted from Stern, N. 2006):



The United Nations Framework Convention on Climate Change (*UNFCCC, 2007*) provides the following analysis of Climate Change in Asia:

Asia has the highest population of any continent in the world, and partly as a consequence it faces some of the most difficult environmental and socio-economic challenges. Land and ecosystems are already being degraded, threatening to undermine food security. Water and air quality are deteriorating while continued increases in consumption and associated waste have contributed to the exponential growth in the region's existing environmental problems. The region is also highly subject to natural hazards, such as the 2004 Indian Ocean Tsunami, the 2005 Pakistan Earthquake, and the 2006 landslides in the Philippines. There is evidence of prominent increases in the intensity and/or frequency of many extreme weather events such as heat waves, tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms, and severe dust storms in the region (Cruz *et al*. 2007). Impacts of such disasters range from hunger and susceptibility to disease, to loss of income and livelihoods, affecting human survival and well-being. For example the extreme weather events in China during 2006 included major storms and flooding in the east and south, as well as heat and drought in central, western and north-eastern regions, killing more that 2700 people and causing USD 20 billion in damages.

Climate change will affect many sectors, including water resources, agriculture and food security, ecosystems and biodiversity, human health and coastal zones (see Table below). Many environmental and developmental problems in Asia will be exacerbated by climate change. Under climate change, predicted rainfall increases over most of Asia, particularly during the summer monsoon, could increase flood-prone areas in East Asia, South Asia and Southeast Asia. In Central and South Asia, crop yields are predicted to fall by up to 30 per cent, creating a very high risk of hunger in several countries. Global warming is causing the melting of glaciers in the Himalayas. In the short term, this means increased risk of flooding, erosion, mudslides and GLOF in Nepal, Bangladesh, Pakistan, and north India during the wet season. Because the melting of snow coincides with the summer monsoon season, any intensification of the monsoon and/or increase in melting is likely to contribute to flood disasters in Himalayan catchments. In the longer term, global warming could lead to a rise in the snowline and disappearance of many

glaciers causing serious impacts on the populations relying on the 7 main rivers in Asia fed by melt water from the Himalayas. Throughout Asia one billion people could face water shortage leading to drought and land degradation by the 2050s (Christensen *et al*. 2007, Cruz *et al*. 2007).

In Asia, the principal impacts of climate change on health will be on epidemics of malaria, dengue, and other vector-borne diseases (Martens *et al*. 1999). The global burden of climate change-attributable diarrhoea and malnutrition are already the largest in the world in Southeast Asian countries including Bangladesh, Bhutan, India, Maldives, Myanmar and Nepal in 2000. Illness and death are expected to increase from diarrhoeal diseases due to drought and flooding, and are also expected from increased amounts of cholera bacteria in coastal waters. An increase in the frequency and duration of severe heat waves and humid conditions during the summer is likely to increase the risk of mortality and morbidity, principally in the old and urban poor populations of temperate and tropical Asia (Epstein *et al*. 1995) and high temperatures and poor urban air quality, such as in Chongqing, China and in Jakarta, Indonesia, could contribute to widespread heat stress and smog induced illnesses in urban populations (Cruz *et al*. 2007).

Table. Impacts and Vulnerabilities to Climate Change in Asia (Christensen et al. 2007 and Cruz et al. 2007).

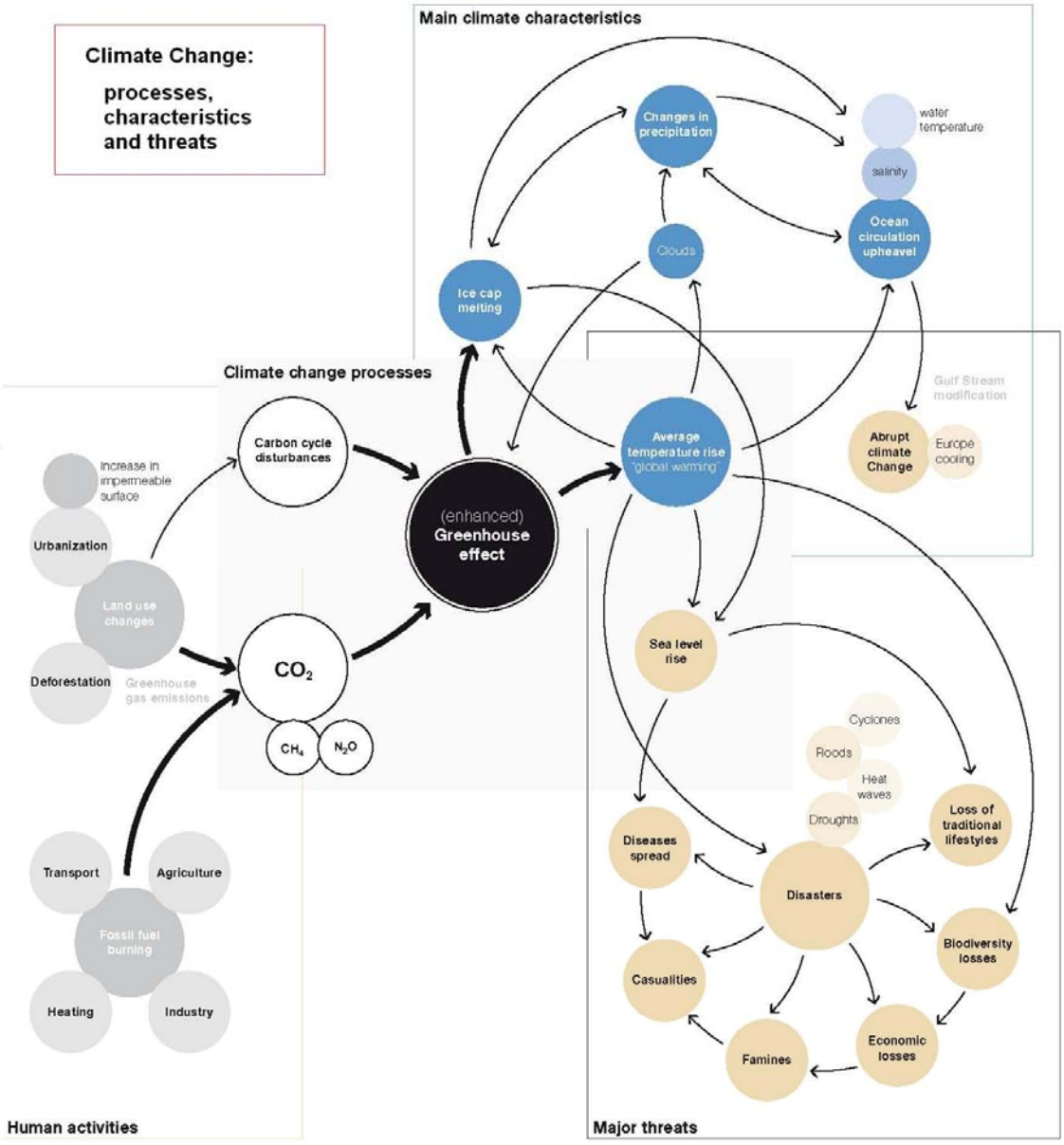
Impacts	Sectoral Vulnerabilities	Adaptive Capacity
Temperature – Warming above the global mean in central Asia, the Tibetan Plateau, northern, eastern and southern Asia. Warming similar to the global mean in Southeast Asia. – Fewer very cold days in East Asia and South Asia. **Precipitation, snow and ice** – Increase in precipitation in most of Asia. Decrease in precipitation in central Asia in summer. – Increase in the frequency of intense precipitation events in parts of South Asia, and in East Asia. – Increasing reduction in snow and ice in Himalayan and Tibetan Plateau glaciers **Extreme Events** Increasing frequency and intensity of extreme events particularly: – droughts during the summer months and El Niño events; – increase in extreme rainfall and winds associated with tropical cyclones in East Asia, Southeast Asia and South Asia; – intense rainfall events causing landslides and severe	**Water** – Increasing water stress to over a hundred million people due to decrease of freshwater availability in Central, South, East and Southeast Asia, particularly in large river basins such as Changjiang. – Increase in the number and severity of glacial melt-related floods, slope destabilization followed by decrease in river flows as glaciers disappear. **Agriculture and food security** – Decreases in crop yield for many parts of Asia putting many millions of people at risk from hunger. – Reduced soil moisture and evapotranspiration may increase land degradation and desertification. – Agriculture may expand in productivity in northern areas. **Health** – Heat stress and changing patterns in the occurrence of disease vectors affecting health. – Increases in endemic morbidity and mortality due to diarrhoeal disease in south and Southeast Asia. – Increase in the abundance and/or toxicity of cholera in south Asia. **Terrestrial Ecosystems**	Adaptive capacity varies between countries depending on social structure, culture, economic capacity, geography and level of environmental degradation. Capacity is increasing in some parts of Asia, for example the success of early warning systems for extreme weather events in Bangladesh and the Philippines. However, capacity is still constrained due to poor resource bases, inequalities in income, weak institutions and limited technology.

floods; – heat waves/hot spells in summer of longer duration, more intense and more frequent, particularly in East Asia.	– Increased risk of extinction for many species due to the synergistic effects of climate change and habitat fragmentation. – Northward shift in the extent of boreal forest in north Asia, although likely increase in frequency and extent of forest fires could limit forest expansion. **Coastal Zones** – Tens of millions of people in low-lying coastal areas of south and Southeast Asia affected by sea level rise and an increase in the intensity of tropical cyclones. – Coastal inundation is likely to seriously affect the aquaculture industry and infrastructure particularly in heavily-populated megadeltas. – Stability of wetlands, mangroves, and coral reefs increasingly threatened.	

In recent years, enormous pressures have been put on Asia's ecosystems to support the ever growing demand for natural resources. The most affected areas are coastal and marine ecosystems, forests and mountainous regions and the flora and fauna within them. Climate change will have a profound effect on the future distribution, productivity, and health of forests throughout Asia, for example northeast China may become deprived of conifer forest.17 Grassland productivity is expected to decline by as much as 40 – 90 per cent for an increase in temperature of 2 – 3° C, combined with reduced precipitation, in the semi-arid and arid regions of Asia.

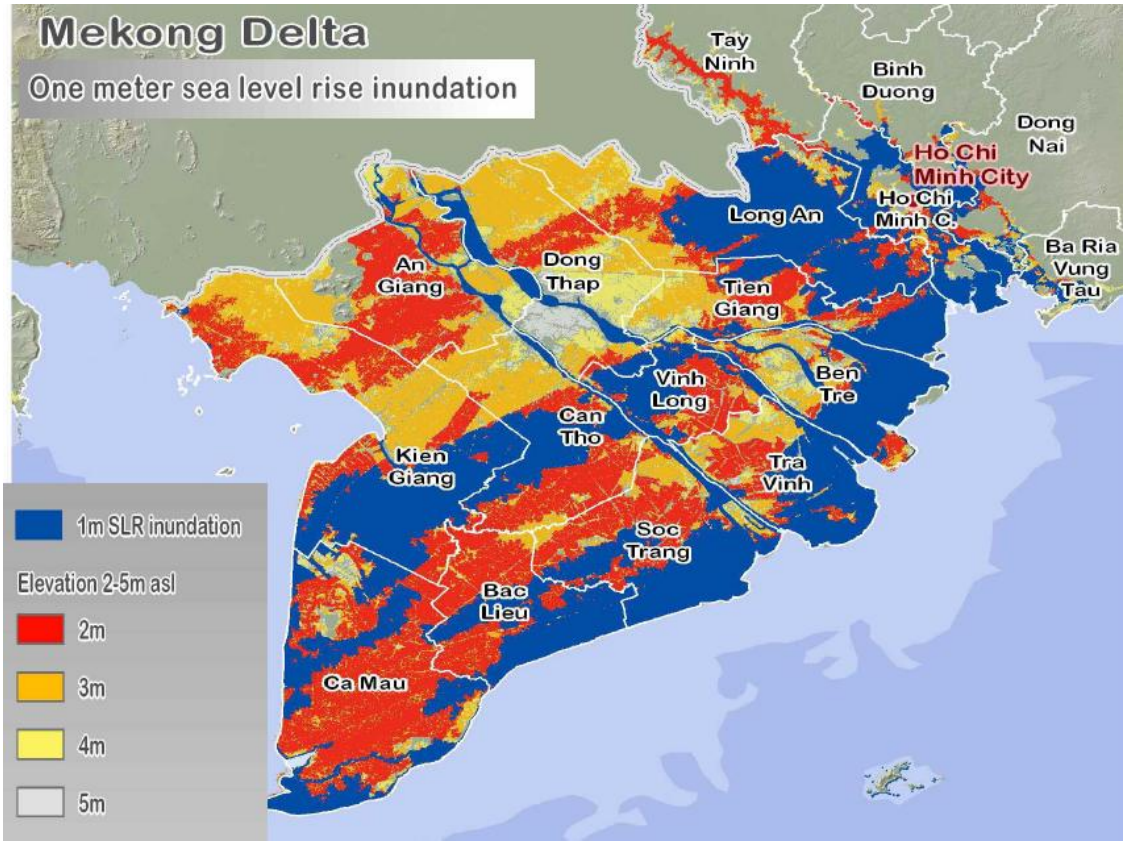
Fisheries in both fresh water and sea water could be affected. Fisheries at higher elevations are likely to be adversely affected by lower availability of oxygen due to a rise in surface air temperatures. In the plains, the timing and amount of precipitation could also affect the migration of fish species from the river to the floodplains for spawning, dispersal, and growth (FAO 2003). Sea level rise and changes in sea water temperature, salinity, wind speed and direction, strength of upwelling, mixing layer thickness and predator response to climate change have the potential to substantially alter fish breeding habitats and food supply for fish and ultimately the abundance of fish populations in Asian waters with associated effects on coastal economies (Cruz *et al*. 2007).

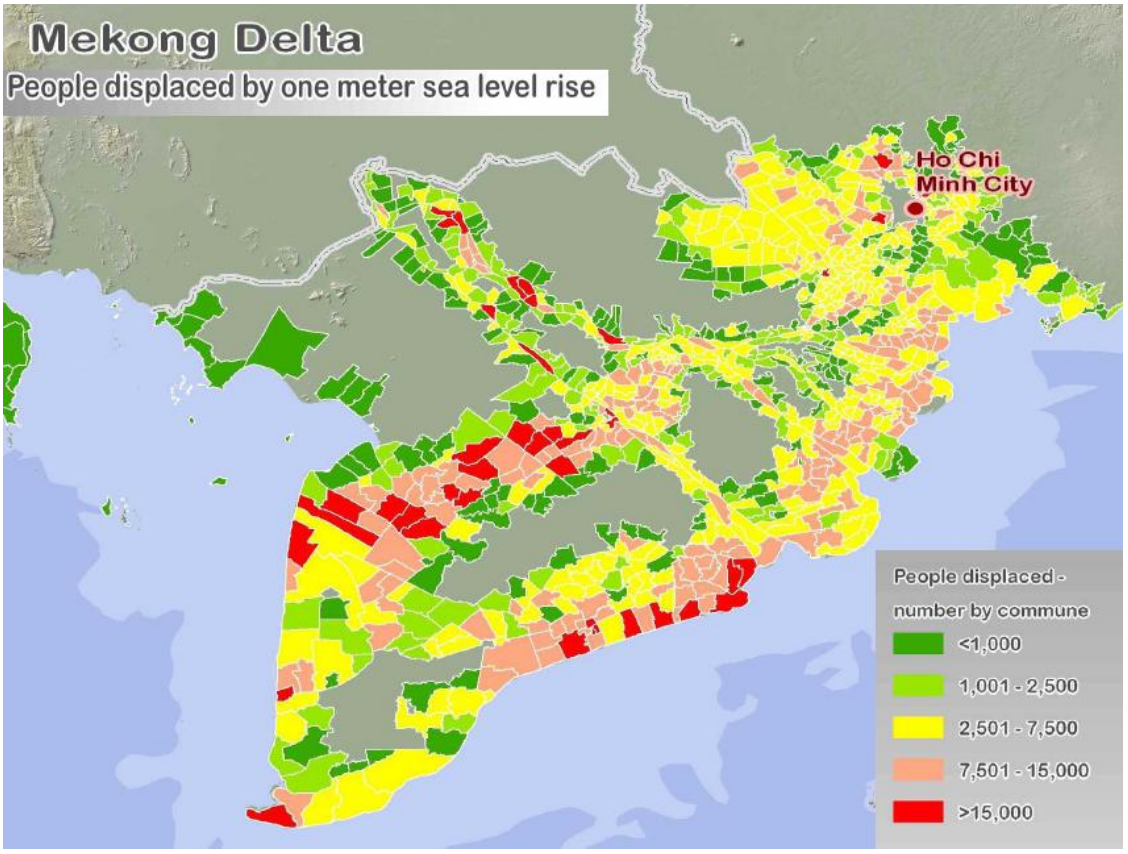
Projected sea level rise could flood the residence of millions of people living in the low lying areas of South, Southeast and East Asia such as in Viet Nam, Bangladesh, India and China (Wassmann et al. 2004, Stern 2006, Cruz et al. 2007) and 30 percent of coral reefs could be lost in the next 10 years (Cruz et al. 2007). The loss may be as high as 88 per cent (59 per cent of global) in the next 30 years (Sheppard 2003; Wilkinson 2004).



Among Asian countries, **Vietnam** will be one of the most severely impacted by Climate Change, because of its long coast which is vulnerable to storms and seas, and because of its large low-lying areas in the southern Mekong Delta, which is the country's largest rice-producing area.

The International Centre for Environmental Management (ICEM, 2007) provides the following maps and tables showing the impact of a one metre sea-level rise (SLR) in the Mekong Delta area.


Mekong Delta
One meter sea level rise inundation
Tay Ninh
Binh Duong
Dong Nai
Ho Chi Minh City
Ho Chi Minh C.
Long An
Ba Ria Vung Tau
An Giang
Dong Thap
Tien Giang
Vinh Long
Ben Tre
Can Tho
Kien Giang
Tra Vinh
Soc Trang
Bac Lieu
Ca Mau
1m SLR inundation
Elevation 2-5m asl
2m
3m
4m
5m



Top 10 provinces: percent inundated by lm SLR

Province	Total area (sq.km)	Area inundated (sq.km)	Percent inundated
Ben Tre	2,257	1,131	50.1
Long An	4,389	2,169	49.4
Tra Vinh	2,234	1,021	45.7
Soc Trang	3,259	1,425	43.7
Ho Chi Minh City	2,003	862	43.0
Vinh Long	1,528	606	39.7
Bac Lieu	2,475	962	38.9
Tien Giang	2,397	783	32.7
Kien Giang	6,224	1,757	28.2
Can Tho	3,062	758	24.7
TOTAL	**29,827**	**11,474**	**38.5**

ICEM also predicts:

By 2100, 14,520 sq km or 4.4% of Vietnam's land area will be permanently inundated
More than 60% or 39 of the 64 provinces and six of Vietnam's eight economic regions will be affected
Close to 20% or 2,057 of 10,511 communes throughout the country will be inundated in part or in whole
85% of total national SLR inundation will affect 12 provinces and cover 12,376 sq km in the Mekong river delta

References

Christensen J H, Hewitson B, Busuioc A, Chen A, Gao X, Held I, Jones R, Kolli R K, Kwon W-T, Laprise R, Magaña Rueda V, Mearns L, Menéndez C G, Räisänen J, Rinke A, Sarr A and Whetton P. 2007. Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt K B, Tignor M and Miller H L (eds)]. Cambridge University Press. Cambridge, United Kingdom and New York, NY, USA.

Cruz R V, Harasawa H, Lal M, Wu S, Anokhin Y, Punsalmaa B, Honda Y, Jafari M, Li C and Huu Ninh N. 2007. Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M L, Canziani O F, Palutikof J P, van der Linden P J and Hanson C E (eds). Cambridge University Press. Cambridge, UK. pp. 469 – 506.

Epstein Y, Sohar E and Shapiro Y. 1995. Exceptional heatstroke: a preventable condition. Israel Journal of Medical Science. 31: pp. 454 – 462.

FAO. 2003. World agriculture: towards 2015/2030 – An FAO Perspective, Bruinsma (ed.). FAO, Rome and Earthscan. London

ICEM, 2007. Rapid Assessment of the Extent and Impact of Sea Level Rise in Vietnam, by Jeremy Carew-Reid

Martens P, Kovats R S, Nijhof S, de Vries P, Livermore M T J, Bradley D J, Cox J and McMichael A J. 1999. Climate change and future populations at risk of malaria. Global Environmental Change. 9: pp. S89 –S107.

Sheppard C R C. 2003. Predicted recurrences of mass coral mortality in the Indian Ocean. Nature. 425: pp. 294 – 297.

Stern N. 2006. The Stern Review on the Economics of Climate Change. HM Treasury, UK. Cambridge University Press. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

UNFCCC, 2007. Climate Change: Impacts, Vulnerabilities, and Adaptation in Developing Countries.

Wassmann R, Nguyen Xuan Hien, Chu Thai Hoanh and To Phuc Tuong. 2004. Sea Level Rise Affecting the Viet Namese Mekong Delta: Water Elevation in the Flood Season and Implications for Rice Production, Climatic Change. 66(1-2): pp. 89 –107.

Wilkinson C. 2004. Status of Coral Reefs of the World: 2004, V. 1. Australian Institute of Marine 5 Science. Townsville, Australia. 302pp.