



(c) Sinhcafe-JSC

Ca Mau at sunrise

1986 Panda symbol WWF World Wide Fund For Nature (Formerly World Wildlife Fund)

WWF and "living planet" are Registered Trademarks

**Planning for climate change** will require radical adjustments to 'business as usual'. Regional cooperation will be essential because administrative boundaries do not coincide with hydrological boundaries. The study specifically encourages planners to:

- ★ Further explore emergency evacuation options (e.g., early warning systems, community education, and evacuation planning) as well as resettlement of vulnerable households in clusters on higher ground, with electricity, safe water, and efficient drainage;
- ★ Develop sound water management strategies that rely on 'soft structures' (e.g., dune restoration, wetland creation, re-vegetation);
- ★ Improve understanding of how hydro-geological processes and human activities affect the vulnerability of Ca Mau's ecosystems; and
- ★ Improve understanding at local and basin-wide levels of the role of forest ecosystem services in adaptation, and especially the economic benefits that healthy forests provide the province.

WWF also urges regional cooperation to ensure that (i) changes in land-use reduce the vulnerability of people and biodiversity to climate change impacts; and (ii) sediment inputs from the entire Mekong basin, continue to reach Ca Mau and the rest of the delta to counter the effects of rising seas.

**In summary, this study underlined the major challenges climate change will pose to Ca Mau Province. Careful planning, based on rigorous science and involving all stakeholders, will be fundamental to ensure sustainable development for the province's people and ecosystems.**

**WWF Greater Mekong Programme Policy Office**

Chulawich 1 Building, 5th Floor  
Chulalongkorn University  
Henri Dunant Road  
Bangkok 10330 Thailand

Phone: +66 2 218 9463  
Fax: +66 2 251 9416  
gblate@wwfgreatermekong.org  
panda.org/greatermekong



for a living planet®

December 2008



for a living planet®



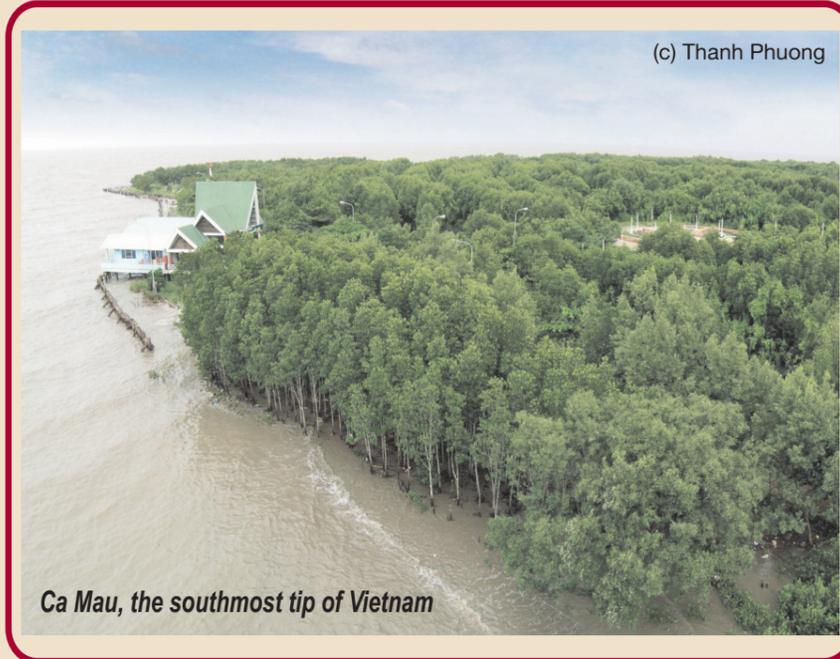
## Assessing the Implications of Climate Change at the Provincial Level: *Ca Mau, Vietnam*

Coastal areas in the Greater Mekong region are particularly vulnerable to the impacts of climate change. To predict how these areas will be affected, their socioeconomic and environmental contexts must also be understood.

In early 2008, the WWF Greater Mekong Programme (GMP), with support from WWF's Macroeconomics Programme, collaborated on a pilot study to assess climate change vulnerability and its implications for economic development in coastal areas. Two provinces - Krabi in Thailand and Ca Mau in Vietnam - were chosen as different examples of coastal geomorphology and economy.

These studies were unique in that for the first time they engaged local stakeholders to explore potential impacts on a variety of sectors using regional scale climate models applied at an appropriate local scale.

A World Bank report (02/2007) put Vietnam, a nation of 86 million people, atop its list of countries most vulnerable to the impacts of climate change. WWF's Ca Mau study confirms at a local level the high degree of vulnerability noted by the World Bank. Findings from the Ca Mau study have not only informed local and regional planners, but also guided the team that is developing Vietnam's National Target Programme for Climate Change (NTP). More than 50 stakeholders, including senior members of Vietnam's NTP preparatory team, met in Ca Mau in June 2008 to review a draft version of this study.



(c) Thanh Phuong

Ca Mau, the southmost tip of Vietnam



Ca Mau Province, Vietnam

**Ca Mau Province** is a region of rich alluvial soils, carried there by the Mekong River system from as far away as Tibet. But even when the seas that wash Ca Mau on either side are quiet, the margin of safety for its 1.2 million people is thin - all of this 5,329km<sup>2</sup> province at Vietnam's southern tip is, on average, only one meter above sea level.

Rice production, fisheries and, more recently, a booming shrimp aquaculture sector are well-developed in Ca Mau, and in 2005 contributed roughly half of its economic output. Ca Mau planners expect rapid growth in the industry and construction sectors over the next two decades.

Land use zoning for agriculture, aquaculture and other sectors is based on spatial control of fresh, brackish and salt water. This is accomplished by a system of canals, sluices and dikes that supply fresh water and sediment and limit saline intrusion.



Ca Mau National Park boasts many rare and precious animals, including long-tailed macaque and grey-legged pelican

has protected status. U Minh shelters the hairy-nosed otter, the Sunda pangolin and other critically endangered species. One hundred and eighty seven bird species have been recorded, including 9 globally threatened species.

### Design of the Study

WWF chose Ca Mau for this study because it is a low-lying coastal province where important biodiversity exists alongside significant economic activities such as fisheries, aquaculture and agriculture. Emphasis was placed on understanding the potential impacts of climate change on local people's lives, which are linked to natural resources and ecosystem services. The study was carried out by WWF in partnership with Vietnam's Southern Institute for Water Resources Planning (SIWRP). The WWF/SIWRP team used a sophisticated hydrological model of the lower delta area to simulate water levels and salinity based on predicted changes in climate over the next 10 and 25 years. Eleven scenarios were developed based on the changes in climate expected to cause the most significant impacts in the province: sea level rise; extreme events; and storm surges. The scenarios were then analyzed with regard to future economic development, using the current provincial development plan as a baseline.

### The Modeling Results

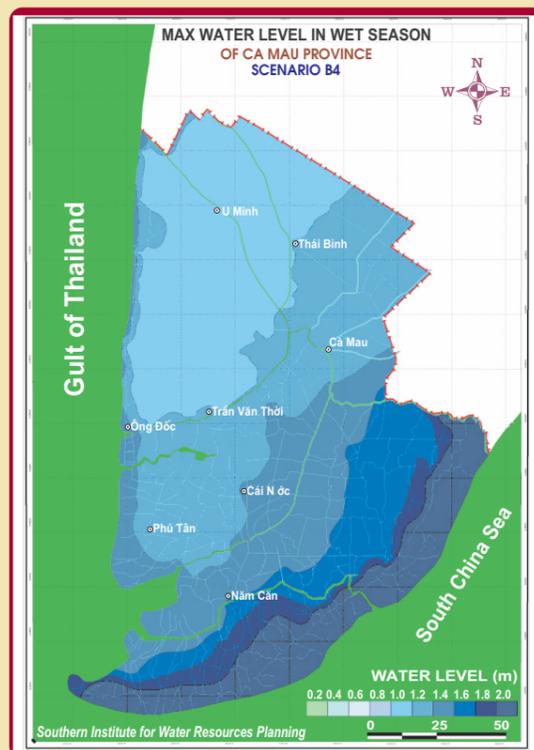
Without adaptive responses and measures to mitigate climate change impacts, the threat to the province is high in all key sectors. Overall, the study indicated that low (25cm) sea level rise (SLR) scenarios can be managed within the framework of the existing provincial development plan, with an important caveat: greater attention must be given to maintenance of 'hard' and 'soft' water management systems and adaptation in farming and aquaculture techniques. High (50cm) SLR scenarios can only be managed through a fundamental restructuring of the provincial development plan

**Farming sector.** Ca Mau has 3,710km<sup>2</sup> of land devoted to agriculture and 2,270km<sup>2</sup> used for aquaculture, particularly shrimp -- a profitable but risky activity. Modeling indicates that major adverse impacts on productivity in all three cropping seasons will result if SLR reaches 50cm. Existing aquaculture areas would be especially hard hit by SLR.

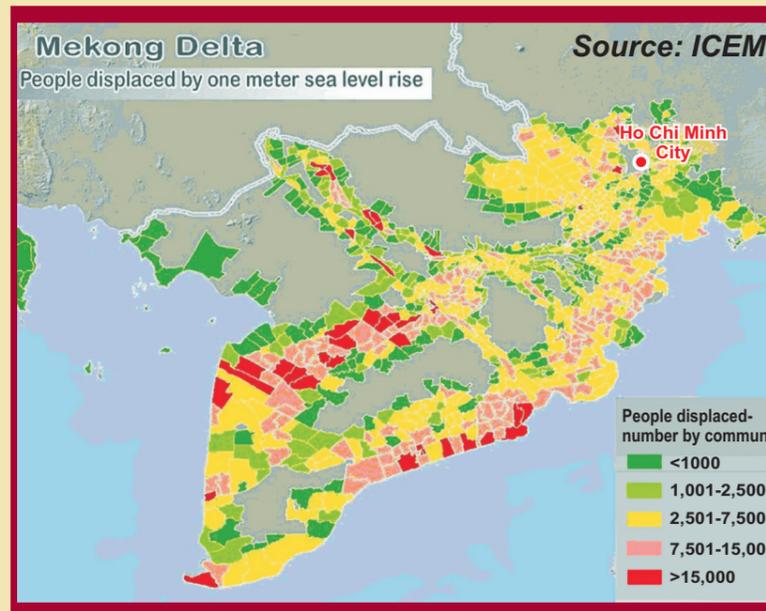
**Forestry sector.** Ca Mau's 1,460km<sup>2</sup> of forests, concentrated on the western coast, the southern tip, and between the coast and sea dike system on the eastern coast, will be negatively affected in any climate scenario.

However, the dry season (January to April) is characterized by freshwater shortages, soil salinization, and, in the peat forest area, leaching of sulfuric acid. Thus the province relies on flooding from the lower Mekong during the monsoon season (May to December) to flush out salt and sulfates and provide rich sediments and freshwater for agriculture and aquaculture.

Ca Mau is also home to 37% of Vietnam's remaining mangrove forest and to the Lower U Minh Forest, a vast freshwater peat swamp. Twenty two per cent of the province's 1,080km<sup>2</sup> of forest



Ca Mau wet season water levels in 2030 under the 50cm SLR scenario, shown here, would increase further due to storm surge



**Buildings.** In high SLR scenarios, Ca Mau's existing hospitals, clinics and first aid stations will be subject to some flooding. Similarly, the province's industrial sector is concentrated in low-lying areas, raising concerns about water contamination by industrial pollutants.

### Impacts and Implications

**Institutional capacity.** There are very significant vulnerabilities for Ca Mau Province, yet some of these impacts may be mitigated if regional planners act urgently. For 2,000 years, the Vietnamese have been dealing with the consequences of monsoon flooding and the typhoons that regularly batter their long coastline. A tradition of community cohesion, reliance on local expertise and a centralized management system gives reason to believe that once national consensus is reached, appropriate strategies can be swiftly and efficiently implemented.

**Mangrove restoration is critically important.** Simply reinforcing the province's dike and drainage systems will not be sufficient to ward off major climate change impacts. The most promising approach is one that derives full benefit from natural (ecosystem) defenses. Healthy mangrove forests will buffer Ca Mau's coasts against storm surges. Seasonal flooding must continue to deposit rich sediments and flush contaminants from Ca Mau's soil.

In Ca Mau, great swathes of mangrove forests have been replaced by diked ponds for shrimp production for global markets. Shrimp aquaculture has brought new wealth to the province, substantially raising incomes for thousands of farm families, but it has also degraded Ca Mau's resistance to destructive storms. This was tragically apparent in 1997, when Typhoon Linda ripped through the province, flattening entire communities, leaving tens of thousands homeless, wreaking havoc on ripening rice, and smashing roads, dikes and bridges.

Incorporating the buffering capacity and other vital services provided by coastal ecosystem into Ca Mau's planning for mitigation of climate change effects is urgently needed. Because rising sea levels will stimulate landwards migration of mangrove forests, care should be taken to site roads and water control infrastructure to permit their retreat.



**Infrastructure.** Interior fields, secondary embankments and canal banks are likely to suffer the worst impacts as sea levels rise. In high SLR scenarios, most roads will be unusable in the wet season.

**Household sector.** In general, urban households have better access to health and civil infrastructure and hence are less vulnerable to climate change risk than rural households. However, both urban and rural households throughout the province would be impacted in high SLR scenarios. Poor people are most likely to suffer the consequences of extreme weather events and rising sea levels, e.g., limited fresh water availability, unsanitary conditions, crop damage, and ecosystem degradation.