Viet Nam Situation Analysis

Andrew Benedict Wyatt, Nguyen Thi Phuong Thanh,
Tang Phuong Gian

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

This report is the project team's findings in 2012 under the project entitled *"Building Resilience to Climate Change Impacts- Coastal Southeast Asia*", implemented by IUCN. No warranty as to the accuracy or completeness of this information is given and no responsibility is accepted by IUCN or its employees for any loss or damage arising from reliance on the information provided.

This publication has been made possible in part by the generous support of The European Union.

Published by: IUCN, Gland, Switzerland, Bangkok, Thailand and Hanoi, Vietnam.

Citation: Andrew Benedict Wyatt, Nguyen Thi Phuong Thanh, Tang Phuong Gian (2012). *Viet Nam Situation Analysis.* Hanoi, Vietnam: IUCN. 95 pp.

ISBN: 978-2-8317-1598-8

Cover Photo: Vinh Trach Dong Commune, Bac Lieu Province by Tang Phuong Gian, IUCN Vietnam

Layout by: Nguyen Thuy Anh and Le Thi Thanh Thuy

Produced by: IUCN Vietnam Country Office

Funded by: The European Union

Available from:

IUCN
Viet Nam Country Office
1st floor, 2A Building, Van Phuc Diplomatic Compound
298 Kim Ma, Ba Dinh District
Hanoi city, Viet Nam
IPO Box 60
Tel: +844-37261575/6
Fax: +844-37261561
Email: info.vietnam@iucn.org
Web: www.iucn.org/vietnam

Viet Nam Situation Analysis

Andrew Benedict Wyatt, Nguyen Thi Phuong Thanh, Tang Phuong Gian

March, 2012

Table of Contents

Preface

This study was conducted as a part of the Building Coastal Resilience in Vietnam, Cambodia and Thailand project.

The overall objective and approach of the project is as follows:

- The project will strengthen the ability of local government and local people to plan for, and adapt to, future climate risks in eight coastal provinces between Ho Chi Minh City and Bangkok: Can Gio, Ben Tre, Soc Trang, and Kien Giang in Viet Nam; Kampot and Koh Kong in Cambodia; and Trat and Chanthaburi in Thailand. Ben Tre, Soc Trang and Kien Giang are located in the Mekong Delta, which is one of the areas of the world that is predicted to be most affected by sea level rise.

- IUCN and project partners will work together to build capacity in these provinces so that local government agencies can conduct vulnerability assessments; identify pilot activities to reduce vulnerability; design, implement, monitor the success of these activities; and carry out cost benefit analysis and feasibility assessments for replicating pilot actions over a wider coastal area.

- The project will identify best practices being developed by local people and provide opportunities for communities in different parts of the coastline to learn from each other. The project will use top-down and bottom-up approaches to ensure policy messages are disseminated at all levels. Networking, study visits, and an annual forum will be used to share knowledge with the other 12 provinces that make up the coastal corridor between Ho Chi Minh City and Bangkok.

This particular study, document's the current situation of the coastal zone of 4 Provinces in the Mekong Delta of Vietnam, Ben Tre, Soc Trang, and Kien Giang; and the Can Gio Biosphere Reserve in Ho Chi Minh City. It also includes a needs assessment of the government in relation to its capacity building needs as well as interventions. These interventions were identified by a review of the Provincial Climate Change Action Plan where they were already completed (Ben Tre and Soc Trang), interviews with government officials, and rapid field visits.

In November 2011, the GIZ project in Bac Lieu Province requested to join the BCR project and they are providing their own funds for Bac Lieu Province to participate in the project. The situation analysis of Bac Lieu is integrated into this document.

The purpose of this Situation Analysis is to provide a convenient and accessible document with the necessary information and materials to inform, design and develop interventions including community level Vulnerability Assessments and Adaptation Plans.

The authors are grateful for the support of the many government officials and staff in all the provinces that gave of their time to inform and provide information to us for the preparation of this report.

Acronyms

%	per cent
°C	degree Celsius
Cl	chlorine
cm	centimetre
g/l	gram/litres
ha	hectare
kg	kilogram
km	kilometres
km²	square kilometres
km³	cubic kilometres
m	metres
m²	square metre
m³/s	cubic metres per second
mm	millimetres
ppt	parts per thousand
VND	Vietnamese Dong (20,000 VND = 1 US$)
ASS	Acid Sulphate Soils
BR	Biosphere Reserve
BZ	Buffer Zone
CTU	Can Tho University
CWPDP	Coastal Wetlands Protection and Development Project
DANIDA	Danish International Development Agency
DARD	Departments of Agriculture and Rural Development
DoNRE	Departments of Natural Resources and Environment
EIA	Environmental Impact Assessment
EZ	Economic Zone
FFE	Forestry and Fishery Enterprise
FIPI	Forest Inventory and Planning Institute
FPMB	Forest Protection and Management Board
FPMD	Forest Protection and Management Division- ‘‘*Kiểm Lâm*” in Vietnamese
FPZ	Full Protection Zone
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
HDI	Human Development Index
IMHEN	Institute of Meteorology, Hydrology and Environment
IUCN	The World Conservation Union
MARD	Ministry of Agriculture and Rural Development
MDMP	Mekong Delta Master Plan
MoF	Ministry of Forestry
MoFi	Ministry of Fisheries
MoNRE	Ministry of Natural Resources and Environment
MoST	Ministry of Science and Technology
MoT	Ministry of Transport
MPI	Ministry of Planning and Investment
MRC	Mekong River Commission
PA.’s	Protected Areas
PC	People’s Committee
PPC	Provincial People’s Committee
PPMU	Provincial Project Management Unit
Sub-FIPI	Southern Sub-Institute of Forest Inventory and Planning
UBND (PC)	Vietnamese: UY BAN NHAN DAN; People’s Committee
UNDP	United Nation Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank

1. Environment and Ecology

There are various schemes to classify the ecological zones of the Mekong Delta. Given the agro-ecological focus of much of the research on the Mekong Delta, classifications based on the underlying soils and topography are the most common since soil types and topography (eg. flood prone) underpin the kinds of ecosystems that are present and agricultural crops that are present. Figure 2 provides a schematic of the 7 zones:

1. Plain of Reeds
2. Alluvial Region
3. Coastal Region
4. Ca Mau Peninsula
5. Trans-Bassac Depression
6. Long Xuyen Quadrangle
7. Seven Mountains Region

This document will utilise this classification system unless cited authors choose to utilise a different system.

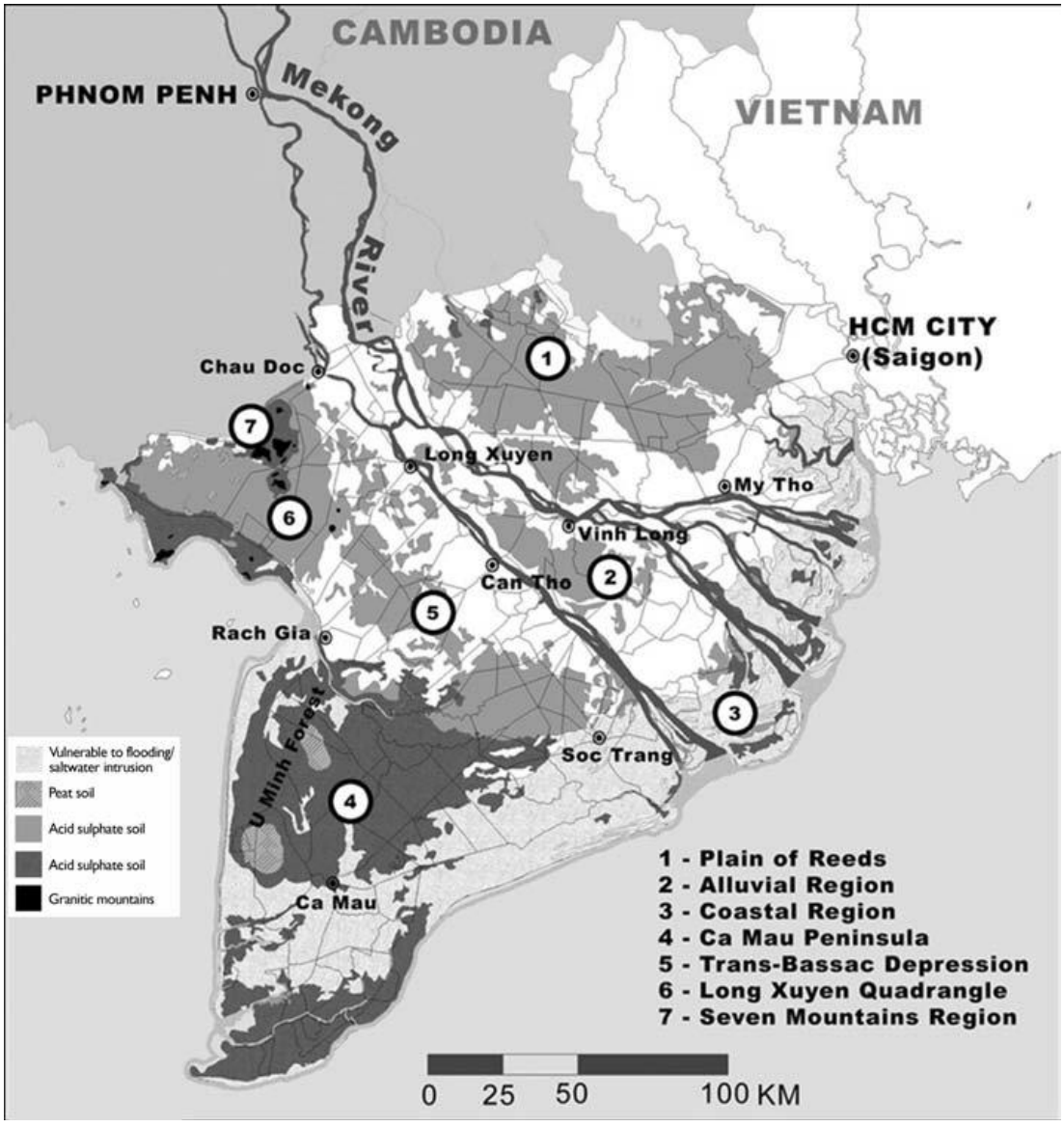


Figure 2. Agro-ecological Zones of the Mekong Delta

1.1. The state of coastal ecosystems

1.1.1. Coastal Mangroves

There is not a lot of accessible information about the original state of the coastal vegetation. The best source of information comes from the French colonial administration dating back to the late 1800s and early 1900s. This information has recently been made accessible by historical research conducted by the GIZ project in Soc Trang (Joffre, O. 2010; Thinh, P.T. 2011).

The mangroves of the Mekong Delta were documented and exploited by the French predominantly for production purposes. Early historical maps by the French reveal that the general pattern and distribution of mangroves are somewhat similar to the coastal mangroves of today.

However, the quality and extent of the mangroves have greatly reduced over time through officially sanctioned exploitation and development, uncontrolled community exploitation, and consecutive attempts at reforestation. While a comparison of early historical maps (Figure 3) with modern day satellite imagery (Figure 6 and 7) does not provide a way to quantify the deforestation that has taken place over time, we can get a general sense of the extent of loss which appears extensive. For example, there appears to be significant strips of mangroves along the coastline of Ben Tre and Soc Trang which is barely discernible in today's satellite imagery. There is also no comparable statistical data of forest cover between the French period and present day Provincial data because administrative boundaries and classifications have changed and are not comparable.

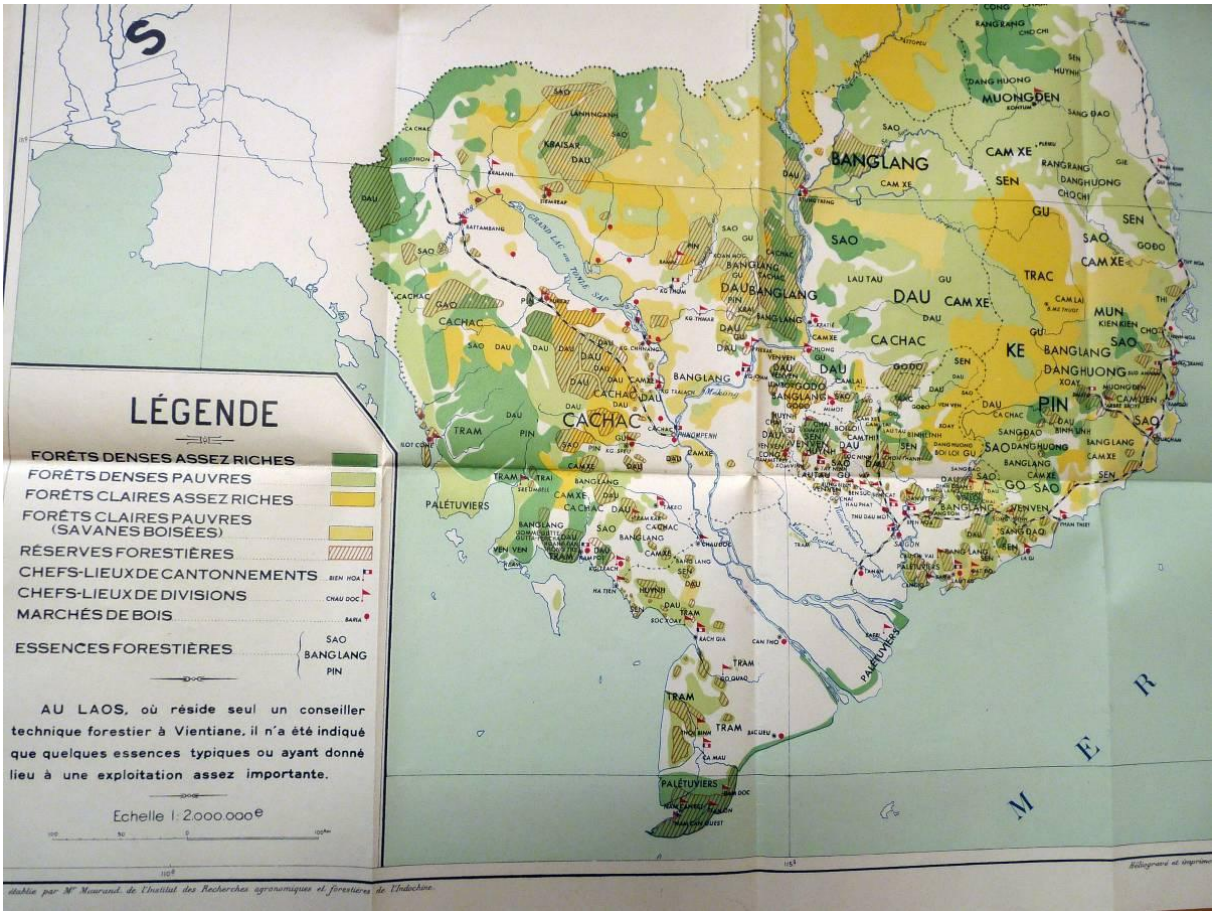


Figure 3. Image of a French colonial map of forest cover in Cochinchina including present day Mekong Delta. (Source: Joffre 2010)

There is also little to no information available as to the original diversity of specific mangrove forests. What is known from French records is that the forests in the western Mekong Delta (Kien Giang) were single

species forests and this differed from the Eastern part of the Mekong Delta (eg. Can Gio, Ben Tre, Soc Trang, Bac Lieu) where forest composition was more diversified. It ought to be noted that today, most of the mangroves on the Eastern coast are now mostly single-species mangroves as a result of successive replanting that have, with few exceptions, focused on just one species (see Thinh, P.T., 2011), either for production purposes (eg. Can Gio), or for bureaucratic expediency during reforestation initiatives (interviews).

Local name	Scientific name	Use and quality
Paletuvier vrai		
Cây đước sành & Viet: Đước (Đước đôi)	*Rhizophora conjuguta* (new name *R. apiculata*)	Common tree in Cochinchine, with a value of $20,000 by m^3. Used for construction (poles), fuel wood and tannin. The tree can be tall and resistant to humidity
Cây đước đưng	*Rhizophora mucronata*	
Cây dá do	*Ceriops sp* (*Rhizophoracee*)	Used for construction (poles), fuel wood and dye
Cây dá nuóc (Dà vôi)	*Ceriops candolleana* (new name *C. tagal*)	Used for wood construction and in fisheries, and tinctures of the bark with red brownish (or dark green, according to sources) colours sold for $4/100 kg of bark[39]
Cây vet đen (Vẹt dù)	*Bruguiera gymnorhiza*	Used as fire wood and later introduced on the market for tannin and charcoal[40]
Cay vet tach (Vẹt khang)	*Bruguiera eriopetala* (new name *B. Sexangula*)	
Non Paletuvier		
Cây mắm (Mắm đen)	*Avicennia officinalis (Verbenacees)*	Fuel wood
Cây Bần đắng (Bần chua)	*Sonneratia acida* (new name *S. caseolaris*) *(Lythrariees)*	Soft wood, fruits
Cây bần ổi (Bần đắng)	*Sonneratia alba*	Soft wood
Cây su (Xu ổi)	*Carapa obovata (Meliacees)* (new name *Xylocarpus granatum*)	Fuel wood, construction wood tannin bark, oil seeds
Cây gía (Giá)	*Excoecaria agallocha (Euphorbiacees)*	Latex (caustic), fuel wood
Cây rau vùng	*Barringtonia sp (Myrtacees)*	Indian oak
Cây cui (Cui biển)	*Heritiera littoralis (Sterculiaces)*	Hard wood for poles
Ô rô	*Acanthus volubilis (Acanthacees)*	Shrub
Palm trees		
Chà là	*Phoenix paludosa*	
Dùa nuóc	*Nypa fructicans*	Palm tree used for roof tops, wild and cultivated, and fruit used to feed pigs

Figure 4. Main mangrove species that were present in French Cochinchina (Source: Joffre 2010).

The implications of single species mangroves are that they will be more vulnerable to environmental and climate change. This has recently been recognised in official development assistance and the GIZ projects in Bac Lieu, Soc Trang and Kien Giang are now piloting small-scale multi-species mangrove replanting. In Ben Tre province, WWF has proposed to establish mangrove nurseries that would facilitate multi-species replanting of the mangroves.

Not a lot is known about the vegetation cover behind the coastal mangrove before and during the French administration because most of the forests in the provinces had already been cleared for rice growing. Based on French records, Joffre (2010) suggests that the inland areas consisted of small and sparce *Melaleuca sp*.

In more recent times, mangrove deforestation has been better documented with the use of modern GIS methods. Anh *et al*. (1999) in an assessment of mangrove cover between 1990 and 1995, revealed that total mangrove cover in the Mekong Delta in 1990 was 208,143 ha. This was reduced to 114,536 ha by

1992 and 83,385 ha by 1995. The predominant cause for their clearance has been shrimp and other agricultural crops. The provinces of Ca Mau, Bac Lieu, and Tra Vinh had the largest loss. This assessment generally supports other studies that also show high rates of mangrove loss during much of the 1990s because of the rapid expansion of coastal shrimp aquaculture (Figure 5).

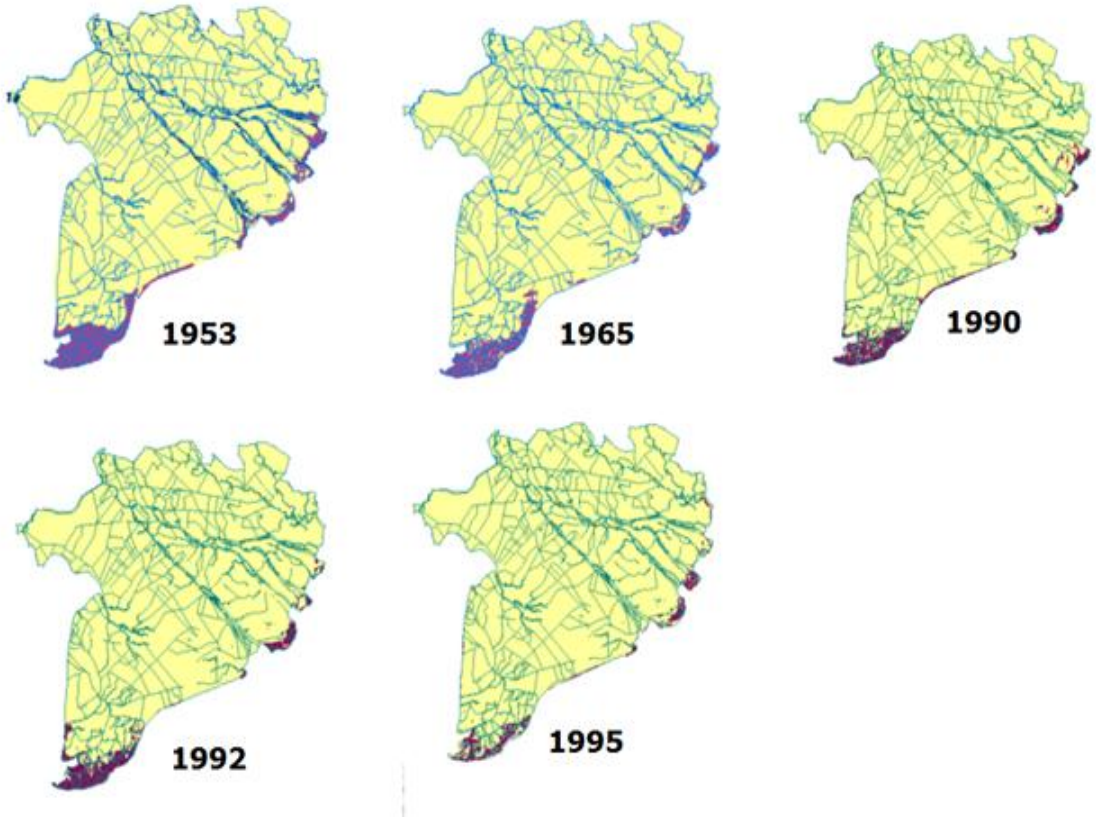


Figure 5. Coastal mangrove loss in the Mekong Delta, 1953 to 1995 (Source: Be, N.V.)

A more recent assessment of land-use change for the period 2004 to 2010 using satellite data (Spot 5) (DRST, 2011) commissioned by IUCN Vietnam finds that the largest rates of mangrove deforestation continue to occur in Ca Mau. In other provinces, coastal mangrove area decreased at a much slower rate with much of the loss occurring as a result of conversion to shrimp aquaculture (Figures 6 and 7).

However, Kien Giang, Bac Lieu, Soc Trang also showed signs of mangrove re-forestation and re-growth (DRST, 2011), though this was not quantified. The reforestation trend is supported by other recent studies (Thinh, 2011) and government reports (interviews) of active reforestation programs (most recently under Programme 661) in all the BCR Provinces. Detailed studies by GIZ in Soc Trang provide an idea of the kinds of reforestation initiatives that have taken place in many of the Mekong's coastal provinces since the mid-1990s. According to Thinh (2011), between 1993 to 2007 Soc Trang Province restored 2,357.66 hectares of mangrove forest. The three main species include *Sonneratia* (1,394.4 hectares), *Rhizophora* (521.12 hectares) and *Avicennia* mixed with other species (440.14 hectares). This included support through several reforestation programmes including the government's Programme 327 from 1993 to 1997 and Programme 661 from 1998 to 2010; the World Bank from 2001 to 2007; and other programs from the Netherlands and Japan.

However, Thinh (2011) suggests that mangrove loss (unquantified) has occurred after reforestation for a number of different reasons including:

- inadequate rehabilitation techniques at different sites particularly on eroded areas, and highland or fallow lands;
- a lack of appropriate structures for optimizing the protective capacity of the forest belt and reducing coastal erosion;

- and a lack of policies and institutions for integrated management of coastal zone.

Outside of Ca Mau, large-scale mangrove clearance for shrimp farming has largely been checked in recent years in the BCR Provinces through increased government enforcement of forest protection regulations and the involvement of communities in co-management arrangements to protect the mangroves. The GIZ project in Soc Trang has been pioneering these institutional developments within mangrove ecosystems since 2009 in the Mekong Delta (see http://czm-soctrang.org.vn/en/About%20the%20project.aspx?ID=3).

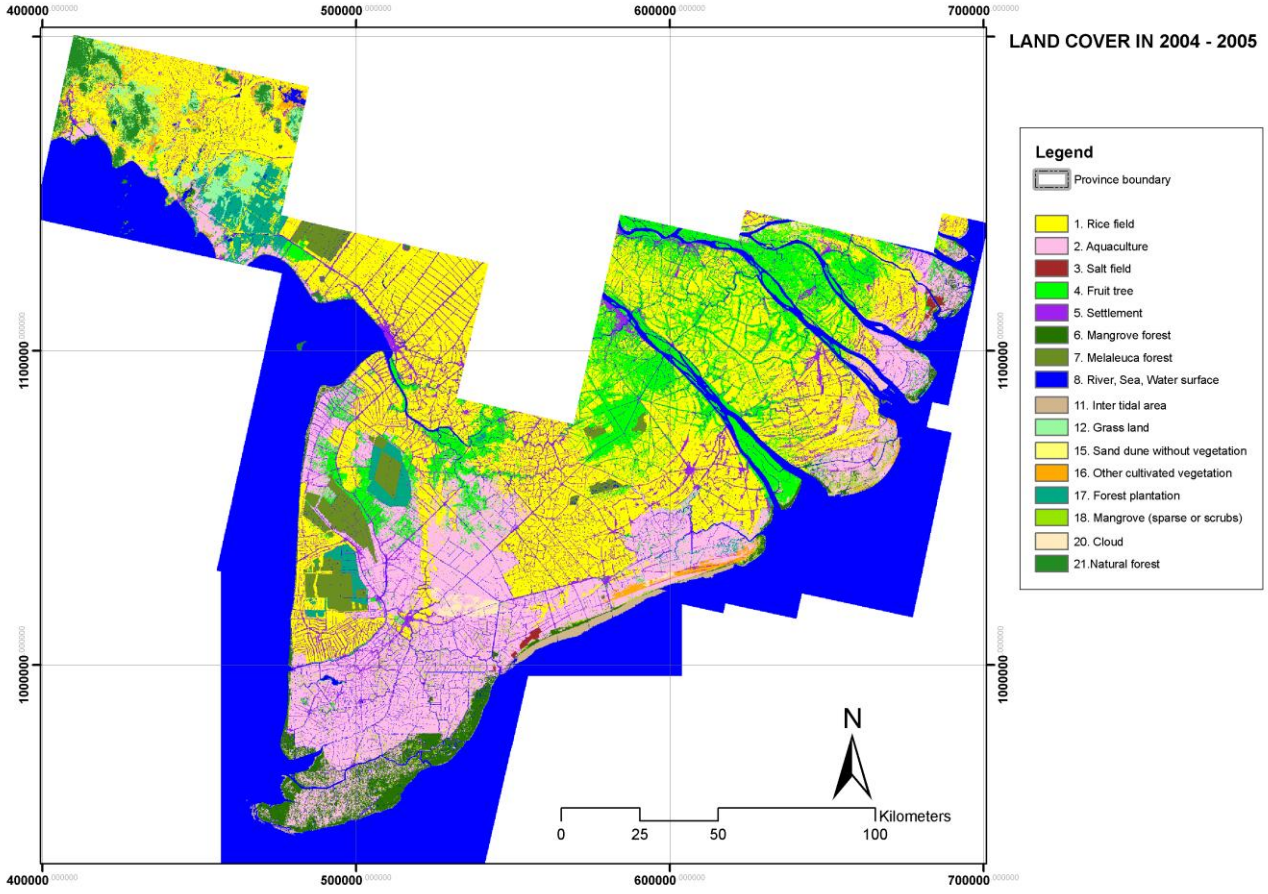


Figure 6. Land cover map of Mekong River Delta in 2004 – 2005 (DRST, 2011)

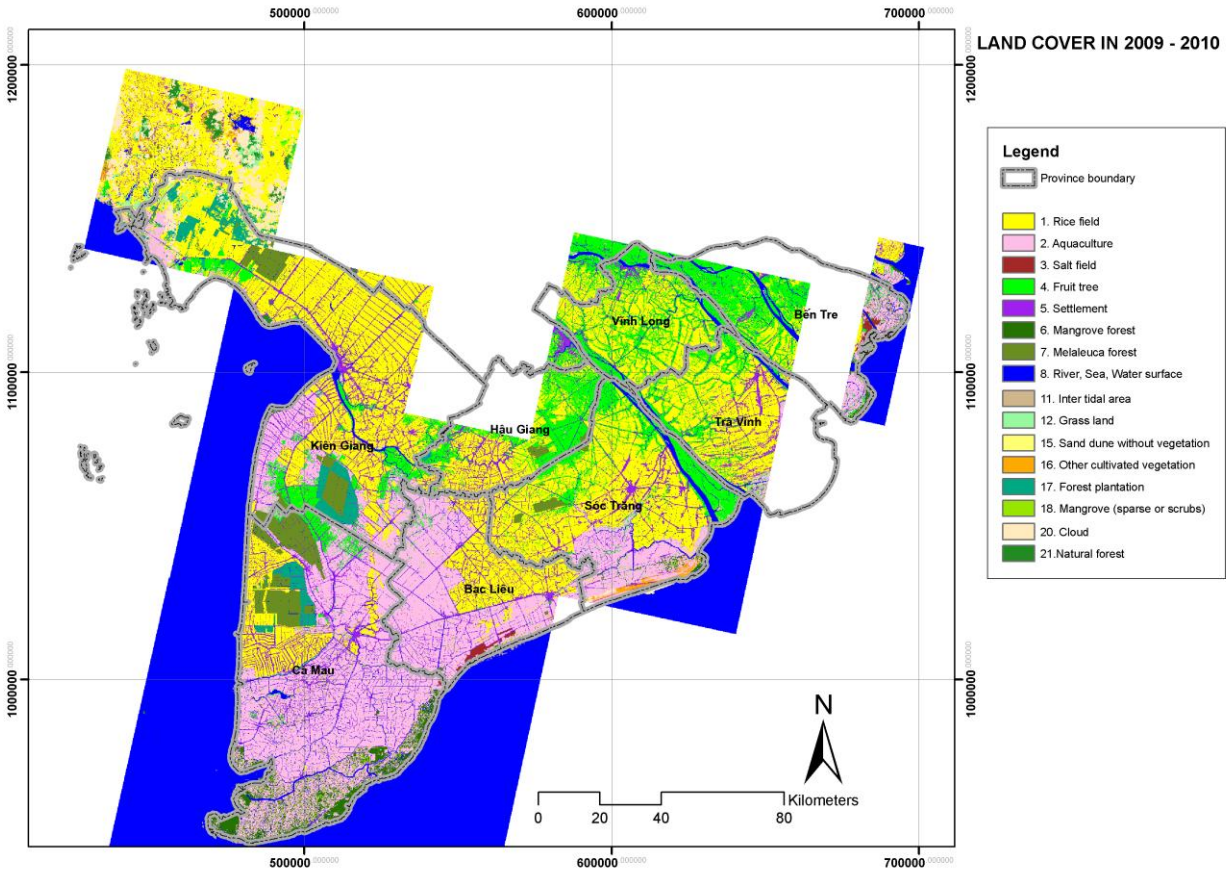


Figure 7. Land cover map of Mekong River Delta in 2009 – 2010 (DRST, 2011)

Presently, mangrove loss from coastal erosion has become an important issue of concern to the government. Some of this erosion is being attributed by the local government (interviews) to possible SLR effects. However, recent modelling work by GIZ in Soc Trang (Albers, T. and von Lieberman, N., 2011) suggests that shoreline changes are the result of natural processes of erosion and accretion. In some areas, loss of land as a result of erosion of up to 30 m per year has been recorded, while in other areas land created through accretion can grow by more than 60 m per year (eg. Cu Lao Dung). Bac Lieu and Kien Giang are also reportedly facing a similar situation of mangrove loss in certain localities (interviews and field observations). Presently there is no data available on the loss of mangroves due to coastal erosion. A common configuration characteristic at these locations is that the mangroves are backed up against the coastal dyke and the loss of the mangrove has exposed the coastal dyke itself to erosion damage (Figure 8 and 9). It is likely that the causes of erosion at each site is a complex interplay of factors including the underlying topography and coastal geomorphology, sediment dynamics, long shore currents, SLR and the configuration of the coastal dyke. The sediment dynamics emanating from sub-catchments such as the Ganh Hao River Catchment between Bac Lieu and Ca Mau are also largely unknown.

Figure 8. Mangrove loss due to erosion at Ganh Hao, Bac Lieu.

Figure 9. Mangrove loss due to erosion at Binh Son Commune, Hon Dat District, Kien Giang. Eroding coastal dyke in the foreground.

1.1.2. Inter-tidal sand flats

The tidal sand flats of the Mekong Delta and Can Gio are important ecosystems for a number of commercially valuable bivalve species. They are also important feeding habitats for migratory birds. Underpinning the food chain are nutrients from the mangroves and upstream sourced nutrients carried in sediment from the Mekong River (Dong Nai River in the case of Can Gio).

In the last decade, the tidal flats have become an important focus of attention because of the profitability of at least two commercially important bivalve species, the Asiatic Hard Clam[1] (*Meretrix lyrata*) and the Blood Cockle (*Anadara granosa*).

There is presently little available data on the amount of tidal flats in the Mekong Delta. Government plans for the expansion of clam farming in the Mekong Delta suggest that there will be available tidal flats for expansion from 15,950 ha in 2015 to 20,590 ha by 2020 (AgroViet, 2011).

[1] Commonly referred to as the Ben Tre Clam (*Nghêu Bến Tre*) or Ben Tre White Clam.

However, there is considerable uncertainty in this assumption. Tidal flats are perhaps the most vulnerable of the coastal ecosystems to climate change as they are subject to erosion due to storms and other coastal conditions, and total inundation from small increases in sea level. In Ben Tre Province, the entire coastline of tidal flats are already fully utilised (Figure 9). However, in Soc Trang where significant accretion is occurring on the downstream of Cu Lao Dung in the Hau estuary, the tidal flats may allow the expansion of clam farming, assuming upstream sourced sediments continue to be available (see Section 1.4.4 for potential threats).

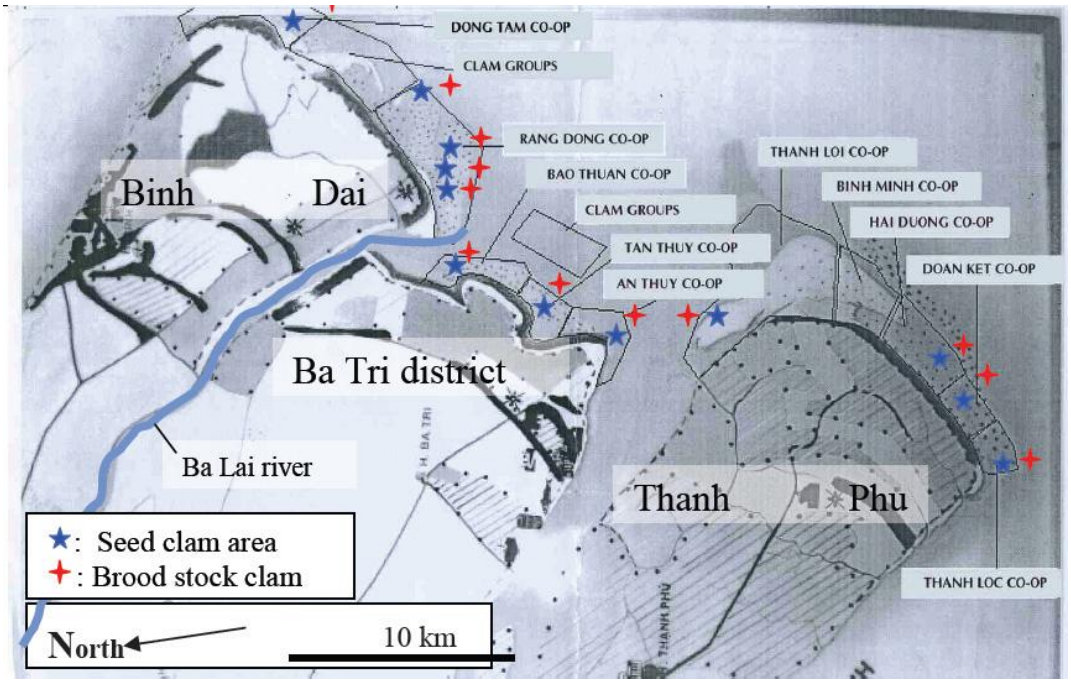


Figure 9. White Clam growing areas in Ben Tre Province and names of Clam Cooperatives. (Source: Luu *et al*. 2009)

1.1.3. Coral Reefs and Sea Grass beds

The coastal waters of south western Vietnam in the Gulf of Thailand are not ideal for coral growth because of muddy bottoms and highly turbid waters. Coral reefs and sea grass beds have developed in areas adjacent to the offshore islands of Phu Quoc, Nam Du, and Tho Chu. The reefs of these islands are relatively similar in terms of morphology as there are minimal fluctuations in the hydrological regime and hydrodynamics of the area. These reefs are normally 50-100m wide and spread to a depth of 10-13m (UNEP, 2007).

Nearly all corals in this region occur adjacent to islands that are located sufficiently far from the coastline to enable coral development in the relatively turbid waters of the Gulf of Thailand. Large reef areas have developed at Tho Chu, Nam Du, and Phu Quoc Islands. Nearly 270 species belonging to 64 genera of hard corals have been recorded at these sites from the limited survey work conducted to date (UNEP, 2007).

In comparison with other major coral reefs in Vietnam, they are relatively biodiverse with 135 recorded species (Table 1).

Table 1. Relative diversity of fish species at major coral reefs in Vietnam (UNEP, 2007).

No.	Location	Family	Genera	Species
1	Co To	16	27	34
2	Cat Ba	16	25	31
3	Cu Lao Cham	33	76	178
4	Nha Trang	38	102	222
5	Ninh Hai	32	81	147
6	Ca Na	37	87	211
7	Con Dao	33	84	202
8	Phu Quoc	27	60	135
Total		**44**	**139**	**411**

The Kien Giang coral reefs and sea grass beds are located and protected within the boundaries of Phu Quoc National Park and the Kien Giang Man and Biosphere Reserve which was established in 2006.

These are important feeding grounds for the Hawksbill Turtle, Green Turtle, and Dugong. The reefs also support an important fishery in Kien Giang Province with mackerel, anchovies, squid, and cuttlefish caught near and around the coral reefs. In Phu Quoc, the total of mackerel and anchovy catch in 2001 was about 3,500 and 12,500 tons respectively (UNEP 2007).

The average coverage of the reef around Phu Quoc was measured at 42% in 2002 which compared favourably with the other major coral reefs in Vietnam (Table 2).

Table 2. Coral reef cover of major coral reefs in Vietnam (UNEP, 2007).

No	Study areas	No. sites	Coverage rank (%)	Average cover (%)	Time
1	Hạ Long–Cat Ba	21	12 - 65	40.6 ± 15.2	1998
2	Bạch Long Vi	5	2.7 - 47.6	21.7 ± 19.0	1995
3	Hai Van–Son Tra	7	35 - 62.7	50.5 ± 15.7	1996
4	Cu Lao Cham	5	18.4 - 53.7	33.9 ± 12.4	2002
5	Nha Trang bay	8	5.6 - 44.4	26.4 ± 15.9	2002
6	Ninh Hai	6	16.3 - 55.9	36.9 ± 13.5	2002
6	Ca Na bay	6	18.4 - 68.4	40.5 ± 24.1	1996
7	Con Đao	8	1.6 - 50.3	23.3 ± 18.2	2002
8	Phu Quoc	6	28.7 - 52.5	42.2 ± 8.60	2002
9	Nam Du	4	37.8 - 62.8	47.4 ± 11.7	2002
10	Tho Chu	4	4.6 - 15.9	11.3 ± 4.80	2002

According to the UNEP (2007) report, decline in coral cover was recorded at a relatively low 3.3 % between 1994 and 2002 (Table 3). There are no recent assessments of the decline of coral cover at Phu Quoc but it is likely to be higher today. Reported pressures on the Phu Quoc reefs in 2002 included; destructive fishing practice (lucrative hookah diving using poison); over-fishing of reef species such as grouper, coral collection for tourism market. The tourism impact was reported to be low in 2002 but is likely to have grown as tourism numbers to Phu Quoc increase.

Table 3. Coral reef cover trend 1994 – 2002 (UNEP, 2007)

STT	Study areas	No. site	Decline of coral cover (%)	Period
1	Ha Long–Cat Ba	-	-7.1	1993 - 1998
2	Cu Lao Cham	5	-1.9	1994 - 2002
3	Nha Trang bay	8	-21.2	1994 - 2002
4	Con Dao	8	-32.3	1994 - 2002
5	Phu Quoc	5	-3.3	1994 - 2002

1.2. Key species of economic and conservation value, and sensitivity to climate change

1.2.1. Economic Species

Aquatic species are by-far the most important commercial species of the coastal zone. These species are exploited by near-shore fishers, small-scale off-shore fishers, and in aquaculture.

Near shore fishers consisting of the poorest segments of the community (eg. mostly Khmer in Soc Trang) collect aquatic products and capture fish near and within the coastal mangroves. A recent survey (Dinh, T.D. 2009) in Soc Trang lists the three most important economically valuable species being exploited are juvenile clams, juvenile crab species, and the elongated goby (Table 4). These species are also the most commonly exploited species in the other BCR Provinces.

Table 4. Most important commercial species to near-shore fishers in Soc Trang (Data sourced from Dinh, T.D. 2009)

Species	No of surveyed households	Households collecting to sell
Juvenile clam (*Meretrix sps.)*	74	72
Elongated Goby (*Glossogobius* sps. ???)	59	61
Juvenile crab (*Scylla sps. and other)*	44	13

A more comprehensive and detailed study in Bac Lieu for GIZ carried out by the Institute of Tropical Biology (Long *et al,* 2010, pp. 6-12), found that out of a total of 82 species found in the coastal zone, 41 species or 50% of the total number of species were of economic value to local communities and a major source of income for households (see Annex 3).

According to the authors, some species such as the Fourfinger threadfin (*Eleutheronema tetradactylum)*, Soldier croaker (*Nibea soldado)*, Giant seaperch (*Lates calcarifer)*, and Bartail flathead (*Platycephalus indicus)* are being exploited unsustainably as juveniles. Singled out are the mudskippers (*Pseudapocryptes* spp.) which are being exploited at the juvenile stage under heavy pressure. The authors call for the species to be managed to ensure their sustainable use.

Off-shore[2] fishers exploit a range of demersal, semi-demersal, and pelagic species of the coast of the Mekong Delta and Can Gio. A recent survey report reported that shrimp, squid, trash fish, demersal and pelagic fish were being exploited, the most commercially valuable being pelagic fish (Sinh and Long, 2011). Trash fish include a large range of low value species caught in trawl nets. Government statistics do not record the species being landed and there is little information on the actual species of shrimp, squid, and pelagic fish being exploited and their value.

The Mekong Delta fishery is highly opportunistic. For example trash fish caught by prawn trawlers are also sold commercially from the same boats. Studies that do identify commercially important fish indicate that the mackerel fishery is the most highly valued followed by the squid and shrimp fishery (Sing and Long, 2011). A recent fishery eco-path study using bottom trawls between 2000 and 2005 off the coast of Soc Trang and Ben Tre has identified: 7 top predator species; 2 Mackeral species; 8 benthic feeders; 12 demersal species; 5 small-pelagic species; 5 trash fish; 8 shrimp species; 6 crab species; and 4 squid species. The most abundant groups were the shrimp followed by demersal fish (Table 5)

[2] Off-shore is generally taken to mean water deeper than 20m in southern areas of Vietnam.

Table 5. Species caught in trawls of the coast of Soc Trang and Ben Tre between 2000 and 2005 (Data sourced from Van *et al*, 2010)

Ecopath Group	Species	No of species	Catch (ton/sq km/year
Top Predators	*Trichiurus haumela* *Trichiurus lepturus* *Lates calcarifer* *Plotosus anguilaris* *Epinephelus areolatus* *Epinephelus akaara* *Epinephelus fasciatus*	7	0.064
Mackeral	*Scoberomorus guttatus* *Scoberomorus commerson*	2	0.017
Benthic Feeders	*Soleidae* *Sillago sihama* *Cociella crocodiles* *Hoplichthys sp* *Rogadius asper* *Dasyatis bleekeri* *Parapercis barbata* *Upeneus suphureus*	8	0.196
Demersal	*Trachynocephalus myops* *Saurida tumbil* *Pristipomoides filamentosus* *Siniperca chuatsi* *Pseudobagrus fulvidraco* *Ophiocara porocephala* *Polydactylus plebejus* *Clupanodon punctatus* *Argyrosomus argentus* *Argyrosomus nibe* *Spotted maigre* *Arius thalassinus*	12	1.036
Small Pelagic	*Harpodon nehereus* *Selaroides leptolepis* *Pampus argenteus* *Formio niger* *Decapterus maruadsi*	5	0.073
Trash Fish	*Harengula sp* *Commersonii anchovy* *Rastrelliger brachysoma* *Selaroides leptolepis* *Cynoglossa lingua*	5	0.585
Shrimp	*Parapenaeopsis cultrirostris* *Parapenaeopsis hardwickii* *Parapenaeopsis hungerfordi* *Matapenaeus tenuipes* *Metapenaeus affinis* *Metapenaeopsis barbata* *Penaeus merguiensis* *Penaeus monodon*	8	1.602
Crabs	*Portunus pelagicus* *Callappa pelagicus* *Portunus sangui* *Portunus pelagicus* *Callappa pelagicus* *Portunus sangui*	6	0.183
Squids	*Sepioteuthis lessoniana* *Sepia inermis* *Loligo spp* *Octopus ocelatus*	4	0.616

The major **aquaculture** species in the coastal areas of the Mekong Delta and Can Gio is the Giant Tiger Prawn[3] (*Penaeus monodon*), Asiatic Hard Clam *(Meretrix lyrata)*, Blood Cockle*(Anadara nodifera)*, and Mud Crab *(Scylla serrata)* (FAO, 2005). In the last year the Mekong Delta has seen the introduction of the White-Legged Shrimp (Litopenaeus vannamei). Its introduction has been controversial because it is not a native species and there have been no studies of its potential impact on native species. This has been a source of disagreement between MONRE and MARD over the last year, with the former wanting to delay its widespread introduction pending impact studies, and the latter contending that there is little evidence elsewhere that the species will create a negative impact. The species is commercially attractive because it is claimed to be less susceptible to disease and has a high growth rate (reference ??).

Climate change sensitivity of selected commercial species

This section is a summary of a recent literature review of potential climate change sensitivity of key commercial species in the BCR project locations. For more detail, the reader should refer to Charlotte, 2011.

Blood Cockle *(Anadara nodifera),* Oyster (*crassostrea commercialis*)

While the review did not include the Asiatic (Ben Tre) White Clam, it can be expected that the CC effects on the Asiatic White Clam will be similar to that of the Blood Cockle. While their habitats do differ, with the blood cockles inhabiting the mud-flats adjacent of the mangroves, and the adult white clams inhabiting the coastal sand-flats that are further away from the influence of the mangroves[4], both these habitats are subject to the same SLR, temperature and chemical changes.

Sensitivity :

- Sea surface temperature change: Reduced fertilisation, size and abnormal larvae leading to reduction in growth rates and yield. Diseases and parasites may also increase with an increase in temperature.
- Changing ocean chemistry: Increasing CO2 levels will lower the pH (acidify) of sea water. Increased acidification may weaken or malform fragile larval skeletons and weaken the calcium carbonate shells of shellfish such as clams and oysters. Maybe some adaptive capacity if rate of change is not too fast.
- SLR: Inundation of intertidal mudflats will destroy key habitat. Adaptation may be possible if there are no barriers to the recession of the mudflats (eg. coastal dykes).
- Altered ocean circulation: Changes in larval dispersal by wild populations of clams, cockle and oyster will no doubt take place if ocean currents change.
- Changes in precipitation and Increase in severity or frequency of extreme events: Long term changes in salinity, turbidity and sedimentation are known to cause physiological stress in bivalves and cause them to close their shells. These conditions can reduce grown rate of bivalves by blocking their feeding apparatus.
- Adaptation: Siting of new clam and oyster growing areas should take into other anthropogenic stressors such as pollution run-off or to reduce these non-climate related stressors at their source.

Mud Crab *(Scylla serrata)*

Sensitivity :

- Sea surface temperature change: Larvae are highly sensitive to changes in temperature and salinity, with mass mortality occurring above 25 degrees C and in low saline conditions. However, increased temperature might be beneficial to the development of juvenile mud crabs in culture systems. Temperature changes that increase the presence of pathogens increases susceptibility of eggs and larvae to disease. Mud crabs are also significant carriers of epizootic in white spot syndrome virus which causes mortalities in cultured shrimp crops.

[3] Other common names include Black Tiger Shrimp and Asian Tiger Shrimp.
[4] It should be noted that for some part of their life-cycle, Ben Tre White Clams do inhabit the mud-flats adjacent of estuarine mangroves where there is shelter and food (Luu *et al*, 2009).

- Changing ocean chemistry: Lowered pH presents a significant problem for calcifying organisms such as crustaceans, as it interferes with shell formation and weakens existing skeletons. Fragile mud crab larval skeletons may be particularly vulnerable to changes in pH, potentially resulting in recruitment failure.
- Altered ocean circulation: Since wild populations of mud crab rely on ocean currents to disperse their larvae, and the larvae themselves rely on currents to bring them back in-shore, wild crabs will be vulnerable to any changes in current or ocean circulation, however the extent to which is unknown.
- Sea level rise, changes in sediment flow due to altered currents and the addition of pollutants could impact on mangroves, negatively impacting wild populations. Mangrove habitats are vital to the survival of wild mud crab species.
- Adaptation: Raising mud crabs within mangroves where there is shade may reduce the effect of increasing temperatures. This will also reduce the risk of transferring white spot syndrome virus to ponded shrimp crops.

Giant Tiger Prawn *(Penaeus monodon)* and White Leg Shrimp *(Litopenaeus vannamei)*

Sensitivity :

- Sea surface temperature change: Higher temperatures increase harmful algal blooms that release toxins into the water, decrease dissolved oxygen, increase competition and parasitism from invasive species, and an increased incidence of disease and parasites. Thermal tolerance is largely unknown.
- Sea level rise: Operational impacts of rising sea level may include damage to pond infrastructure, changes in aquaculture zoning, increased insurance costs, reduced freshwater availability, and competition for space with ecosystems providing coastal defence or simply loss of land available for shrimp aquaculture. Sea level rise may also decrease the flushing rate of shrimp ponds resulting in a reduction in water quality.
- Altered ocean circulation: Changes in oceanographic function, for example wind speed or velocity, currents and wave action, altered tidal applitudes may cause a decreased flushing rate of shrimp ponds that can affect food availability to stock, whilst also altering water exchanges and waste dispersal, contributing to a reduction in water quality.
- Changes in precipitation: Rapid changes in salinity that would result from increased precipitation events can cause increased stress, leaving shrimp vulnerable to disease.
- Increased severity or frequency of extreme events: Storms and extreme tidal flooding cause large waves and high winds and structural damage to coastal communities, which would almost certainly impact shrimp production.
- Drought: Severe droughts, for example El Nino's, may result in reduction in water quality and increase associated disease. Altered/reduced freshwater supplies may exacerbate existing climate impacts on shrimp (i.e. increased temperature, decreased salinity, sea level rise and acidification) and will ultimately result in high costs to maintain pond levels
- Adaptation: Shrimp are sensitive to high and very low salinity levels however shrimp can be acclimatised to total freshwater immersion using a gradual introduction technique as outlined by Briggs and Funge-Smith (1997). Moving inland has been seen to be a way in which coastal pollutants and risks associated with storms and flooding can be mitigated in the shrimp industry and as such low salinity rearing has removed a key constraint to the expansion of the industry into inland, delta and riparian areas (Flaherty et al. 1999).

Seabass (*Lates calcarifer*)

Seabass are a popular cultured species in the Can Gio mangroves.

Sensitivity :

- Sea surface temperature change: Seabass appear to be vulnerable to low temperatures as compared to other cultured species. So they may benefit from higher temperatures. But there is limited information available on the exact upper thermal tolerances of Seabass.

- Sea level rise: Loss of mangrove habitats as a result of SLR will result in loss in cultured area.
- Changing ocean chemistry: The sensitivity of tropical marine fishes to changes in pH at large magnitudes or by large increments is unknown. Fish eggs are much more sensitive to pH changes than juveniles or adults, and consequently the largest effects of acidification are likely to be on reproductive performance.
- Changes in precipitation: Seabass larvae are sensitive to changes in salinity, despite greater tolerance in older life stages, and salinity needs to remain between 25 and 30ppt (marine) to avoid mortality in aquaculture systems. Seabass fry can tolerate freshwater when they attain a size of 4.5 mm total length, but growth is reduced (Boonyaratpaliin 1997).
- Changes in the severity/frequency of extreme events: Seabass are less sensitive to changes in turbidity than most other cultured finfish, extreme events causing disturbances the water column may not produce as much as a threat.
- Adaptation: Pilot studies in Vietnam have shown that culturing Seabass in brackish water inlets previously not used for this purpose, has been successful. The experiment was carried out in areas with highly variable temporal conditions such rainfall (and therefore salinity) and turbidity.

Mackerel *(Rastrelliger brachysoma)*

Sensitivity :

- Sea surface temperature change: Mackerel spawn offshore however after egg hatching, juvenile mackerel travel onshore via currents to develop in mangrove/wetland environments. Mackerel are sensitive to changes in temperature in various stages of their lives, from egg to mature reproducing adult, as they inhabit different zones of the coast from mangrove to open ocean. Both temperature and salinity appear to govern the migration patterns of mackerel; they were observed to show higher susceptibility towards temperature variations than to salinity, and overall catch rates suffered adversely from a rise in both values.
- Sea level rise: Juvenile mackerel inhabit mangrove and intertidal wetlands so they will be particularly vulnerable to the effects of sea level rise on these habitats.
- Changing ocean chemistry: The sensitivity of tropical marine fishes to changes in pH at large magnitudes or by large increments is unknown. Fish eggs are much more sensitive to pH changes than juveniles or adults, and consequently the largest effects of acidification are likely to be on reproductive performance.
- Altered ocean circulation: Changes in the strength or direction of these currents could influence larval transport along the coastline, possibly sending larvae to unsuitable habitats. Changes in circulation patterns could also influence the production and distribution of mackerel's main food source, micro-zooplankton with a high phyto-plankton content.
- Adaptation: Biogeographic range shifts may occur in response to changing temperatures. However, range shifting will depend on the availability of suitable habitat, food and conditions for breeding.

Squid *(Loligo spp)*

Sensitivity :

- Sea surface temperature change: Some research suggest that squid will thrive in the face of a global warming of the seas, with increased growth rates, accelerated life histories and rapid turnover in populations, which could potentially lead to population expansion at the expense of slower growing competitors. However, there is a negative relationship between incubation temperature and hatchling size so that under higher temperatures, hatchlings emerge smaller. Smaller squid hatchlings may mean smaller adults, or at least no net increase in size-at-age, even if growth rate is substantially elevated by temperature.
- Changes in precipitation: Salinity is an important factor influencing embryonic development and survival in squid. Squid larvae are intolerant to freshwater, and as such are extremely vulnerable to reduced salinity events such as heavy rainfall and associated freshwater runoff or river flows.

- Changing ocean chemistry: Highly sensitive to pH change with decreased ability to bind oxygen for transport to the tissues which may have implications for growth, reproduction and other physiological processes at different life stages.
- Altered ocean circulation and nutrient flows: Changes in primary production associated with changes in nutrient flows/upwelling are of particular significance as this constitutes the basis of the food chain for these organisms.
- Adaptation: Squid have an extremely fast growth rate and rapid rate of turnover at population level, which means they can respond quickly to ecosystem change. Limits to thermal tolerance can result in squid shifting their latitudes.

1.2.2. Conservation Species

Aquatic Species

A recent survey (Long *et al*, 2010) of aquatic species in Bac Lieu has recorded seven species of conservation value (Table 6) out of a total of 82 species found in the coastal zone of Ba Lieu Province. No recent similar survey is available for the other BCR provinces, however it is highly probable that the same species occur in the other provinces. There is presently no conservation program for these species and the authors identify a number of threats in general including, the taking of juveniles and the use of fine mesh nets.

Table 6: List of fish species of conservation value recorded in Bac Lieu coastal zone (Long *et al*, 2010)

No.	Common names	Scientific names	SĐVN 2007	IUCN 2008
1	Flapnose ray	*Rhinoptera javanica*		VU
2	Ribbontail stingray	*Taeniura lymma*		LR
3	Indo-Pacific tarpon	*Megalops cyprinoides*	VU	
4	Ladyfish	*Elops saurus*	VU	
5	Chacunda gizzard shad	*Anodontostoma chacunda*	VU	
6	Narrow barred tigerperch	*Datnioides polota*	VU	
7	Spotted archerfish	*Toxotes chareareus*	VU	

Notes: *VU – Vulnerable; LR: Lower Risk*

The same survey (Long *et al,* 2010) has identified two marine catfish species, *Pangasius krempfi and Pangasius polyuranodon*. Both these species are migratory species, the better studied of the two, *Pangasius krempfi,* having been documented to migrate to tributaries in Laos (Hogan *et al*, 2007). While not threatened at present, they could come under threat should mainstream hydropower dams be built on reaches of the Mekong River below their spawning tributaries in Laos. Refer to Section 1.4.4. below for a discussion on the threat to the marine catfish from mainstream hydropower.

1.3. Climate change scenarios

The reader should keep in mind when reviewing this section that many of the assumptions and much of the data used to estimate how the natural and human systems might be impacted by climate change are subject to uncertainty. Emission scenarios and climate modelling are the two main sources of uncertainties in climate change assessment.

1.3.1. Mekong River Basin Scenario

According to the MRC's (2011) first assessment of the potential impacts of climate change on the Mekong River Basin, changes in mean annual temperature and rainfall are predicted which will impact on Mekong River flows. These flow changes will in turn impact on the timing and severity of the floods in the Mekong Delta and salinity conditions in the coastal areas of the Mekong Delta.
Any attempt to assess the vulnerability of the coastal areas of the MD must therefore consider upstream climate change scenarios. Furthermore, an assessment of climate change impacts must integrate the predicted development impacts on river flows such as the impacts from planned mainstream hydropower dams. This later issue is considered in Section 1.5 below.

Using the two IPCC (2000) defined global development scenarios of A2[5] and B2[6], the downscaled modelling[7] utilised in the MRC study predicts the mean annual temperature of the entire MRB, under scenario A2, to increase by 0.7 °C. The highest temperature change of 0.9 °C is predicted to occur in the Upper Mekong Basin (UMB) while change in the Lower Mekong Basin (LMB) will be 0.7 °C. The temperature changes under scenario B2 is slightly higher (see Figure 10). This translates into a 0.020-0.023 °C increase per year (MRC, 2011, p. 8).

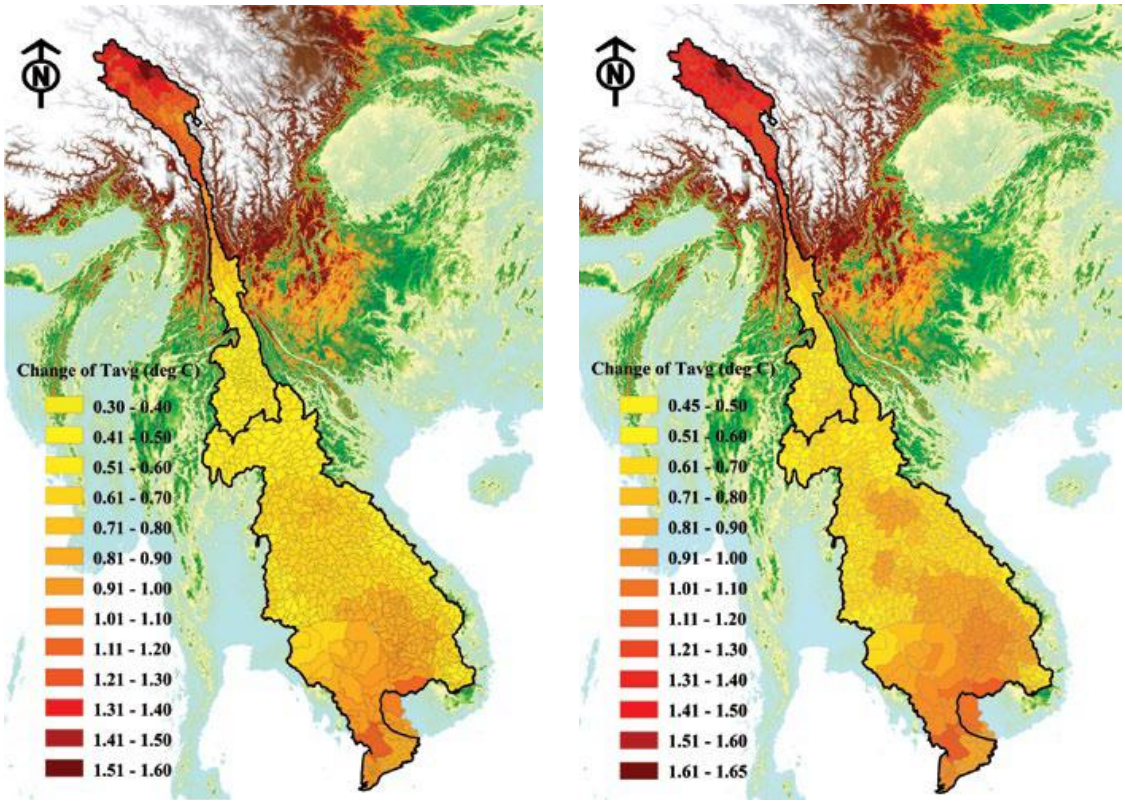


Figure 10. Temperature changes in the MRB for A2 scenario (left) and B2 scenario (right) for the period 2010-2050 compared to 1985-2000 (Source: MRC, 2011, p.9).

[5] A2: regionalization, emphasis on human wealth. Regional, intensive (clash of civilizations). The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines. (IPCC, 2000)

[6] B2: regionalization, emphasis on sustainability and equity. Regional, extensive (mixed green bag). The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels. (IPCC, 2000)

[7] Global scenario prediction data were downscaled to the Mekong Region using the PRECIS model system. The PRECIS data of climate change emission scenarios A2 and B2 were generated by a dynamic downscaling method
taking into account regional characteristics. Change in temperature and rainfall were analysed by comparing the projected averages for 2010-2050 with a baseline of 1985-2000.

Projections for precipitation change show an increasing trend in the mean annual rainfall for the entire MRB except in Cambodia and the Mekong Delta. An approximate 5% increase in mean annual rainfall is predicted for the entire MRB, with no change or a decrease of up to 8% predicted for the Mekong Delta during the dry season. In the UMB, the wet and dry season will produce more rainfall (MRC, 2011, p. 8).

Changes in the flow regime of the LMB are expected as a result of the predicted change in rainfall. Annual mean flow is predicted to increase by 4-13 % for the wet season and 10-30% for the dry season (*ibid*, p.8). The increased flow in the wet season will increase the risk of flooding and low lying areas of the Mekong Delta are particularly at risk. Flood affected areas are estimated to increase by 9% but this estimate does not consider the compounding effect of sea level rise in the coastal areas of the Mekong Delta (*ibid*, p.8).

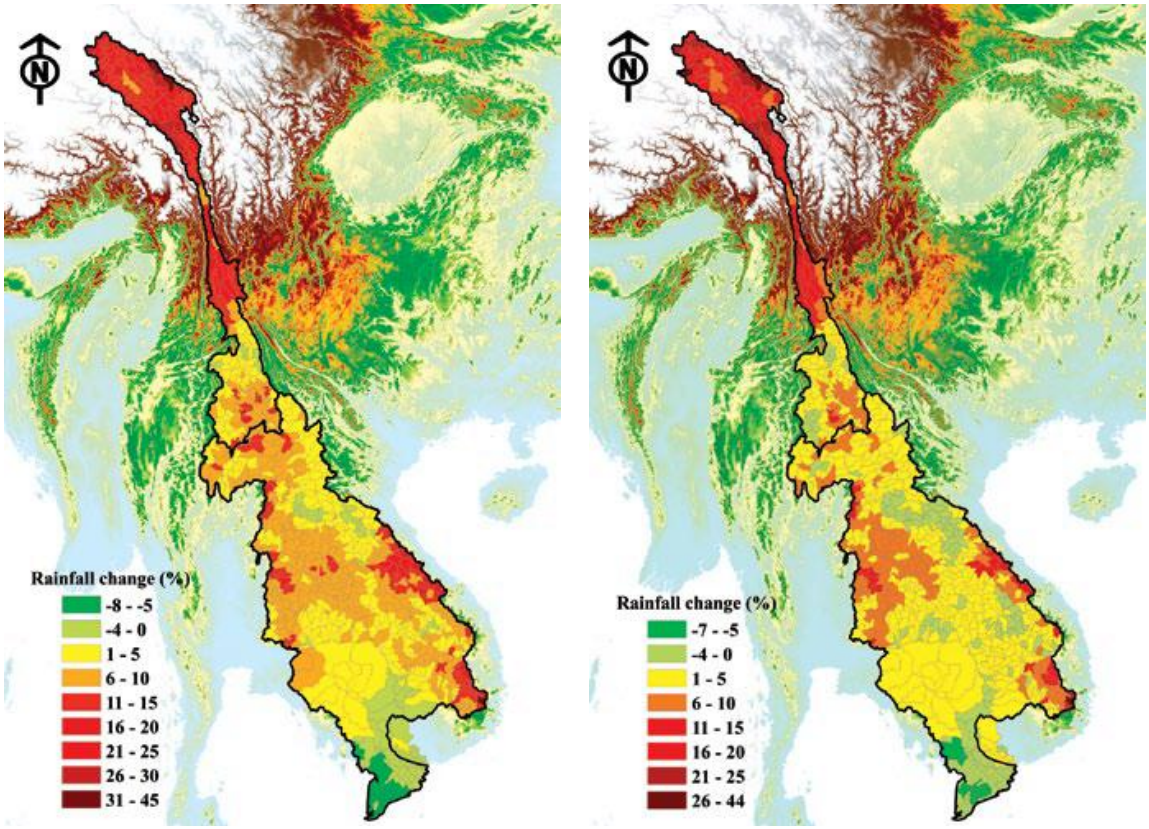


Figure 11. Rainfall changes in the MRB for A2 scenario (left) and B2 scenario (right) for the period 2010-2050 compared to 1985-2000 (Source: MRC, 2011, p.9).

1.3.2. Climate Change Historical Trends in the Mekong Delta

Analysis of local climate trends over the last 30 years are useful indicators that climate change is already occurring. Local communities, when consulted, have already detected such changes (Tuan, L.A. and Du, L.V. 2011).

Such analysis is not available for all the Mekong Delta Provinces, but are available for some provinces such as Ben Tre where a recent World Bank funded study is available. The results are indicative of the kinds of trends that have occurred in the coastal areas of the Delta, such as at Can Gio, Soc Trang and Bac Lieu though the magnitude and timing may differ between different Provinces. There may be different historical trends at Kien Giang because of its location further South, facing the Gulf of Thailand.

Recent analysis of climate trends in Ben Tre Province over the period 1978 to 2010 presented in a World Bank (2011, pp. 31-32) study indicates:

- No significant trend in mean annual minimum temperature;

- A significant increasing trend in both the wet and dry season mean annual maximum temperatures of 0.0442 °C/year (Fig. 12). Wet season temperatures have increased by an average of 0.044 °C/year and dry season temperatures by 0.039 °C/year;
- The total number of days per year with a temperature of over 30 °C has increased significantly for both the wet and dry seasons (Fig. 13). The increase has been by an average of 3.23 days/year or 1.56 days/year and 1.66 days/year in the wet and dry seasons respectively;
- Following the above trend, the total number of days with a temperature over 35°C has significantly increased by an average of 0.26 days/year, in the dry season by 1.45 days/year. There was no significant increase detected for the wet season;
- No significant trend in mean annual rainfall.
- Mean monthly humidity for the year has risen significantly by an average of 0.076 %/year (Fig. 14) and also significantly for both wet and dry seasons by 0.046 %/year and by 0.117 %/year respectively.
- Evaporation data showed a significant decreasing trend of 8.04 mm/year (Fig. 15). Decreasing trends were also evident for both wet and dry seasons, with total evaporation falling by an average of 2.97 mm/year in the wet season, and by 5.06 mm/year in the dry season.

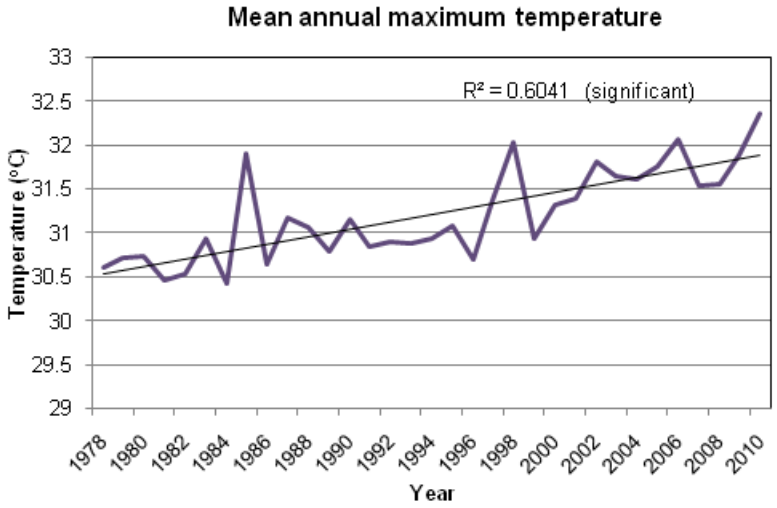


Figure 12. Mean annual maximum temperature (1978 - 2010)

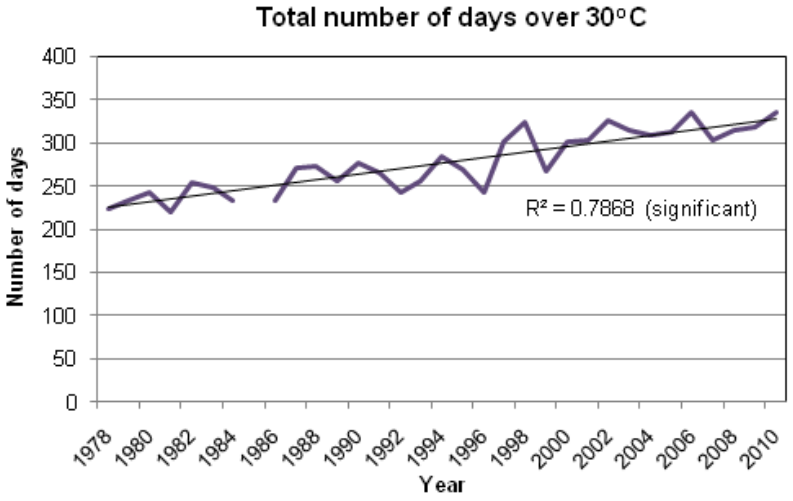


Figure 13. Total number of days over 30°C (1978 - 2010)

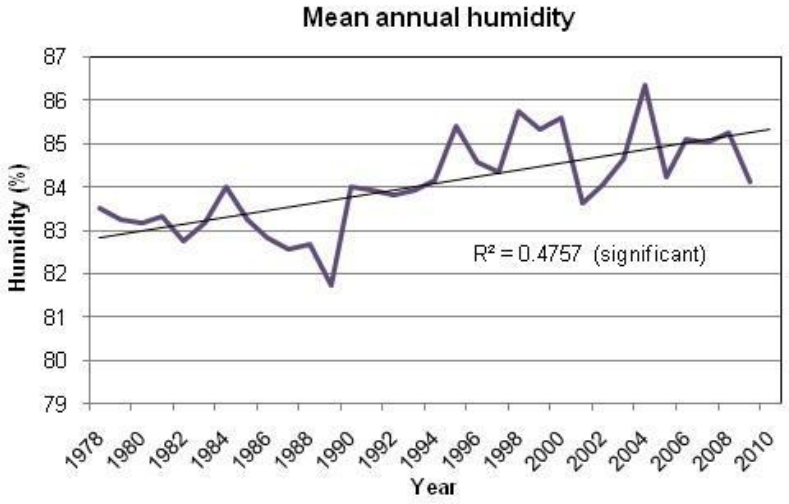


Figure 14. Mean annual humidity (1978 – 2010)

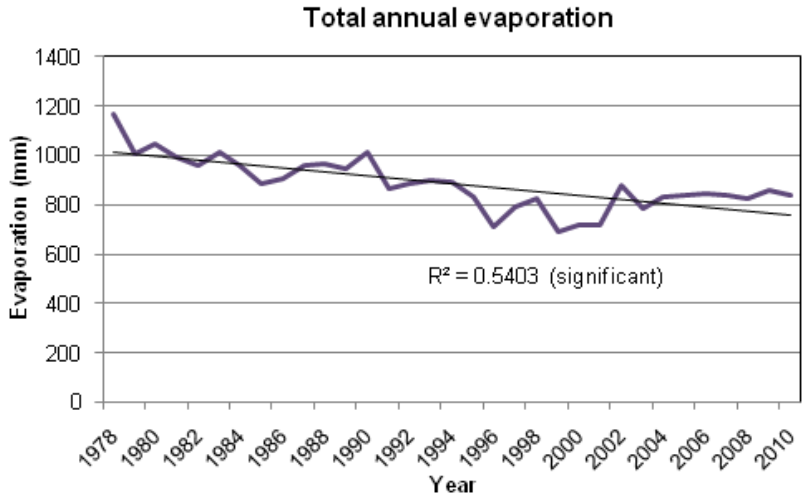


Figure 15. Total annual evaporation (1978 – 2010)

Sea level rise data has been collected at a number of marine hydro-meterological stations along Vietnam's coast including one at Vung Tau Province which has been recording data since 1918 (relocated in 1992). Vung Tau is located immediately North of Can Gio. Data from this station has been used by the USGS (cited in World Bank, 2011) to develop SLR scenarios for the Mekong Delta. The linear analysis performed for this location reveals a SLR trend of about 6 mm per year between 1979 and 2001 (Figure 16). Vietnamese researchers have reported a sea level rise of 13 cm at the Vung Tau station (Cong Van, 2009).

However, the USGS analysis cautions that the Vung Tau data was not corrected for vertical land movements (eg. tectonic movement and subsidence). This is a critical issue for SLR projections in coastal areas. A global comparison found that the Mekong Delta is currently sinking by as much as 6 mm per year, primarily as a result of groundwater extraction (Syvitski *et al*., 2009). If these figures are accurate, this would double the rate of sea level rise with a relative SLR rate of 12 mm/yr.

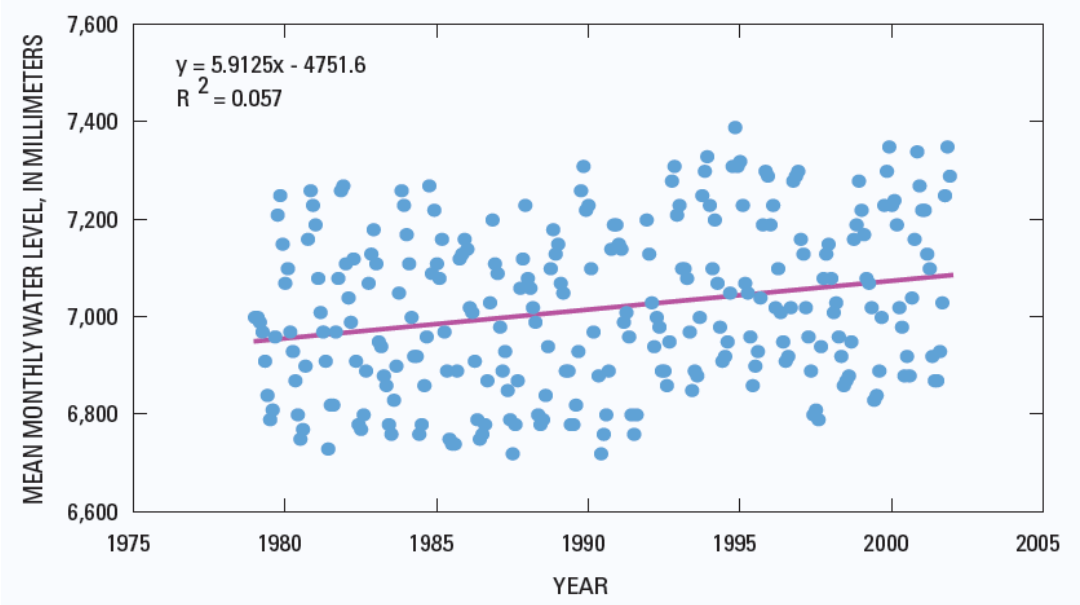


Figure 16. Linear sea level trend for the Vung Tau - tide gage record from 1979 to 2001 (Source: USGS, 2010).

1.3.3. Climate Change Scenarios for the Mekong Delta

Temperature

Maximum and minimum daily temperatures in the Mekong Delta are projected to rise over the next 30 years according to SEA START modelling (Figure 17 and 18). Recent analysis by the World Bank (2011, p. 33) indicate varying magnitudes of change ranging from half a degree by 2020 up to slightly above 1 °C by 2035 depending on the model being used - MONRE for the former and CLIMsystems for the latter.

The total number of days per year with a temperature of over 35 °C is expected to increase (Figure 19) according to SEA START modelling. This is consistent with the trend over the last 33 years.

While the worst affected areas are the inland provinces, coastal areas including the BCR provinces are also affected.

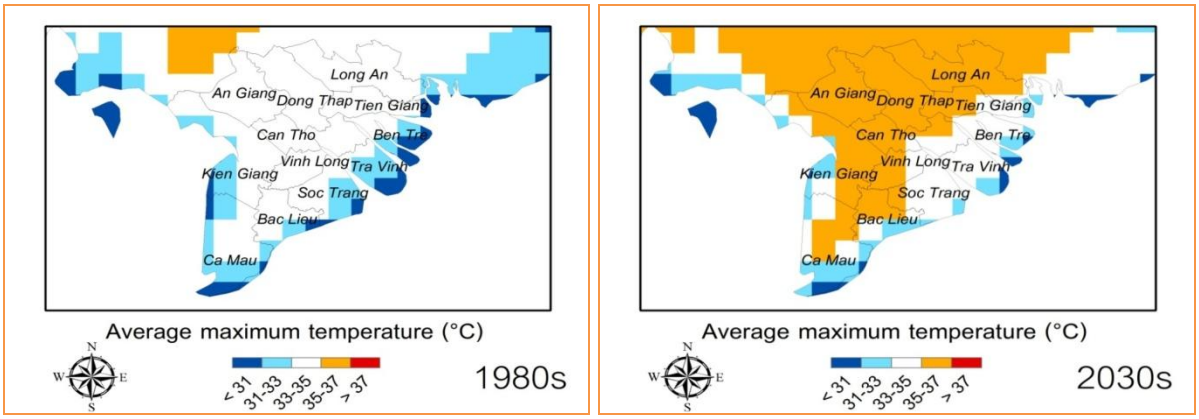


Figure 17. Average maximum temperatures for the Mekong Delta (Source: Can Tho University-SEA START)

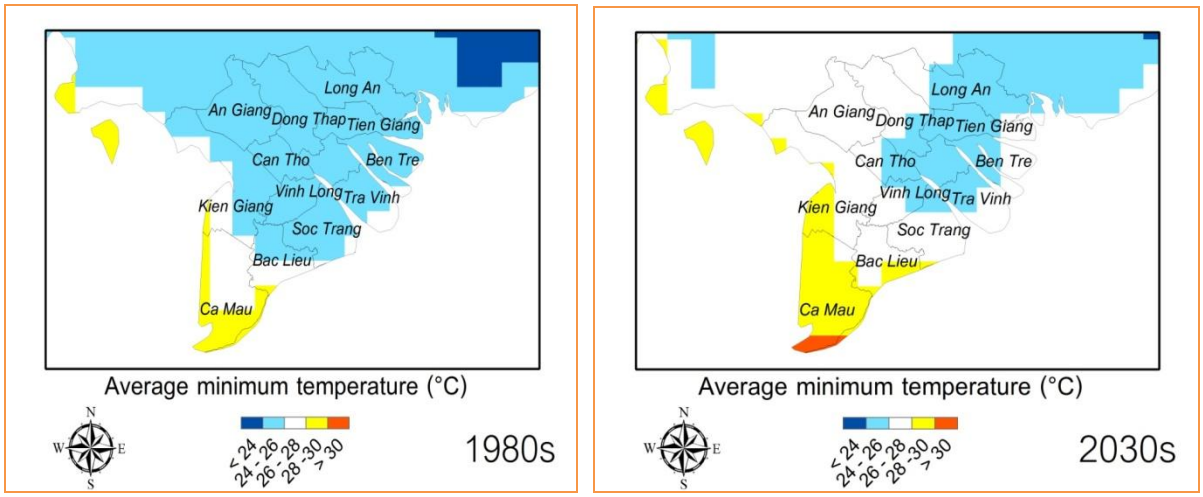


Figure 18. Average minimum temperatures for the Mekong Delta (Source: Can Tho University-SEA START)

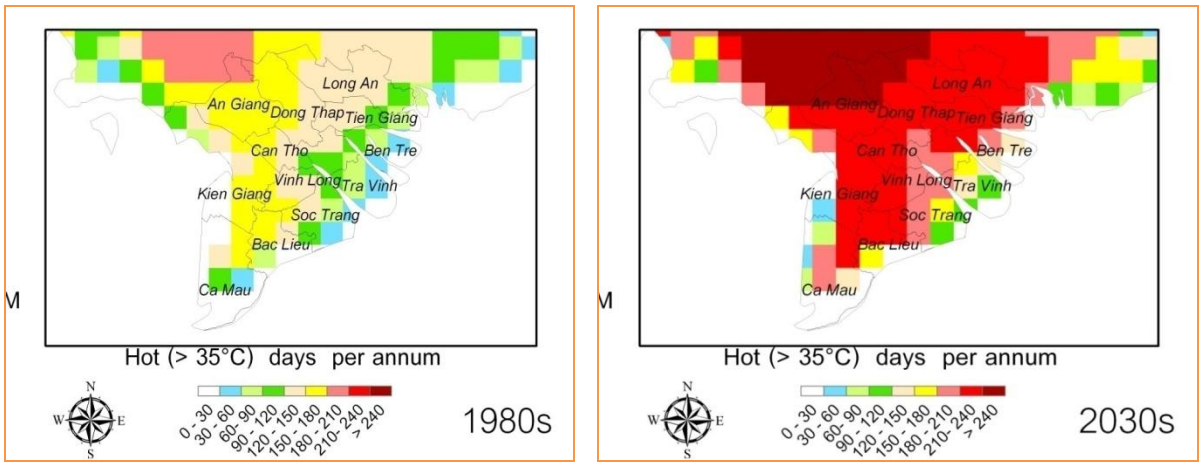


Figure 19. Number of hot days > 35 °C for the Mekong Delta (Source: Can Tho University-SEA START)

Precipitation

Projected annual precipitation changes across the Mekong Delta are complex with changes in the timing and magnitude of the wet and dry seasons for different Provinces (Figure 20). Annual precipitation changes are projected to increase within the range of 51 to 100 mm for the Mekong Delta according to early CSIRO modelling (2008) cited in the recent World Bank study (2011, p. 33). The projected change is characterised by an increase during the wet season of between 0 and 100 mm and a slight decrease during the dry season of between 5 mm and 9 mm.

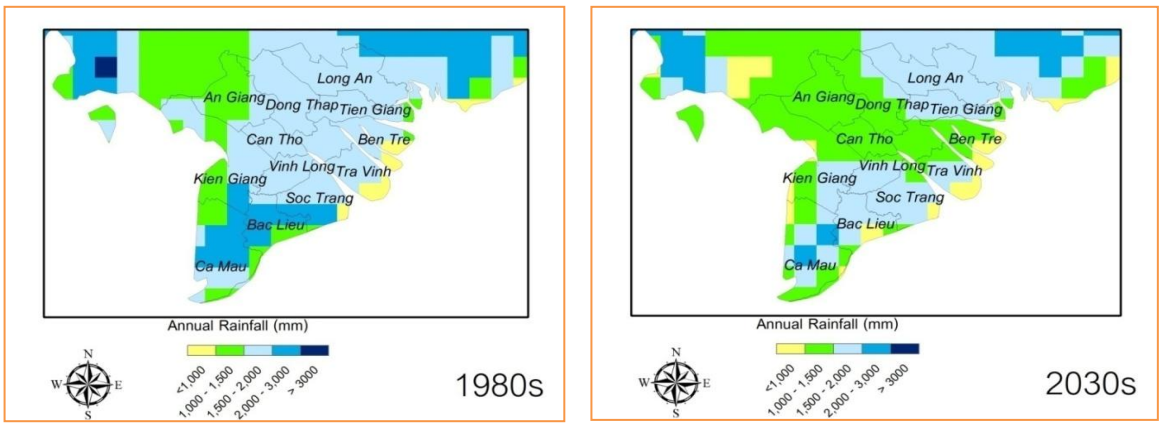


Figure 20. Annual Rainfall for the Mekong Delta (Source: Can Tho University-SEA START)

Sea Level Rise and Flooding

Early projections for flooding in the Mekong Delta have suggested that the most important factor would be due to SLR. SLR modelling by ICEM (Carew-Reid, 2007) reveals that about 31% of the Mekong Delta could be inundated by a 1 meter sea level rise by 2100 (Table 7). A 1 meter sea level rise by 2100 has been projected by the IPCC (2007) as a possible A2 scenario. More recent analysis suggests that this might be an underestimation and that higher levels may be possible (World Bank, 2011).

The BCR Provinces of Ben Tre (50% of the Province inundated), Soc Trang (43%), Kien Giang (28%) and Bac Lieu (38%) are amongst the worst affected Provinces in the Mekong Delta.

Table 7. Inundation projections for a 1 m SLR by 2100 in the Mekong Delta Provinces (Carew-Reid, 2007, p. 14).

Economic Region	Province	Inundated area (sq.km)	% of SLR area	% of province area	% of total land area*
Mekong River Delta	An Giang	192.3	1.32	5.45	0.06
	Bac Lieu	961.9	6.62	38.87	0.29
	Ben Tre	1,131.4	7.79	50.14	0.34
	Ca Mau	1,182.8	8.14	22.75	0.36
	Can Tho	757.7	5.22	24.75	0.23
	Dong Thap	389.4	2.68	11.53	0.12
	Kien Giang	1,756.8	12.09	28.22	0.53
	Long An	2,168.9	14.93	49.42	0.66
	Soc Trang	1,424.6	9.81	43.71	0.43
	Tien Giang	783.2	5.39	32.68	0.24
	Tra Vinh	1,021.3	7.03	45.72	0.31
	Vinh Long	606.4	4.17	39.69	0.18
Mekong River Delta Total		12,376.7	85.19	31.00	3.76

Approximately 27 % of the total population of the Mekong Delta Provinces of approx 18 million lie within the flood impacted areas. This could potentially displace 4.8 million people.

The BCR provinces are again amongst the worst affected Provinces with approx 54% of the population of Ben Tre, 35% of Soc Trang, 18 % of Kien Giang, and 45% of Bac Lieu projected to be impacted by inundation (Table 8).

Table 8. Population affected by a 1 m SLR by 2010 in the Mekong Delta Provinces (Carew-Reid, 2007, p. 14).

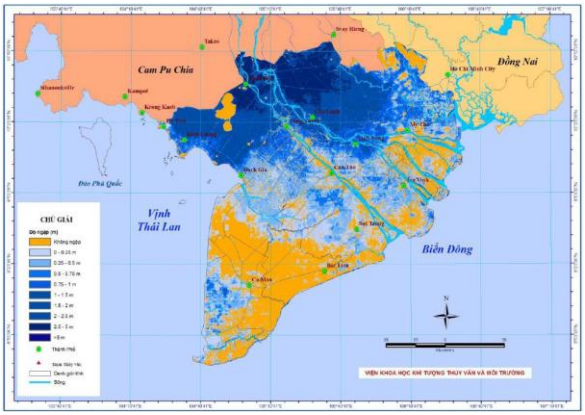
Economic Region	Province	Number of people affected	Total population of province	People affected as percent of total population of province	People affected as percent of total population within SLR inundation zone
Mekong River Delta	An Giang	197,085	2,372,860	8.3	3.36
	Bac Lieu	383,764	857,521	44.8	6.54
	Ben Tre	759,174	1,389,730	54.6	12.94
	Ca Mau	182,956	1,206,390	15.2	3.12
	Can Tho	426,511	2,046,210	20.8	7.27
	Dong Thap	222,289	1,662,590	13.4	3.79
	Kien Giang	295,989	1,590,910	18.6	5.04
	Long An	581,456	1,488,070	39.1	9.91
	Soc Trang	457,821	1,307,200	35.0	7.80
	Tien Giang	497,075	1,728,190	28.8	8.47
	Tra Vinh	418,066	1,101,850	37.9	7.12
	Vinh Long	364,414	1,152,190	31.6	6.21
Mekong River Delta Total		4,786,600	17,903,711	26.7	81.56

However, the ICEM study does not take into account the projected CC related hydrological changes in the Mekong Basin such as higher rainfall and river flows outlined in 1.4.1.

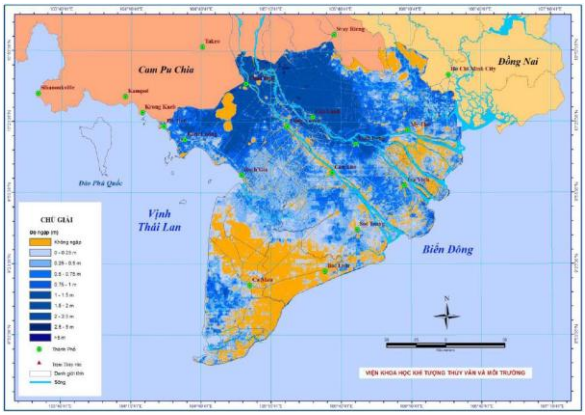
More recent analysis suggest than an increase in flooding in the Mekong Delta would be caused almost equally by the increased flow from the upstream Mekong and sea level rise. During dry years the sea level rise would cause most of the changes. Modelling work that takes into account projected hydrological changes has been undertaken by the Institute of Meteorology, Hydrology and Environment (IMHEN, part of MONRE) as a part of Danish funded project looking at impacts of climate change on water resources. Flooding maps were generated for the current situation as well as SLR of +15 cm, + 25 cm and + 30 cm for the A2 and B2 scenario. Flooding maps of the Mekong Delta are provided below for the A2 scenario. Under a +35 cm SLR scenario, much of coastal Ben Tre, Soc Trang and Bac Lieu provinces, and all of Kien Giang Province would be inundated during the wet season (Figure 21).

This modelling work does not take into account flow changes that will occur from expanding upstream hydropower operations or the previously mentioned problem of subsistence. Another important factor is presently not being considered in SLR and flooding projections for the coastal and tidally influenced areas of the Mekong Delta are changes in the monsoon weather systems affecting the oceanic currents and storms from the sea. There are no studies that quantify these effects yet (World Bank, 2011).

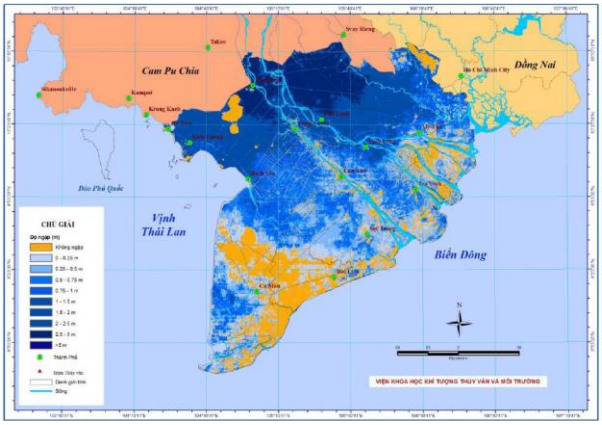
PRESENT



+15 CM SEA LEVEL RISE



+25 CM SEA LEVEL RISE



+35 CM SEA LEVEL RISE

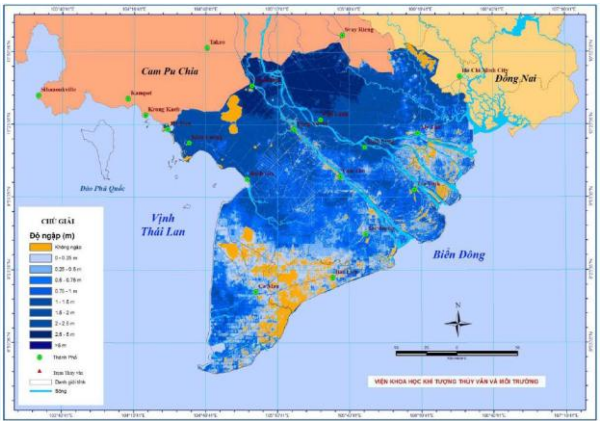


Figure 21. Expansion of wet season flood zone with various sea level rise projections under the A2 scenario (Source: World Bank, 2011)

Salinity Intrusion

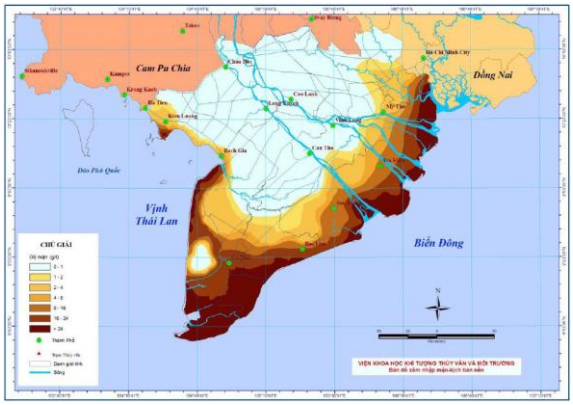
Recent modelling of salinity intrusion by IMHEN (World Bank, 2011) has been undertaken combining SLR with projected changes in surface runoff. However this modelling does not account for flow changes that will result from upstream hydropower dam developments. The modelling projects that all coastal provinces

of the Mekong Delta may experience an increase in salinity levels and an inward movement of salinity affected areas (Figure 22).

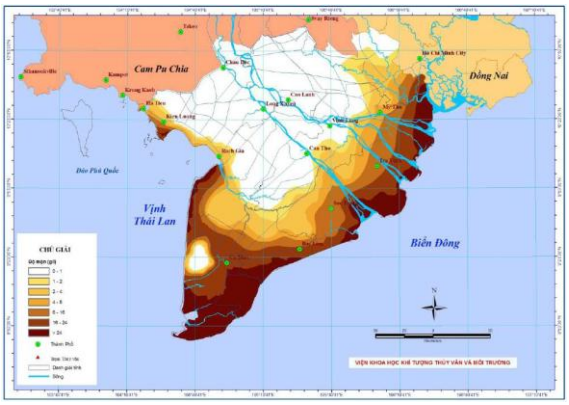
In relation to the BCR Provinces, the coastal strip such as that in much of Kien Giang will experience an increase in saline concentration of approx 1 to 2 g/l with a SLR of +35 cm compared to current levels. Salinity levels may not increase in the coastal strip of Ben Tre, Soc Trang, and Bac Lieu, but is projected to move further inland (*ibid*).

World Bank (*ibid*) analysis suggests that higher underground water extraction for agriculture to compensate for increasing salinity levels will create a vicious cycle of over-pumping and salinity increases. The impacts of over-pumping for agricultural purposes on salinity may be greater than climate change alone. Other factors include the expansion of hydropower developments in the LMB that is projected to reduce dry season mainstream flows leading to an increase in salinity levels. The impacts from hydropower development may similarly have a greater effect than climate change alone. The higher rainfall runoff in the Mekong Delta during the wet season may have a positive effect and reduce salinity, however the slightly lower dry season runoff leading to slightly higher salinity levels in the dry season may create greater extremes between wet season salinity and dry season salinity.

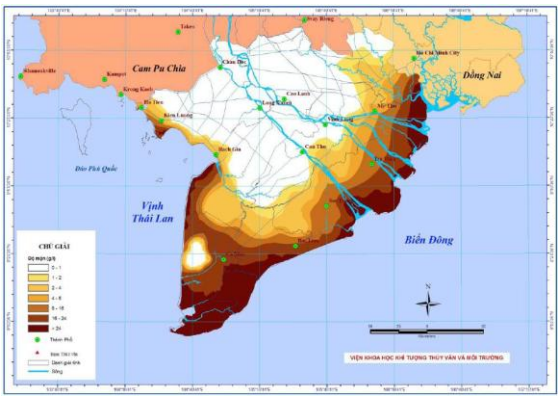
CURRENT



+15 cm SLR



+25 cm SLR



+35 cm SLR

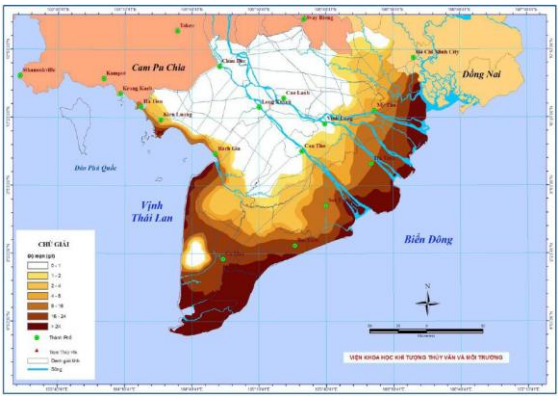


Figure 22. Expansion of salinity intrusion areas under scenario A2 in the Mekong Delta (Source: World Bank, 2011, p.42).

Storm frequency and intensity

There are contradictory projections for storm frequency in Southern Vietnam. An ADB study (2010, p.3) of CC adaptation for HCMC suggests that “tropical storms and typhoons are expected to land more frequently in the southern region of Viet Nam”. The ICEM (2007) study also projects higher storm frequencies for the Mekong Delta.

However, analysis of storm frequencies by MONRE (2009) and Low (cited in World Bank, 2011) has highlighted that while there is a high degree of uncertainty associated with storm projections, historical observations suggest that there has been a decrease of the mean frequency of typhoons in Vietnam (Figure 23). The possible mechanisms that affect the frequency of typhoons in latitudes such as the Mekong delta are complex and poorly understood (World Bank, 2011).

The MONRE (2009) study also reports that the typhoon tracks have been moving southward and the typhoon season ending later.

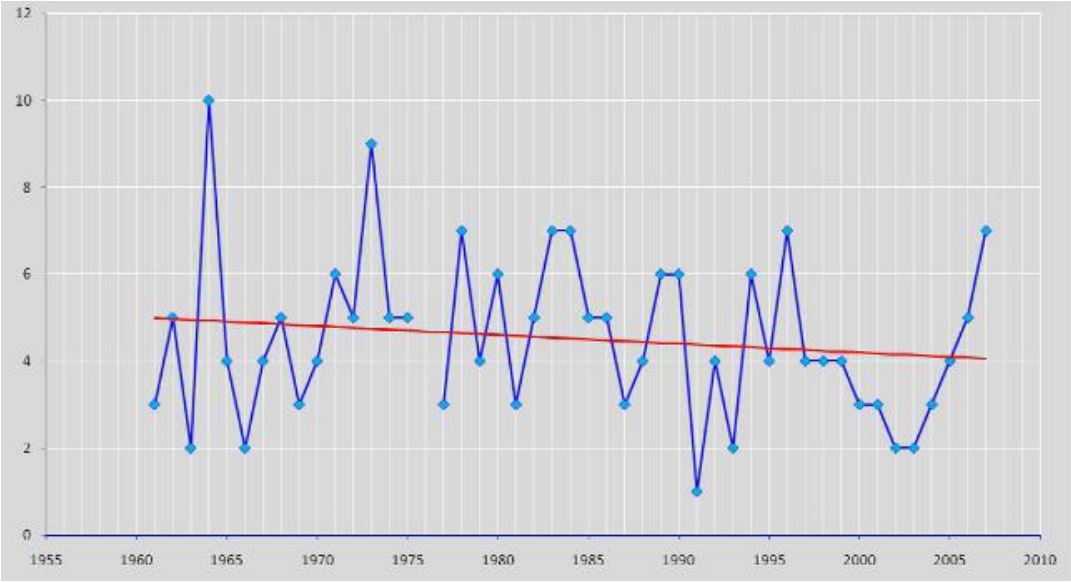


Figure 23. Number of typhoons landing on the coast of Vietnam between 1961 and 2007 (Source: Low, 2010; cited in World Bank, 2011).

MONRE sourced data documents actual typhoons that have landed in Southern Vietnam (Fig 18). With reference to the BCR provinces, it ought to be noted that Kien Giang does not experience typhoons as it is sheltered from the predominant South-Westerly tracks of the East Sea typhoons.

Figure 24 documents the number and intensity of historical storms with 6 of the 7 storms to land between 1961 and 2007 being a category 10 or less on the Beaufort scale. The most intense storm, Durian in 2006, was a category 13.

While projected storm frequencies may be in dispute, there is general consensus that increasing sea water temperature is projected to increase the intensity of the storms in the Mekong Delta (ICEM, 2007, ADB, 2010, World Bank 2011, Supakorn, 2011). There are no projections available for the magnitude of change.

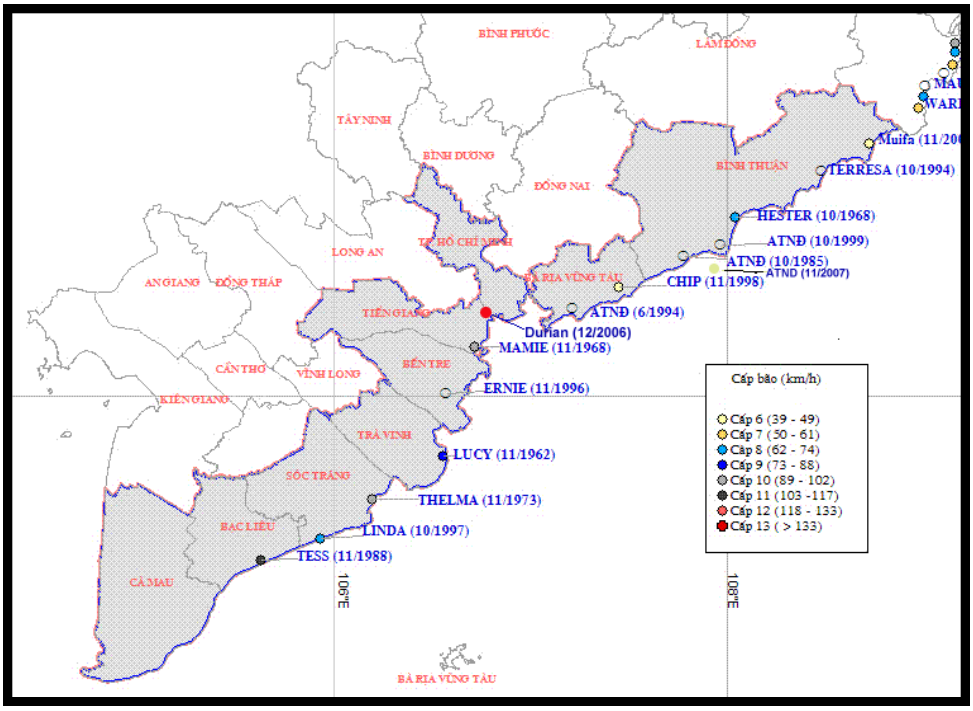


Figure 24. Typhoon landings and intensity between 1961 and 2007 in Southern Vietnam (Soc Trang PPC, 2011).

1.3.4. Downscaled Climate Change Scenarios for the BCR Provinces

Downscaled scenarios were prepared by SEA START (2011) for the purpose of assisting government level technical staff in each of the BCR provinces with CC scenarios for the purpose of conducting community level vulnerability assessments. The work is an incomplete draft and scenarios for Soc Trang are not yet available. However, Soc Trang Province has completed its CC Action Plan which consists of downscaled scenarios for Soc Trang sourced from MONRE and these could be used instead. Similarly, Ben Tre Province has also completed a CC Action Plan and has access to its own scenarios for the province. Can Gio, Kien Giang, and Bac Lieu do not yet have government produced downscaled scenarios.

The available SEA START scenarios are provided in Annex 1 without interpretation as this has already been provided in the above section for the Mekong Delta and there is little variation between the provinces for most of the CC scenarios.

1.4. Ongoing drivers of change and major developments

1.4.1. Drivers of coastal land-use change

Section 1.1 outlined the major land-use changes that have occurred over the last 10 years in the Mekong Delta. This section examines the drivers of these changes and the conversion of coastal mangroves and rice-based agriculture, to aquaculture, in particular cultured Giant Tiger Prawn (*Peneaus monodon*) and its implications in relation to CC.

High profits are cited by most studies as the key driver of the shift to shrimp aquaculture in the coastal areas of the Mekong Delta (Brennan *et al.*, 2002; Be *et al.,* 2003; Trung *et al*., 2004; World Vision, 2004). Others (Lebel, *et al*, 2002; Joffre, O.M. and Schmitt, K., 2010) have cited growing demand in national and international markets, and national and local government policy that supported the intensification and expansion of shrimp growing areas - from 90 000 ha in 1991 to 460 000 ha in 2003 (Vo, 2003; Ministry of Fisheries, 2004).

Mono-cultured shrimp is a high risk investment in comparison to traditional rice-shrimp farming that dominated coastal areas of the Mekong Delta until the late 1990s. Losses from disease and natural disasters such as floods and storms are common place today.

To manage the risk of disease, there is growing use of chlorine to clean out ponds in between crops. This recent practice escapes any form of regulation presently and the impacts of flushing the chlorine out into the mangroves is undocumented. There is also widespread use of antibiotics in most shrimp farming communities today to suppress disease which suggest that the shrimp are being produced under conditions of high-stress from various environmental and production factors.

For example, year round production of shrimp in coastal areas away from the estuaries, such as in Vinh Chau District, Soc Trang, and the coast of Bac Lieu, puts the shrimp in environments with high salinity of above 30 ppt. This is at the upper levels of their tolerance range of 15 to 30 ppt. The salinity at the end of the 2011 wet season in Bac Lieu was reported to be 36 ppt (Buu, D. C., pers. comm.).

Shrimp farming in the coastal zone has a number of impacts that will increase the vulnerability of coastal communities to climate change and their adaptive capacity.

Large-scale mangrove clearance for shrimp farming has largely been checked in recent years in the BCR Provinces through increased government enforcement of forest protection regulations and the involvement of communities in co-management arrangements to protect the mangroves. The GIZ project in Soc Trang has been pioneering these institutional developments in the coastal zone of the Mekong Delta (see http://czm-soctrang.org.vn/en/About%20the%20project.aspx?ID=3). Furthermore, all the BCR provinces have ongoing reforestation plans in place (various interviews).

However, some existing shrimp farms will continue to pose a threat to the mangroves as SLR sets in. Shrimp farms continue to occupy much of the land area demarcated as buffer-zones between the mangroves and the coastal dyke in Ben Tre, Soc Trang, and Bac Lieu (Figure 25 and 26). In Ben Tre and Bac Lieu, extensive shrimp farms are located within the mangroves (Figure 27 and 28). In both cases, the impoundment banks of the shrimp ponds create an effective barrier to the SLR induced retreat of mangroves. Relocation and resettlement of these shrimp farms and households can be costly and problematic for the government who has to compensate the owners of the farms and/or to find equivalent land and livelihoods for the resettlement. The World Bank funded Coastal Wetland Protection and Development project (World Bank, 2008) illustrated the challenges faced in terms of livelihood restorations in Bac Lieu and Ca Mau during resettlement when households were resettled out of the buffer zone.

Figure 25. Shrimp farms located in buffer zone between mangrove and coastal dyke, Vinh Chau District, Soc Trang.

Figure 26. View of shrimp farms from the coastal dyke located in the buffer zone. Coastal mangrove is seen in the distance. Vinh Chau District, Soc Trang.

Figure 27. Integrated shrimp and *Rhizophora* mangrove farms in Hoa Binh District, Bac Lieu.

Adaptation to SLR may be possible by moving the shrimp farms inland and away from the mangroves and high salinity areas. In Thailand, *Paneaus monodon* has been successfully raised in low salinity or freshwater aquaculture. However, the implications here are that this will displace or reduce existing rice growing areas. Recent growing concern over the loss of rice growing land nationwide may bring this move into conflict with government policy.

There will also be a costly need to modify existing water infrastructure presently designed to service rice growing to ensure the supply of high quality water and waste water disposal for aquaculture. In Bac Lieu, this has already been occurring with shrimp farms now located up to 9 kms inland from the coast. Many of

the sluice gates in the coastal dyke, previously designed to keep out saline water to facilitate rice growing, have now been opened permanently to allow seawater in to service the shrimp farms (Figure 28).

Figure 28. Coastal sluice-gates are no longer operational and left in disrepair in Vinh Hau District, Bac Lieu.

1.4.2. Over-extraction of under-ground water in the coastal zone

In high salinity coastal areas away from the major tributaries of the Tien and Hau River, there is growing use of underground fresh water to dilute shrimp and artemis ponds which is lowering ground water tables in coastal areas such as in Vinh Chau District, Soc Trang.

Certain vegetable and fruit crops that thrive in coastal saline and sandy soils such as onions, garlic, peanuts, sugarcane, Vietnamese apple (Figure 29), etc. are also placing a demand on underground freshwater sources since irrigation infrastructure has been converted to service the shrimp farming needs for brackish water delivery.

Figure 29. Vietnamese apple farm owned by a part Khmer household, Vinh Chau District, Soc Trang Province.

Provincial government piped-water systems for household use in the coastal zones of the BCR Provinces are also heavily reliant on the underground freshwater sources. In all the BCR coastal locations, the Provincial Centre for Rural Water Supply and Sanitation (PCERWASS) run local pumping and water treatment stations for distribution to local households for household use.

It is likely that the reported lowering of the water table by District and Commune government officials in Hon Dat District, Kien Giang, and Tran De and Vinh Chau Districts in Soc Trang during the BCR fieldwork (interviews) is a combination of all these uses which is more than the aquifer is able to recharge.

The over-extraction of underground freshwater will increase salinity intrusion, further reducing water quality in a vicious cycle until the freshwater source no longer becomes economically viable to extract. A recent World Bank (2010) supported review of water supply infrastructure to adapt to CC in Ben Tre Province has suggested that some of these water pumping stations may need to be relocated away from the coastal areas pending further investigations.

The lowering of the coastal groundwater table will likely be compounded by upstream developments in the upper-delta provinces of An Giang and Dong Thap where former wetlands have been dyked off to facilitate rice intensification resulting in reduced recharge of the underground aquifers that feed the coast (Hashimoto, 2001; IUCN, 2011).

Land subsidence as a result of the over-extraction of groundwater could already be occuring in already vulnerable low lying coastal areas such as Vinh Chau District in Soc Trang; Hon Dat and An Bien District in Kien Giang; and Vinh Hao and Ganh Hao in Bac Lieu. While there are no fine grained studies of land subsidence in these localities, a global comparison using remote sensing data found that the Mekong Delta is currently subsiding by as much as 6 mm per year, primarily as a result of groundwater extraction (Syvitski *et al*., 2009, p. 4). These far exceeds the rate of aggradation (sediment deposition) which the same study (*ibid*, p. 4) estimated at 0.4 mm/yr.

There are presently no local scale fine grained studies or monitoring of coastal subsidence in the Mekong Delta despite monitoring methods such as Surface Elevation Tables (SET)[8] being available. There is presently one recent installation in the Can Gio Biosphere Reserve.

1.4.3. Dyking the Mekong Delta

An important driver of change in the Mekong Delta is the Mekong Delta Master Plan (MDMP). Since the 2009 United Nations Climate Change Conference which was held in Copenhagen (CoP15), Vietnam has actively sought Dutch development assistance and expertise in dyke building to assist Vietnam to ‘save’ Vietnam’s rice bowl from climate change. At the Copenhagen conference, Nguyen Khac Hieu, deputy director general of the government's climate change agency stated that “The rice bowl of Vietnam will be severely affected" without action. He went on with an appeal, "It's not only for Vietnam's sake but also for the world's food safety," calling for help to enable the country to adapt.

As a result, Vietnam and the Netherlands entered into a partnership agreement in 2010 to develop the next Mekong Delta Master Plan. The purpose of the Mekong Delta Master Plan is to provide an integrated policy framework that presents recommendations on water management and climate change adaptation in relation to desired land-use, and serves as a guide for further sub-regional planning and for the identification and formulation of investment projects. See Section 2.2.4 for more detail on the Mekong Delta Master Plan.

A ToR and call for consultant proposals for the next MDMP was issued in September 2011 and the process is scheduled to last for 18 months.

A key investment project that appears in a synthesis report (Deltares, 2010) of existing studies by key Vietnamese agencies is a proposal to raise, reinforce and complete the existing coastal dyke system for the Mekong Delta, including for the first time, 2 large-scale sluice gates across the Tien River tributary (Cung Hau Sluice and Co Chien Sluice) between Ben Tre and Tra Vinh Province; the Ham Luong Sluice in Ben Tre; Vam Co sluice upstream of Can Gio; and the Cai Lon and Cai Be sluice in Kien Giang (see Figure 30).

There is not yet any official analysis of the implications of these proposed developments for the coastal mangroves, many of which are already being eroded, exposing the existing dyke to wave action and erosion. Large-scale sluice gates on major tributaries such as the Tien River could also be expected to cause changes in coastal salinity which may create unsuitable habitat for the dominant mangrove species in the tributaries.

[8] See http://www.pwrc.usgs.gov/set

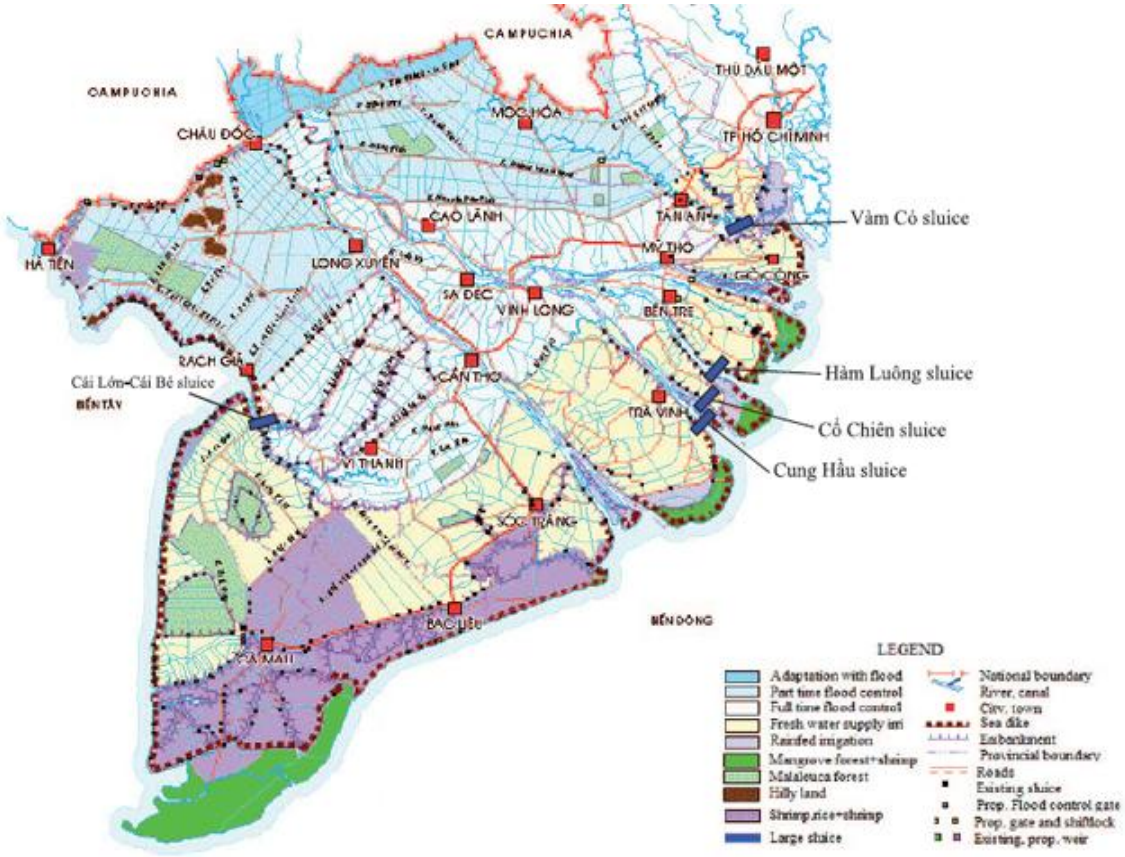


Figure 30. Proposed dyke and sluice gate developments for the Mekong Delta (Deltares, 2010)

1.4.4. Upstream Hydro Developments

The development of mainstream hydropower dams on the Lower Mekong River Basin poses a serious threat to the Mekong Delta and is likely to increase its vulnerability to climate change.

Presently there are at least 12 proposed dams (Figure 31) to be built with one, the Xayaburi in Lao PDR, at an advanced stage of planning.

According to a Strategic Environmental Assessment (SEA) of the hydropower dams (ICEM, 2010) commissioned by the MRC, the building of the dams will result in a likely overall economic loss for Vietnam with significant impacts on the Mekong Delta borne predominantly by poorer communities.

While the impacts to the Mekong Delta will be Delta wide, the most significant losses to the coastal areas of the Mekong Delta will be the result of:

- Changes in river flows caused by the mainstream dam operations could result in a lower flow in the high-flow season and increased flow in the low-flow season but when combined with CC projections for hydrological changes in the MRB (see Section 1.3.1 above) they could result in higher flow in both seasons. Effects could include changes to coastal salinity levels and the transport of sediment further out to sea.

- Sediment retention behind the dams is expected to result in a loss of nutrients to the Mekong Delta's marine ecosystems, estimated at 4,535 tonnes of phosphates per year. The sediment plume which carries nutrients into the marine ecosystem supports and underpins the food-chain that feeds important commercial fisheries such as squid, shrimp, and mackerel. There may also be negative effects on the coastal clam culture.

- Sediment retention behind the dams will also result in the loss of sediments leading to increasing coastal erosion and land-loss in the coastal areas. Between 50 and 75% sediment loss is estimated though it is not clear what proportion of the loss will result along the coastline. Climate change induced SLR compounded by sediment loss to the coastal areas will increase the rate of land-loss.

While studies are yet to be done to quantify and predict the effects of sediment loss, there are already lessons to be learnt from the Red River Delta in Vietnam, and from international experience in the Mississippi Delta in the USA.

In the Red River Delta, some coastal areas experienced decreased sedimentation rate and increased erosion after the Hoa Binh hydropower dam was completed. Vietnamese scientists (Cat *et al*, 2005) who have quantified the analysed the causes of coastal erosion along Vietnam's coastline have identified a complex combination of causes. For example, causes of coastal erosion at Cat Hai in Hai Phong were attributed to the combination of sediment retention by the Hoa Binh dam, neo-tectonic subsidence of the estuary, and SLR. This has made the coastline vulnerable to wave and tide action during the S.E. monsoon.

In the Mississippi Delta, a 2009 communication (Blum, M.D., Roberts, H.H. 2009) from researchers involved in research on sediment dynamics in the Mississippi River, stated that a loss of 50% of the sediment load in the Mississippi River due to retention by upstream dam developments over the past few centuries has occurred. The sediment loss has resulted in the 25% loss of the deltaic wetlands of the Mississippi Delta. The communication concludes that the 'drowning' of the Mississippi Delta is inevitable because SLR is now rising at least 3 times faster than when the delta was being constructed. The loss of the coastal wetlands by 2005 left New Orleans vulnerable to extreme storms such as Hurricane Katrina which almost destroyed the city in August 2005. Hurricane Katrina's destruction of New Orleans was the most expensive natural disaster in US history.

Disruption to fish migrations is also a major and immitigable impact that has also been identified in the ICEM (2010) SEA. The SEA, in reference to one controversial dam, states:

> "Don Sahong dam blocks off the Hou Sahong channel, one of more than ten channels that flow over the Khone falls at the southern end of Siphandone. The Hou Sahong channel is the only channel through the Khone Falls complex which is passable during the dry season. The Don Sahong project would represent an impassable barrier to Mekong dry season fish migration." (ICEM, 2010, p. 31)

In terms of mitigation, the SEA states:

> "Fish passes are not a realistic mitigation option for Mekong mainstream dams. Fish ladders may be a mitigation option for low dams on tributaries, but existing types and sizes of fish ladders cannot accommodate the intensity and diversity of fish migrations on the mainstream." (ICEM, 2010, p. 18).

Dams such as the Don Sahong, Stung Treng and Sambor dam have been identified as causing impact to migratory 'white fish' species that are of important economic value to both freshwater and coastal capture fisheries which are relied upon predominantly by poor communities (AMRC, 2007). At least two marine giant catfish species (*Pangasius Krempfi and Pangasius polyuranodon*) occurs in the coastal waters of Bac Lieu (Long *et al*, 2010) and presumably much of the Eastern coastline of the Mekong Delta in economically significant numbers. The better studied of the two species, *P. krempfi,* spends much of its life feeding off the coastal mangroves but undertakes the long distance migration to river tributaries in Laos to spawn (Hogan *et al*, 2004; Hogan *et al,* 2007; Baird *et al*, 2004). The building of the mainstream dams would pose a major threat to this species by blocking their migration route.

The SEA had recommended a moratorium of 10 years on mainstream dam developments pending further studies. In January 2012, the Vietnamese Government, through MONRE, issued a call for expressions of interest from qualified international consultants to conduct its own study of 'The Impacts of Mainstream Hydropower on the Mekong Delta' beginning April 2012. The ToRs (MONRE, 2012) call for the consultant to:

1. **Develop computational and physical models of LMB mainstream reservoirs** to understand reservoir hydrodynamic and sedimentation processes, turbine and spillway releases and hydrological conditions under continuous, peaking and emergency operations.
2. **Develop databases and field survey/monitoring programs** to collect sufficient baseline data for modeling and assessment of the impact of LMB mainstream hydropower.
3. **Quantify the impact of LMB mainstream hydropower** in terms of Mekong's: (i) hydrological regime, (ii) sediment and nutrient load, (iii) downstream water quality, (iv) fish migration and (v) navigation.
4. **Develop a rigorous scientific evidence base** on the implications of Mekong mainstream hydropower development on the natural, social, economic and institutional systems of the Mekong

Delta, separating impacts from other upstream development pressures including Lancang and tributary hydropower and mega-irrigation diversion.

5. Facilitate a consultative process to disseminate findings and **identify and integrate avoidance and mitigation options for adverse impacts** of upstream development on the Delta.

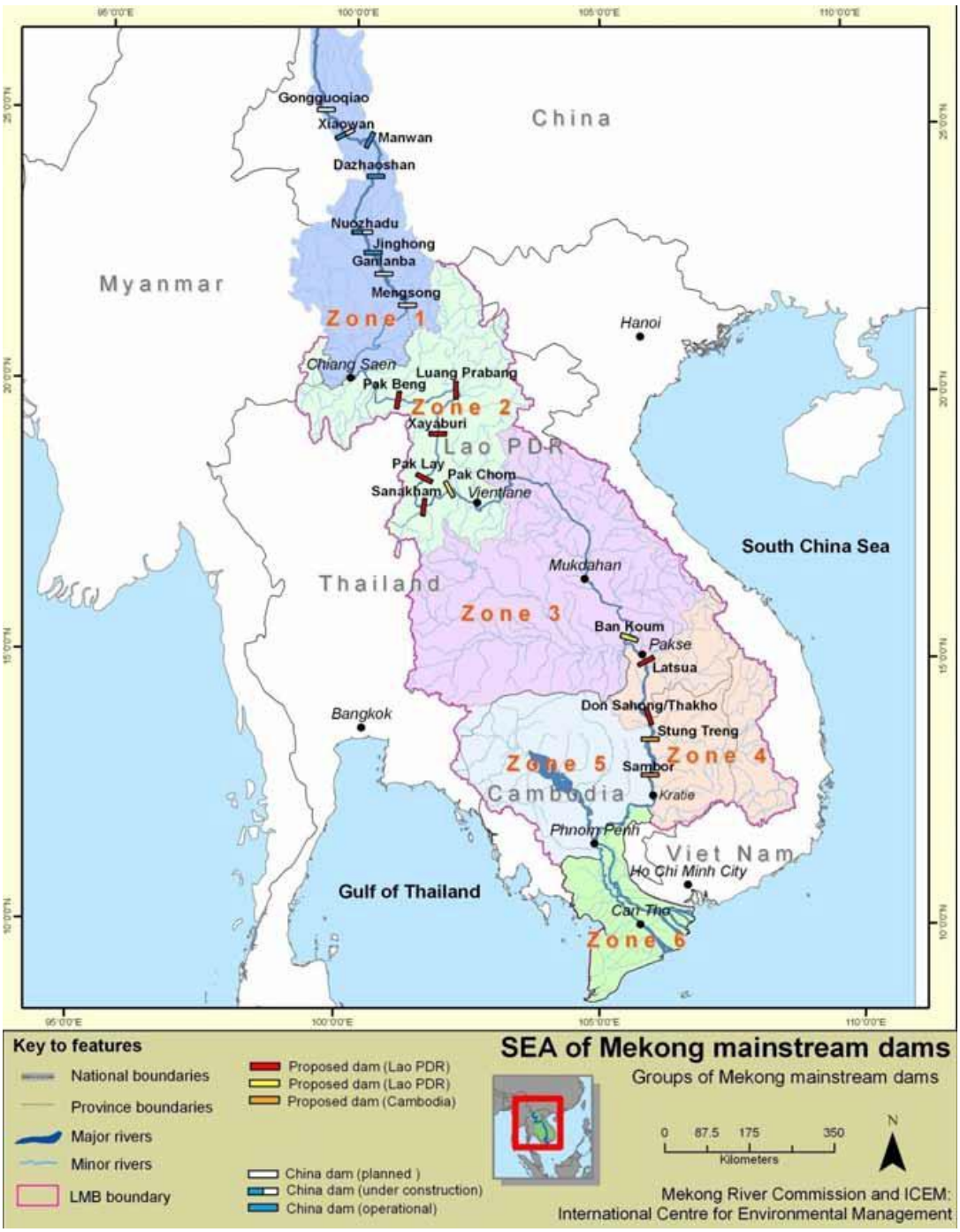


Figure 31. Mekong mainstream hydropower dams (Source: ICEM, 2010)

Besides hydropower dams, several other upstream developments will have an impact on the hydrology of the Delta. For instance, the Thai Government has made plans for water diversions from the Mekong Basin for irrigation purposes. Also the Lao PDR and Cambodia are planning irrigation development projects. If these projects and plans are implemented, the dry season discharge of the Mekong River to Vietnam would be reduced and saline intrusion will become more serious. Some research predicts that discharge will be reduced by 24% in April and the area affected by saline intrusion may increase by 7% as a result (Deltares, 2010).

2. Society and Governance

2.1. Demographics of the target provinces

The average population density of the Mekong Delta is 426 persons/km2 which is higher than the Vietnam average but less than half that of the Red River Delta. Ben Tre Province is the most densely populated of the BCR project provinces with 532 persons/km2 followed by Soc Trang (393), Bac Lieu (347) and Kien Giang (268).

The only ethnic group that is of significance in the Mekong Delta are the Khmer. Of the total 1.3 million Khmer that live in Vietnam, 1.2 million are located in the Mekong Delta. They make up 6.9% of the total population of the Mekong Delta. The biggest populations of Khmers are to be found in Soc Trang (397.014), followed by Kien Giang (210,000), Bac Lieu (70,667) and a very small population in Ben Tre of just 578. In terms of the proportion of Khmers in each Province, Soc Trang has the highest proportion of Khmers with 30.5% or its total population followed by Kien Giang (12.4%), Bac Lieu (8.1%) and Ben Tre (0.46%).

Table 9. Population, population density, and ethnicity in 2010

Province	Population (Thous. pers.)	Area (Km2)	Population density (Person/km2)	Khmer (persons)	Khmer (% of population)
Vietnam	86,927.7	331051.4	263	1,260,640	1.5
Red River Delta	19,770	21,063	939	0	0
Mekong Delta	17,272.2	40518.5	426	1,183,476	6.9
BenTre	1256.7	2360.2	532	578	0.46
Soc Trang	1300.8	3311.8	393	397,014	30.5
Kien Giang	1703.5	6346.3	268	210,899	12.4
Bac Lieu	867.8	2501.5	347	70,667	8.1

Data source: General Statistics Office of Vietnam, 2010

2.2. Institutional mechanisms for coastal management

2.2.1. Integrated Coastal Management

As an institutional form or management approach, Integrated Coastal Management (ICM) is a relatively new concept in Vietnam. Through various initiatives since 1995, Vietnam has been formulating various ICM initiatives at the central level and implementing them at the local level through pilot projects supported by government and international organizations.

By 2008, the government had established an organization called the Vietnam Administration for Seas and Islands (VASI) within MONRE with the objective of coordinating cross-sectoral developments of seas, coasts and islands. Governmental Decree No. 25/2009/ND-CP on Integrated Marine Resources Management and Environmental Protection dated 6 March 2009 (in force in May 2009) marked the first integrated policy covering coasts, seas, and islands in Vietnam. It provides guidance on ICM implementation, coastal functional zoning and marine spatial planning (Chu Hoi, 2009). The decree identifies VASI as responsible for coordinating the implementation of ICM plans and programmes. Pollution control, environmental accidents, natural disaster preparedness and coastal protection are among the key ICM issues addressed.

However, according to the Deputy Administrator of VASI, Dr. Nguyen Chu Hoi (2011), ICM initiatives have faced numerous challenges and obstacles during implementation including:

- Lack of an institutional arrangement for ICM at different levels of government;
- Lack of national system of ICM policy and laws, and low enforcement;
- Collaboration between agencies/sectors and stakeholders in ICM development and implementation is very limited;

- Incorporation of ICM into national and provincial socio-economic plans is weak and lack of special technical guidelines;
- Incorporation of the climate change and sea level rise impacts into the ICM is still not addressed;
- Lack of human resources and capacity in ICM development and implementation;
- Lack of sustainable financing mechanism for ICM plans at both central and local level;
- The awareness and participation of local community in the ICM cycle is unclear;
- Formal academic training and education programs on ICM are limited;
- The skill of the staff from agencies responsible to ICM at both central and local level is still very weak.

At the provincial level in coastal provinces of the Mekong Delta, VASI is represented by an office referred to as sub-VASI in the DoNRE. The sub-VASI's are an even newer office then VASI at the National level, most only starting operations in early 2011. They face considerable challenges as stated above in terms of human resources and even a role amongst the more established sub-departments of DONRE and DARD.

As a result, in practice, most of the coastal zone in the Mekong Delta is still managed on a sectoral basis.

2.2.2. Coastal Mangrove Management

According to the 2003 Land Law, MONRE is charged with the management of lands, including wetlands. MONRE is responsible for land use planning, overseeing surveying and land use mapping, land allocation and registration, and issuance of land use certificates.

The roles of MARD and MONRE in mangrove forests overlap considerably, creating a large potential for confusion about regulatory authority. On paper, MARD has jurisdiction over the trees in mangrove forest, while MONRE has jurisdiction over the land itself. Forest activities, however, will almost always affect both trees and the land. Further complicating the question of jurisdiction between these two ministries, MARD regulates aquaculture and fisheries, while MONRE regulates geology, mining and water. A summary of this division of jurisdiction is shown in Table 10.

Table 10. Division of responsibility between MoNRE and MARD (Hawkins, S. *et al*. 2010)

Ministry of Natural Resources & Environment *Management of land, including wetlands*	**Ministry of Agriculture & Rural Development** *Mangrove forest & fisheries management*
• Land-use planning • Surveys and mapping • Land allocation • Land registration • Issuance of land-use certificates • Geology and mining • Water	• Forest-use planning • Forest protection and development • Forest boundary demarcation • Forest allocation and leasing • Forest conversion • Aquaculture and fisheries management

At the Provincial and District levels, the two Ministries have their implementing agencies or Departments, DONRE and DARD, which report to their respective Ministries via the Provincial Peoples Committee (PPC). Figure 32 provides an illustration of the overall institutional structures that are involved in mangrove management.

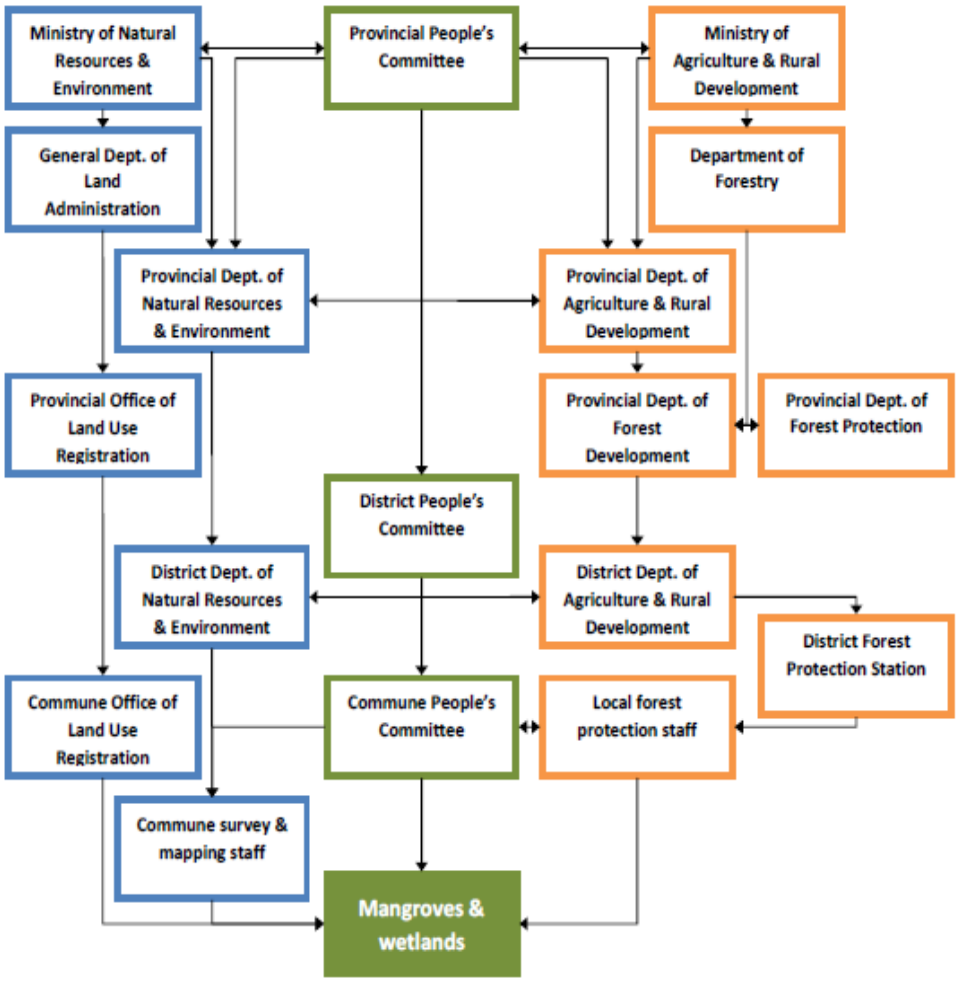


Figure 32. Institutional structure for Mangrove Management (Hawkins, S. *et al*. 2010)

In the coastal zone of the BCR Provinces where mangroves are present, the Forest Protection Department (FPD) – considered a sub-department of DARD – is a key actor. In some provinces, for example Ben Tre Province, the province has established a specific, lower level, Forest Management Board to coordinate and implement the multiple functions of regulation, monitoring and development in relation to its coastal mangroves across this province's three coastal Districts of Thanh Phu, Ba Tri, and Binh Dai.

The coastal mangroves in the Mekong Delta are not contiguous zones of mangroves. They are a complicated patchwork of different classifications of forests (conservation, protected area, ecological restoration zones, special use, buffer zone), land tenure and land use within and around the coastal mangroves (Fig 33).

Figure 33. The coastal mangrove at An Thuy Commune, Ba Tri District, Ben Tre Province.

The buffer zones, which are important areas of economic and livelihood development, are themselves another patchwork of land tenure and land use that come under the jurisdiction of DONRE and DARD at the District and Commune levels. The Commune level Peoples Committee is responsible for working directly with the community to ensure that higher levels of government regulation are followed by the community and to mobilise the community when community action is necessary, such as establishing co-management arrangements within the Commune.

With respect to agriculture or aquaculture based livelihoods DARD coordinates with DONRE, the department responsible for land allocation, land use zoning and issuing the land use rights for individual households to engage in livelihood activities according to the defined zones. In theory, if DARD wants to reclassify land for an alternate use, the proposal is sent to DONRE to assess whether the request conflicts with other regulations over which it has jurisdiction, such as ground water availability.

2.2.3. Fisheries Management

Fisheries management previously came under the jurisdiction of the Ministry of Fisheries. In late 2007, the Ministry was disbanded and its functions integrated into MARD as the Directorate of Fisheries. The functions and mandates of the Directorate are stipulated by Decision No. 05/2010/QĐ-TTg dated 25/01/2010 signed by the Prime Minister. Within the Directorate there are a range of operational departments including a Department of Aquaculture and a Department of Capture Fisheries and Resource Protection.

In all coastal provinces, the fisheries sub-department within DARD, under the direction of the Provincial People's Committee, is responsible for implementing fisheries law, regulations, licensing, and national fisheries policy at the provincial level. The Provincial People's Committee can make resolutions, decisions, standards, and quotas on fisheries within the province that are in-line with the fisheries directives and regulations set by the Directorate of Fisheries within MARD. For example, the Directorate is responsible for (i) setting the total allowable catch and fishing capacity for regions, (ii) protection measures relating to the marine environment and living resources; and (iii) zoning (eg. marine protected areas), monitoring and research (DERG and CIEM. 2010; Pomeroy *et al*, 2009). Each province then allocates the allowable effort in its province. Entry rights are allocated first to fishers in their own province (Pomeroy *et al*, 2009).

At lower levels of government, fisheries offices are placed within the District DARD. There are no fisheries offices at the commune level, but in communes where fisheries are important, one or two members of the

commune may be appointed to be in charge of fisheries management but they are self-funded by the communes which usually results in poor performance (Pomeroy *et al*, 2009). Major fishing fleets and communities in the Mekong Delta are located in Binh Thang Commune, Binh Dai District, Ben Tre; Tran De District, Soc Trang; Ganh Hao Town, Bac Lieu, and Ta Cau, Nam Du, An Thoi and Tho Chu in Kien Giang Province (Sinh and Long, 2010).

Over the last decade it has been widely recognised that Vietnam's fisheries, in particular the near-shore fisheries are being exploited un-sustainably. For the off-shore fishery, TACs are no longer widely used because of problems with data accuracy and comprehensiveness which is required to calculate reliable maximum sustainable yields. As a result, production targets are usually set out in provincial development plans that place a heavy emphasis on economic growth (DERG and CIEM, 2010).

The unsustainable near-shore fishery has received considerable policy attention in recent years. For over a decade, the general objective here has been to find alternative livelihoods for near-shore fishers. Yet the numbers of fishers exploiting the near-shore fishery have been growing steadily. Pomeroy et al (2005) suggests that the solution will involve improved fisheries statistics, resources for provincial fisheries staff, and a sectorally coordinated and integrated approach involving a mixed strategy of resource management; resource restoration; economic and community development; and new governance arrangements.

2.2.4. Disaster Risk Management

Vietnam has long experience with natural hazards and resulting disasters. As a result, the country has a comprehensive system of formal disaster risk management. The coordination and implementation of disaster risk management falls within the responsibility of MARD's rural development mandate. The mandate of the ministry defines its role to "unify the management of dike construction and protection, headwork for prevention of floods and typhoons and efforts to prevent and combat flash flooding, floods, typhoons, drought, and landslides along riversides and coastal areas" (cited in Birkmann *et al*, 2011).

In order to supervise the implementation and maintenance of disaster prevention measures (such as dykes and shelters) and to organize disaster response (e.g. on-the-spot dyke repair units) MARD and its line departments are in charge of coordinating committees of flood and storm control of which one is in place at the national level and at every province, district and commune respectively.These committees are headed by high ranking officials of MARD or by leading officials of the People's Committee at each respective level and include representatives from the different planning agencies and other relevant institutions such as the Red Cross or the Women's Union (Birkmann *et al*, 2011).

In November 2007, the Prime Minister approved the new long-term National Strategy for Natural Disaster Prevention, Response and Mitigation to 2020. This strategy confirms the role of MARD as focal agency for disaster risk management and sets out guiding principles and objectives for the next years. These comprise the improvement of early warning systems, the improvement of planning and building codes in view of natural hazards, the fostering of capacity building at all levels, the relocation of people in disaster-prone areas and the upgrade of structural protection measures such as sea dykes, flood resistant embankments or storm shelters (*ibid*).

2.2.5. Climate Change Adaptation

One of the most important recent developments on climate change action was the establishment of the Vietnam National Target Program to Respond to Climate Change (NTP). This initiative was officially put into place by Prime Minister Decision 158 in December 2008.

The NTP covers the period 2009–2015 and its main objective is the integration of climate change actions into development strategies, programs, and plans in all sectors. In practical terms, the NTP outlines primarily research, analytical and capacity building activities with emphasis on adaptation, aiming at

informing the formulation of climate change priorities. It involves all relevant ministries, sectors, provinces and local governments.

The MoNRE is given the key role as focal agency for all climate change response activities in Vietnam. The ministry and its subsidiary departments at the lower levels, therefore, have to coordinate response measures and facilitate the communication of other ministries, sectors and the localities with the national Government.

At present, the NTP process is behind schedule because of human and financial resource constraints. Most Provinces are at the stage of implementing the first 2 objectives in Table 11 with some Provinces ahead of others in achieving the 2010 targets.

Table 11. National Target Program Objectives and Targets (Source: Garschagen, 2010).

Objective[3]	Targets to be achieved by 2010 (selection)	Targets to be achieved by 2015 (selection)
Assessment of climate change impacts in Vietnam	– scenarios based on existing data – pilot projects for assessment	– update/completion
Identification of response measures	– implement pilot/test projects in different sectors and locations	– wide scale implementation based on lessons learned
Establishment of scientific and practical basis for response measures	– development of a national science and technology program on climate change	– completion and updating of climate change database – update research and implement results
Consolidation of organisational structure and capacity building amongst relevant institutions	– development of framework for legal documents and mechanisms – coordination amongst ministries, sectors and localities	– mechanisms to prioritize climate change activities
Raising public awareness and human resources development	– over 10% of population and over 65% of Government staff with basic knowledge on CC	– over 80% of population and 100% of Government staff with basic knowledge on CC
Promotion of international cooperation and support	– establish bilateral and multilateral cooperation mechanisms for implementing the national target plan	– completion and effective implementation
Mainstreaming into development planning (socio-economic, sectoral, local)	– guidance documents and classification of measures	– mainstreaming into future planning – assess implementation for period 2010-2015
Development and implementation of action plans and (pilot) projects	– ministries and local authorities complete action plans	– action plans being implemented

In the BCR Provinces, only Ben Tre and Soc Trang had completed their first draft report of the Provincial Climate Change Action Plan (PCCAP). The PCCAP for Ho Chi Minh City (Can Gio) has not been officially released at time of writing, and those for Bac Lieu and Kien Giang are only just starting (see Table 12).

Table 12. Status of the Provincial Climate Change Action Plan (PCCAP) in BCR Provinces.

Province	Status of PCCAP (first report)	Status of pilots
Ho Chi Minh City (Can Gio Biosphere Reserve)	Completed but under review and not officially released (Dec 2011)	None yet in Can Gio Biosphere Reserve
Ben Tre	Completed (May 2011 by ...)	Government, ODA and NGO (see Section 4.1) pilots underway
Soc Trang	Completed (August 2011: study carried out by Southern Environmental Technical Center)	Some government pilots underway GIZ soc Trang project activities are also addressing some of the identified needs, eg. comanagement of mangroves, coastal erosion analysis, and livelihoods. (see Section 4.1).
Bac Lieu	PCCAP just beginning Dec 2011 to be completed by March 2012	Government pilots not yet started but working with other agencies. Example, some activities being conducted by GIZ Bac Lieu are aligned with climate change adaptation objectives, eg. multi-species mangrove replanting pilots (see Section 4.1).

Kien Giang	PCCAP scheduled for completion in June 2012.	Government pilots not yet started but working with a number of agencies such as ADB and MRC on preparing vulnerability assessments and adaptation plans. GIZ Kien Giang Project also addressing some needs, eg. dyke design and mangrove reforestation techniques in high wave energy areas.

A review of the PCCAP for Ben Tre and Soc Trang is provided in Section 4.2. An assessment of potential Provincial actions and pilots where the BCR project can assist is also provided.

A key implementation challenge at the Provincial level is the coordination between the different government agencies with DoNRE as the lead coordinating agency. As a part of the NTP initiative, each province upon implementation of the PCCAP establishes a Standing Office on Climate Change under the directive of the Provincial Peoples Committee to coordinate all climate change initiatives. The Office is chaired by a DoNRE representative (Director or Vice-Director) who coordinates the office and invites other agencies such as DARD and DPI and their sub-departments (like sub-VASI and Forest Protection) to attend meetings and activities. Ben Tre and Soc Trang had established the Standing Office at time of writing and serve as the coordinating unit for the BCR project.

In practical terms, the poor relationship and coordination between DoNRE and DARD in particular poses a challenge for coordination and participation in the project. The BCR partner at the Provincial level is sub-VASI under the directive of DoNRE. However, many of the potential BCR interventions (see Section 4.2) will involve DARD sub-departments (eg. forest protection, aquaculture, fisheries, dyke planning, etc.). Care needs to be taken to ensure the participation of DARD in particular from the beginning of the project.

The experience of the PCCAP in Ben Tre and Soc Trang to date suggests a number of key weaknesses in the process to date.

First, the preparation of the PPCAP does not include any capacity building for Provincial government staff. The fourth objective of the NTP (see Table 11 above) states that capacity building is required in relevant organizations. Presently the PPCAP are conducted by external government consultants (eg. Southern Environmental Technical Center in the case of Soc Trang) in very short periods of time. A template approach is utilized and Provincial data from different sectors collected and reviewed. An analysis is conducted by the consultants with some consultation of Provincial technical staff. Short field observations may be made. The role of the Provincial technical departments and staff has been to provide requested data to the consultants and joint discussions on and prioritization of potential adaptation projects.

Second, the PCCAP does not involve community level vulnerability assessments and as such they do not include studies and assessments of exposure, sensitivity, and adaptation capacity for specific ecosystems and communities. They could be better described as expert driven climate change impact assessments which are just one part of a vulnerability assessment. There is also very little attention paid to the interplay between ecological systems and infrastructure. Hence, as the government moves towards further refinement of its PCCAP as is required by 2015, there is a need for more fine-grained vulnerability assessments of particularly vulnerable communities such as those on the coast in order to identify locally appropriate adaptation options.

Third, there is limited and unsystematic stakeholder involvement. Follow up initiatives focused on capacity building and vulnerability assessments need be pro-active in involving other key agencies that have an important role in communications and disaster preparedness/relief such as the Women's Union and the Red Cross to ensure that they are not left out of the process. While the Women's Union in Ben Tre was involved in consultations during the formulation of the PCCAP, this did not occur in Soc Trang suggesting there is not a systematic approach to involving all relevant stakeholders in adaptation planning processes within the Provinces and by government consultants.

2.2.6. Mekong Delta Master Plan[9]

For the first time in its history, the Mekong Delta Master Plan (MDMP) will address the issue of climate change. A new 10 year MDMP is now under preparation, beginning in September 2011.

Historically, the MDMP has been an important mechanism that has shaped long term policy and planning for land-use in the Mekong Delta and the necessary infrastructure to support such land-use. For example, past MDMP's have determined where coastal salinity control dykes were built in order to facilitate intensification of coastal rice production in the 80s and 90s. Similarly, the MDMP also determined the need for flood control dykes in the Plain of Reeds to facilitate intensification of rice cultivation to meet policy objectives such as increasing rice exports.

Since the 2009 United Nations Climate Change Conference which was held in Copenhagen (CoP15), Vietnam has actively sought Dutch development assistance and expertise in dyke building to assist Vietnam to 'save' Vietnam's rice bowl from climate change. At the Copenhagen conference, Nguyen Khac Hieu, deputy director general of the government's climate change agency stated that "The rice bowl of Vietnam will be severely affected" without action. He went on with an appeal, "It's not only for Vietnam's sake but also for the world's food safety," calling for help to enable the country to adapt.

As a result, Vietnam and the Netherlands entered into a partnership agreement in 2010 to develop the next MDMP in the context of climate change. The purpose of the Mekong Delta Master Plan is to provide an integrated policy framework that presents recommendations on water management and climate change adaptation in relation to desired land-use, and serves as a guide for further sub-regional planning and for the identification and formulation of investment projects.

A ToR and call for consultant proposals for the MDMP was issued in September 2011 and the process is scheduled to last for 18 months. According to Deltares (2011) - the Dutch consultant responsible for preparations of the study - the expected results of the Mekong Delta Plan comprise the following aspects:

- An integrated approach based on a strategic vision (2100) for the Mekong Delta;
- A long term Delta Program (2010-2100), translated into a coherent package of short term measures (2015-2025), including an implementation agenda;
- Strengthened inter-governmental co-operation and institutional arrangements, legislation and financing options;
- Political willingness at the different levels of government to participate in an integrated approach;
- Incorporation of the findings and recommendations into the National Water Plan, the next national socio-economic development plan and related provincial socio-economic development plans;
- Support by the major donor agencies/countries to adapt, where necessary, their loans and investment programs to the Mekong Delta Plan.

The implications of the MDMP, based on preparatory document reviews by Deltares (2010), are contentious. Current documents emphasize the need to raise and strengthen the coastal dykes along the entire coast of the Mekong Delta, and includes the building of extremely large scale sluice gates across the Tien River estuary between Tra Vinh and Ben Tre Province and other large estuaries in Ben Tre. Section 1.4.3 previously discussed the implications of such proposals. As such, the MDMP process should not be ignored and initiatives to engage and feed BCR partner experience into the MDMP should be pursued (See Section 4.3, and 4.4 for recommendation).

2.2.7. River Basin Management

Coastal ecosystems and geomorphologic processes are influenced by wider scale developments at the delta and river basin scale (See Section 1.4.4 for example). The Law on Water Resources (1998) indicates that the primary planning and management unit for water is at the level of the river basin and River Basin Organizations (RBOs) are to be responsible for water management in river basins.

In 2001, the first 3 RBOs were established, being the Red River, the Dong Nai and the Cuu Long (Mekong Delta) River Basin Organisation (CLRBO). In 2004, MARD created a Standing Office for RBOs as a coordinating unit. Later RBOs were moved from MARD to MONRE and MONRE has been responsible for preparing river basin plans since. In December 2008, the Prime Minister approved the Decree No.

[9] also referred to as the Mekong Delta Plan in documentation.

120/2008/ND-CP on river basin management. This Decree stipulates a number of general policies and responsibilities regarding river basins:

- Water resources in a river basin must be uniformly managed without division among administrative levels, between upstream and downstream; the fairness, rationality and equality in obligations and interests among organizations and individuals in the same river basin must be ensured;
- Ministries, branches, local administrations at all levels, organizations and individuals shall bear joint responsibility for protecting the water environment in river basins according to law, and actively cooperate in tapping benefits brought about by water resources and ensuring the interests of population communities in river basins;
- The exploitation, use and development of water resources must be combined with the environmental protection and sustainable exploitation of other natural resources in river basins.

RBOs were seen to be necessary in Vietnam because the hierarchical administrative system of government in Vietnam does not promote lateral coordination. For example, if there is a water diversion conflict between two commune-based irrigation schemes on either side of a river, located in neighbouring provinces, there is no easy mechanism for optimizing the water diversion. Theoretically, an RBO with a sub-catchment mandate could be used to facilitate lateral coordination between such communes and Provinces. Without an RBO there is also no mechanism to resolve issues between downstream and upstream Provinces.

However, experience since the first RBOs were established in Vietnam has shown that it has been extremely difficult to establish coordination mechanisms within the government administration that cut across the normal lines of authority. Thus, establishing a lateral coordinating mechanism such as with RBOs has not been as straightforward as originally expected in Viet Nam.

According to one MRC assessment (MRC, undated online resource), a serious problem is that when RBOs are legally established in Vietnam, they do not become active, for lack of any significant task, for the following four reasons:

- The RBO system is unfamiliar and officials are not sure how it should work and what it should do that is not already being done.
- Some of the mechanisms that should be in place are not – for instance, hydropower planning, through Electricity Viet Nam (EVN) could be incorporated into RBO planning, but is actually carried out quite independently.
- The emerging issues for water management in Viet Nam, particularly conflicts over the use of water, are not recognised as being serious enough for urgent action.
- Strategic water resources planning at basin level has not been initiated.

The chairman of all three RBOs is the same Vice-Minister of MARD, and members are representatives of central ministries, located in Hanoi. It is clear that for the Dong Nai and CLRBO such membership poses logistical difficulties. Hanoi-based officials have little direct contact with the water management activities of these basins. The national level does not have a direct incentive to solve water management problems in the provinces, because those problems are only brought to ministries in a general sense, either by political initiative from above, or by upward pressure from provinces (MRC, undated online resource).

Perhaps one of the more serious problems related to the functioning of the CLRBO is that while the RBO councils have associate members derived from the provincial DARDs, there is no direct link to the PPCs of any province, although the PPC is the major decision-making body under the central level, for water management. Inappropriate memberships of large RBOs mean that they are not likely to be effective.

To date, because the inter-provincial coordination is still poor to non-existent, the RBOs have not been working as effectively as intended (Deltares, 2011).

2.3. Stakeholder analysis – including conflict issues

The previous section on institutions illustrates a complex landscape of numerous stakeholders with often overlapping responsibilities and jurisdictions leading sometimes to conflicts between and among the agencies. There is weak collaboration between Provinces, between sectors and the various administrative

layers and this can result in incompatible or conflicting land-use that results in sub-optimal solutions both at a local and delta scale.

Some examples have already been discussed. For example, at the delta-scale, section 1.4.2 and 1.4.3 above has discussed the inter-provincial issue of dyke developments in the upper-delta possibly causing impacts on ground water availability in the coastal provinces or increasing the risk of flooding. A dysfunctional Cuu Long RBO means that these inter-provincial conflicts are not being addressed. Indeed they are being ignored while the risks increase.

Within the coastal zones, there is unsuitable land-use such as vegetable crops (eg. water melons) being grown in the coastal areas which maybe depleting ground water through over-pumping, thereby increasing exposure to salinity intrusion into ground water sources, and SLR by causing land subsidence. Here there is tension between DARD promoting whatever kinds of crops that can grow in the coastal zone, and DONRE's role as a regulator of underground water sources with the latter often in a position of powerlessness as successful crops such as water melons expand spontaneously (Fig 34).

Figure 34. Watermelon growing land in Ben Tre with well for pumping under-ground water.

Agencies such as DARD have also had conflicts of interest as it has supported the expansion of shrimp farming at the expense of the coastal mangroves which it also has the responsibility to protect. At the same time, DONRE also finds itself in a difficult position to monitor and regulate the pollution from the shrimp farms in the form of effluent releases and the use of destructive practices such as the use of chlorine. This partly arises out of a lack of resources but also the tension that it finds itself in as the environmental regulator and not wanting to be seen to be curbing the shrimp production targets set by the Provincial PPC and DARD. DARD's role in protecting the mangroves also brings it into conflict with communities, particularly the poor who have no other options but to make use of the open access mangroves and tidal flats. While there are no widespread reports of open conflict today, illegal exploitation of the mangroves, albeit on a small-scale, continues today in contravention of conservation or protection rules.

Over the last decade, government agencies have come to the realisation that they are not able to protect resources such as the coastal mangroves and fisheries without the involvement of the community to reduce the confictual roles that they find themselves in. Today, there is growing acceptance and use of the idea of comanagement to reduce conflict and to get better management outcomes.

2.4. Co-management

It is now widely accepted in Vietnam by most stakeholders that some control and management of common property resources must be decentralised to local levels to be effective. Without some form of ownership and 'buy-in' from the natural resource users, compliance with regulations can be expected to be weak.

Furthermore, the amount of resources that would be required to monitor and control most natural resources such as mangrove forests and fisheries resources is simply too large to be realistic. Given the open-access nature and the lack of clearly defined property rights, everyone can access mangroves and fishing grounds, leading inevitably to over exploitation. Shifting to rights-based system in the form of co-management has been shown to be a workable system in the Vietnamese context. This can take the form of consultation with resource users, and shared management responsibilities between resource users, local government and central government.

There have been a number of successful pilot comanagement initiatives that have been implemented in Vietnam over the past few years. Examples of these include the Tam Giang Lagoon in Hue Province (2005), Au Tho B in Soc Trang Province (2007), and the Rang Dong Fisheries Cooperative in Ben Tre Province (1997).

Of these examples, the Rang Dong Cooperative has been relatively successful. Established in 1997 at the provincial level to manage clam growing on 900 ha of intertidal land, average unit prices increased by a factor of thirteen to US$1.30/kg, and this success was reinforced recently when full Marine Stewardship Council (MSC) certification was awarded. The fact that almost a dozen new cooperatives have emerged in Ben Tre following the example of Rang Dong also shows the potential for pilot schemes to evolve into the mainstream .

An example of a mangrove comanagement initiative has been the Au Tho B example that was established through the initiative of GIZ in Soc Trang Province. The initiative provides useful documentation on the elements of a comanagement system in a coastal mangrove ICAM context (Lloyd, 2010). This involves:

> **Step 1:** consultation (this includes surveys, information about the process, getting acceptance for co-management, capacity building and awareness raising) and organisation. This step will end with the formal establishment of a resource user group.
>
> **Step 2:** a series of negotiation meetings which will end with a formal agreement between the local authorities and the resource users. The agreement specifies who can do what, where, when, how and how much and must apply the key principles of zonation and monitoring.
>
> **Step 3:** implementation of the agreement.
>
> **Step 4:** monitoring and evaluation involves a feed-back loop to re-negotiations (adaptive management) and must be applied throughout the co-management process and implementation.

The Au Tho B initiative has recently been taken a step further with the establishment of a clam cooperative within the same community that is now funding the mangrove co-management through a pilot Payment for Environmental Services (PES) arrangement. Should the clam cooperative prove to be sustainable, this essentially self-funded co-management arrangement looks like a potentially sustainable model that could be duplicated elsewhere such as in Bac Lieu where co-management has not yet been utilized to manage coastal natural resources.

Despite these successes, a recent review of co-management experience in Vietnam concluded that there was still a limited conceptual understanding of co-management concepts, a tendency to adopt a technical-output rather than a process-oriented approach, and a dominant focus on product, rather than service-based benefit-sharing mechanisms (Swan, 2011).

3. Needs, Opportunities and Recommendations

This section of the Situation Analysis identifies and presents the needs of Can Gio Biosphere Reserve, Ben Tre Province, Soc Trang Province and Kien Giang Province in relation to the BCR project. It also identifies opportunities arising out of other related projects, locations which are the most suitable regarding the objectives of the project, and provides recommendations on activities and collaboration.

The purpose of the needs assessment in the following section is to enable IUCN and their partners to identify activities of common interest, and to agree on and implement a feasible workplan.

3.1 Current Projects and Initiatives of Relevance to the BCR Project

Presently, there are numerous projects that are underway, or being planned for implementation in the Mekong Delta. Some of these projects are focused on climate change, others are not but are of interest to the BCR project because they are focused on issues that are related to climate change or coastal management. By identifying these projects, we hope that we can propose or develop collaboration so that we can achieve synergies and strengthen any planned interventions.

The following table identifies these projects and discusses their relevance to the BCR project.

AGENCY	PROJECT DESCRIPTION	RELEVANCE TO THE BCR PROJECT
CAN GIO		
USGS / HCMC University of Natural Sciences	**Assessing Coastal Vulnerability to Sea Level Rise: Coastal Elevation and Modelling for Adaptation in Vietnam** The project has established (2010) a Surface Elevation Table (SET) device within Can Gio Biosphere Reserve to monitor the long term response of the mangroves to sedimentation and sea level rise. This site is one of only 2 installations in Vietnam, the other being in the Red River Estuary, that was funded under a first phase. The project is currently seeking funding for a second phase for further possible installations that have not yet been decided. USGS has provided training for HCMC University of Natural Sciences to install and use the equipment. Modelling capacity is being introduced. Information on the method is available at http://www.pwrc.usgs.gov/set	A long term monitoring site is available to accurately monitor relative elevation changes with regards to sedimentation and sea level rise in the Can Gio mangrove. The monitoring method would be of use for long term monitoring purposes of the coastal mangroves at the other BCR project sites.
BEN TRE		
Danida	**National Target Program to Respond to Climate Change** Danida funds a Senior Provincial Advisor based in Ben Tre to provide technical support to the Ben Tre Provincial Government on the implementation of the Province's Climate Change Action Plan. The present adviser contract is from September 2010 to August 2012.	Senior Provincial Advisor is available to provide advice in partnership with his DONRE counterparts on coordination, initiatives, etc.
WWF / Danida	**Ecosystem based adaptation to climate change: Rapid Integrated vulnerability**	The methodology that was utilised by

	and adaptation assessment of selected communes in Binh Hai District, Ba Tri District, and Thanh Phu District. The assessment was carried out by Can Tho University utilising a modified framework of the risk based approach documented in WWF's Flowing Forward Water Working Notes (Le Quesne, 2010). The method involved the use of climate change projections and scenarios, and household level surveys of local level impacts and awareness over the past 10 years. An assessment of impacts, risks, adaptive capacity was made leading to a vulnerability assessment and adaptation options. A draft report was presented on 4 November 2011 in Ben Tre City.	WWF/Can Tho University will be of use in reviewing the BCR's proposed VA methods. Capacity within the Ben Tre government agencies to implement and utilise VAs in other areas/context is not yet built and BCR can assist with this.
World Bank	**Climate Change Vulnerability in the Water and Sanitation Sector of Ben Tre Province** This assessment was recently concluded in September 2011 with the publication of a major study report (AECOM, 2011). The vulnerability assessment covered issues relating to changing weather patterns, extreme events, hydrology and salinity intrusion and their potential effects on surface and ground water resources, water supply and sanitation infrastructure, livelihood vulnerability, poverty, and adaptive capacity.	The project has documented the CC risks to surface and ground water sources in the Province that could be of importance to the BCR project. The project will give advice on possible actions related to water resource management.
Oxfam GB	**Project 1: Managing Climate Risks through Livelihood Diversification project sites: Thua Duc and Thoi Thuan Commune, Binh Dai District** Duration: Oct 2009 – Sept 2010 Outcomes: 1. Assessing the Vulnerability of Climate change, building adaptation action plan • ToT provided to key provincial authorities • Provided training on Integrated DRR and climate change planning • Guidance on establishing the adaptation action plan at commune level 2. Supported commune people to diversify their livelihoods with models of water melon, blood clam, crab, forest protection skills, provided tank for storing water, early warning. 3. Mobilized the use of DRR Integrated DRR and climate change plan to provincial Socio Economic Plan	The methodology that was utilised by Oxfam GB, and their experience will be of use in providing lessons learnt in the process of doing CC assessment and adaptation plans at a community level. There is also project experience from Thanh Phong Commune, Tan Phu District which is being considered as a pilot site (see Section 4.3) and potential for collaboration for follow up activities. This project will go into a second phase with a focus on livelihood adaptation in the same localities.

	Project 2: Building equitable resilience to the impacts of climate change and disasters. Project sites: Thua Duc & Thanh Tri – Binh Dai dist; Thanh Phong and Thanh hai – Thanh Phu dist Duration: Sept 2010 to August 2011 The three project components were: 1. Livelihood groups have contributed to natural resource management through conducting research, involvement in farmers' field schools, and employing livelihoods adaptation options such as extension training, saline tolerant crops, adjusted seasonal calendar, land use management, cultivation practices for rice farmers, shrimp farmers, fishermen, salt producers, aquaculture collectives. Through these activities the resilience of livelihoods will be significantly increased. 2. Integration climate risk analysis and adaptation activities into commune action plans through advocacy efforts. 3. Local authorities and poor communities have improved knowledge in identifying climate risks, hazards and disasters, and have the necessary skills to employ traditional coping strategies, adaptive options and action planning.	
SOC TRANG		
GIZ / BMZ	**Management of Natural Resources in the Coastal Zone of Soc Trang Province** The US$4.2 million project has entered into the second phase in 2011 and covers all 3 coastal Districts of Soc Trang; Cu Lao Dung, Tran De, Vinh Chau. The project is scheduled to continue for 3 years to the end of 2013. Project otputs in this second phase include: 1. Expanding the coastal co-management model developed in Phase 1 to two other pilot sites. 2. Integration of conservation objectives in village development and land use planning 3. Techniques for effective management and rehabilitation of mangrove forests including the establishment of mangrove nurseries 4. Participatory environmental impact monitoring system developed and tested	VAs and capacity building on VA is not designed into the project but is seen as an essential element in coastal zone management that GIZ would like the IUCN BCR project to implement. Synergies will be gained by targeting GIZ's key government partners and participants as well as communities to work with in order to value add to the GIZ initiative. At the same time, the GIZ project is piloting alternative livelihoods (Item 7) that may prove to be applicable options for CC

	in 3 pilot areas 5. Environmental awareness raising materials for local communities and authorities developed and capacity building training carried out 6. Staff of local authorities, and social and women organisations provide new advisory services to coastal communities 7. Opportunities for partnership with the private sector, to create income for local communities as part of aquatic value chains 8. Concept for the sustainable financing of ecosystem services provided by coastal wetlands developed and tested 9. A legal and institutional framework for Integrated Coastal Management is jointly developed by technical departments and submitted to the PPC for approval	adaptation. Excluding the marine environment, the project has generated significant high-quality information and knowledge on the coastal ecosystems of the Province including the mangroves and its biodiversity.
World Bank	**Coastal Resources for Sustainable Development** This five-year pipeline project which is presently undergoing its feasibility study includes a $100 million loan from the WB and non-refundable aid of US$5 million from the Global Environment Fund (GEF). MARD will be the implementing agency. The objective of the project is to improve the management of coastal resources in support of sustainable fisheries in selected coastal provinces of Vietnam. The focus is on the near-shore fishery. Soc Trang is one of 7 provinces to be included in the project. The project will not reach the World Bank Board before May 2012 which means implementation will not begin until late 2012 or early 2013	The project may not get under way until late in 2012 or early 2013. However, the project may provide synergistic assistance for livelihood adaptation options that are expected at the mid-way point of the BCR project, particularly in relation to the near-shore fisheries and aquaculture. Close communication with DARD once the project gets underway will be necessary to achieve synergies.
Wegeningen University / Can Tho University	**Production Capacity for Climate Change Adaptation in Coastal Area of Mekong River** This 3 year project (2011 – 2013) had its inception workshop in August 2011 in Soc Trang City. The project is a CC adaptation research project focused on agricultural production and species adaptation in response to projected salinity intrusion and upstream hydrological changes. The project has an upstream research component focused on An Giang Province. Vinh Chau District is suggested as a pilot study site for the project.	Collaboration between this project and the BCR project could yield synergies in assessment methods and identified adaptation options in relation to suitable cultivated species to respond to salinity intrusion issues.

KIEN GIANG		
GIZ / BMZ, AUSAID	**Conservation and Development of the Kien Giang Biosphere Reserve Project** This three year project has run from July 2008 to June of 2011. A second phase of the project is presently under consideration and a public document is not yet available. First phase activities are continuing at present. The first phase objectives of the project are: 1. Assessment of flora and fauna biodiversity hot spots. Used by the National Parks for protecting and monitoring endangered species and those with key functions in the Park's ecosystems. 2. Improved management of the protected areas, coastal forests, and the conservation of endangered species. Better understanding of the ecosystems and their hydrology leading to better ways to protect them. 3. Improved capacity and technical knowledge of income-generating opportunities and improved marketing. 4. Awareness programme materials on the importance and relevance of biodiversity and protection of natural ecosystems have been adopted by the Provincial implementing agencies and are being disseminated widely within the province and nationally. 5. The training programme aims to increase the resilience of the ecosystems by improving the management capacity of district and provincial administrations. National park staff will have better skills with regard to fire and water management.	VAs and capacity building on VA has not been a part of the project but is seen as an essential element in coastal zone management. Synergies will be gained by targeting GIZ's key government partners and participants as well as communities to work with in order to value add to the GIZ initiative. At the same time, the GIZ project is piloting alternative livelihoods (Item 3) that may prove to be applicable options for CC adaptation. Excluding the marine environment, the project has generated significant high-quality information and knowledge on the coastal ecosystems of the Province including the mangroves and its biodiversity.
MRC / VNMC	**Climate Change Risk and Vulnerability Assessment in Kien Giang Province** This project has been a part of the MRC's regional project to pilot CC adaptation approaches beginning with a CC impact assessment. The project has just recently presented the findings of its Assessment at a July 2011 workshop (http://www.mrcmekong.org/news-and-events/events/1st-meeting-of-climate-change-adaptation-demonstration-projects/agenda-of-the-1st-meeting-of-climate-change-adaptation-demonstration-projects/). The project has conducted a provincial level CC impact assessment and a more local level vulnerability assessment was conducted in Binh Giang Commune, Hon Dat District, by the Southern Institute of Water Resources and Research utilising a risk based approach. According to Provincial authorities, the project did not include a	The methodology that was utilised by MRC/SIWRR will be of use in informing the BCR's proposed VA methods. Considerable background data has been collected and CC modelling on the range of CC scenarios have been produced including modelling on SLR and flooding arising from upstream hydrological changes.

	capacity building component. The assessment is heavily biased towards a focus on livelihoods, agriculture and infrastructure.	
MEKONG DELTA		
Institute of Tropical Biology / Algen Sustainables / Can Tho University	**Vietnam Aquatic Biofuel Project** This 88,000 Euro project is funded by the Netherlands Government for a 3 year period ending in 2013. This project is working to utilize various brackish water, vegetative macro-algae (seaweed) that grows naturally in nutrient-rich farmed aquaculture ponds as an alcohol feedstock. The project team has completed a botanical survey of aquatic plants in Vietnam and parts of Cambodia that meet criteria for ease of cultivation and conversion. Certain species are effective bio-filters that improve shellfish health and are found in abundance. Farmers encourage its growth, but have not mastered the best practices of its intentional cultivation. Excess biomass is presently skimmed from ponds by farmers and left to rot on the pond banks. The project advocates value-added use of this otherwise wasted aquatic farming by-product. The project will in its later stages introduce extensive co-culture of the most promising species, arrange for scheduled harvest and pickup, and convert the low-cellulose/low-lignin vegetative material into alcohols suitable for fuel blending and derivative products. Presently the 2 provinces of Bac Lieu and Ca Mau are earmarked for co-culture field-trials. Other locations may be considered on a self-funded basis.	The successful implementation of this project will represent an important new livelihood opportunity that could provide an important adaptation option for salinity affected coastal areas under SLR scenarios. The project co-leader is seeking additional funding to trial suitable seaweed growing substrates/platforms in Ben Tre Province.
Can Tho University	**Mekong Delta Inter-Provincial Climate Change Network** • Initiative began from a failed attempt by VRN (with funding from Rosa Luxemburg Foundation/Party) to start a network of 4 provinces (An Giang, Kien Giang, Can Tho, Ca Mau) for the purpose of building awareness about CC in local government and communities. • Initiative failed because partners did not have the necessary Authority and mandate to start up such a network. • VRN and government partners then approached CTU to facilitate. • CTU organised the first workshop which brought in all the other Provinces in	CTU is open to collaboration with this initiative. Some BCR partners have suggested the need for inter-provincial collaboration.

	2010 • Official CTU invitation letters to participate were issued to all relevant provincial government departments to participate. This is a standing letter that is in place now enabling continued participation without additional paperwork. • Agenda was to respond to government and community needs in CC awareness and capacity building. The network does not have a policy advocacy agenda. • Rosa-Luxemberg funding via VRN of approx $50,000/yr over 2 years was provided for community and government training workshops both at CTU and in the Provinces over the course of 2010 and 2011 • Other minor funding has been drawn ad-hoc from existing projects where objectives were aligned but there is no committed long term funding for the network. • Human resource constraints are a major issue. • Network convened for a second time in Nov 2011 to discuss an MOU with the network members. This is not finalised.	

3.2 Provincial Action Plans, Partner Needs, and Recommended IUCN Assistance

This section presents the needs of the partners and our recommendations on how the IUCN BCR project can assist with those needs. The needs and recommendations are analysed against the Provincial Climate Change Action Plan where it has been completed, ie. Soc Trang and Ben Tre.

Column 1 presents the identified Climate Change Action Plan projects or activities that are of relevance to the BCR project objectives.

Column 2 presents the expressed needs of partners.

Column 3 presents our recommendations of the kinds of activities that could be supported by the BCR project. In some cases, we have made recommendations in support of a project or activity that is identified in the CC Action Plan even if there was no direct partner request.

1	2	3
CLIMATE CHANGE ACTION PLAN ACTIVITIES OF RELEVANCE TO THE BCR PROJECT	**INDICATED NEED FROM PARTNERS (as suggested during Situation Analysis meetings and updated with input from validation/feedback meetings)**	**RECOMMENDED IUCN BCR ASSISTANCE**
CAN GIO BIOSPHERE RESERVE and HCMC sub-VASI		
The Climate Change Action Plan for HCMC has been conducted but is not yet publicly available from the HCMC government. It is presently going through the final approval stages.	Developing a Payment for Environment Services (PES) regulation for Can Gio Biosphere Reserve in order to provide incentives for local household/lease-holders to protect the forests. (Can Gio)	IUCN Vietnam has commissioned a study (Aug 2011 – March 2012) to conduct a study of the Can Gio Mangroves that includes a situation analysis of the mangroves, local livelihoods and impacts, remote sensing analysis of land-cover and land-use changes over the last 10 years, and ecosystem service maps.
	Enhancing CC awareness of government managers and technical staff (sub-VASI)	Advanced awareness raising workshops on climate change issues for government managers and technical staff Training for government managers and technical staff on media and communications on CC impacts and adaptation Involve Women's Union as a primary partner to ensure women are being informed
	CC scenario analysis capacity building for technical staff (Can Gio and sub-VASI)	Involve technical staff in VA training workshops organised for other Provinces.

	Learning from others experiences (Can Gio and sub-VASI)	Include Can Gio Biosphere Reserve and sub-VASI as members in the Mekong Delta Inter-Provincial CC Network. International exchanges with BCR partners in Thailand and Cambodia
	(From feedback meeting) Assist technical staff, the management board as well as community to enhance CC awareness, including: • VCA methodology • Pilot VCA at one commune/hamlet	This request will depend on the availability of funding from the BCR project. ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement a VA in 1 pilot commune or hamlet to demonstrate its use in identifying vulnerable mangroves and mangrove based livelihoods.
	(From feedback meeting) Training to develop CC communication documents.	Training for technical staff and management board on media and communications on CC impacts and adaptation
	(From feedback meeting) Conservation projects for endangered plants such as Lumnitzera littorea and other important habitat.	Not coastal resilience related so outside the scope of the BCR project. But may be of interest to IUCN through other funding channels.
BEN TRE		
The Ben Tre CCAP consists of 39 priority projects to be implemented by 2012 and a further 36 projects to be implemented between 2013 and 2015. The following are identified priority activities under each project (2011 – 2012)		

that are of relevance to the BCR project		
Project 7 Investigate and assess the status and impact of climate change on mangrove forests for management, protection and integration with social policies		ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below – to demonstrate its use in identifying vulnerable mangroves and mangrove based livelihoods
Project 8 Propose and implement solutions for sustainable management of mangrove to balance ecology, improve livelihoods and quality of life		ToT training to develop adaptation plans out of the VAs and identify suitable pilot activities for implementation
Project 13 Building monitoring and measurement systems of indicators related to climate change such as temperature, rainfall, salinity, salinization on groundwater and surface water, sea level		While the BCR project does not have the capacity to build the proposed monitoring systems, BCR could assist with identification of suitable long-term monitoring plots to monitor ecosystem responses to CC in key ecosystems such as mangroves including monitoring for upstream hydrological and sediment transport changes Establish the ecological monitoring sites and develop monitoring methods and protocols
Project 16 Research to identify necessary areas for the adjustment of farming systems due to saltwater intrusion	Identification of new livelihoods for women to adapt to CC (Women's Union)	ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below

		Develop adaptation plans out of the VAs and identify suitable pilot activities for implementation.
Project 30 Upgrade embankment system in coastal and estuarine area	Dyke erosion is severe in some locations like Thanh Phu. Dykes need to be upgraded to control salinity intrusion (DARD)	Infrastructure development is not within the objective or scope of the BCR project to fund. BCR can assist with a Vulnerability Assessment that may be able to inform the dyke planning process in a way that would consider impacts to ecosystems as well as human safety and livelihoods.
	Training on doing vulnerability assessments at all levels of government	ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below ToT training on developing adaptation plans out of the VAs and identifying suitable pilot activities for implementation
	Need to adjust the Provincial development strategy to 2020 in the 3 coastal Districts Assist with developing Provincial policy to respond to CC Deadline for next Provincial Development Plan 2011 to 2015 in now	Assist with the formulation of short and long-term adaptation options that are locally appropriate and can be integrated into Provincial development and sectoral strategies/plans
	Water supply infrastructure to cope with projected freshwater scarcity	Infrastructure development is not within the objective or scope of the BCR project to

		fund. World Bank has been assisting Ben Tre in this area. BCR can assist with a Vulnerability Assessment that may be able to inform the water supply planning process in a way that would consider impacts to ecosystems as well as livelihoods.
	Exchanging CC information and experience with other Mekong Delta Provinces	Establish a Mekong Delta Provincial government coastal climate change network to enable governments to exchange information and experience. Once experience has been built, this group could provide useful advice for national level policy. International exchanges with BCR partners in Thailand and Cambodia
SOC TRANG		
The Soc Trang CCAP consists of 25 discrete projects for the short term 2011 – 2015 and another 11 projects over the longer term 2016 – 2020 The following are identified activities under each project for the short term implementation 2011 - 2015		
Project 1. 1. Developing and implementing strategies to improve public awareness on climate change. 2. Develop and implement communication plans on climate change in the type of media (television, radio, newspaper, website ...). 3. Organizing training courses and further trainings for the target group (managers at all levels, communities, students ...).	Enhancing CC awareness of government managers and technical staff at all levels including GIZ partners such as Forest Managers. Raising women's awareness of CC impacts (Women's Union)	Advanced awareness raising workshops on climate change issues for government managers and technical staff including GIZ partners such as Forest Managers. Training for government managers and technical staff on media and communications on CC impacts and

		adaptation Involve Women's Union as a primary partner to ensure women are being informed
Project 2. 1. Develop climate and environmental monitoring program 2. Improve capacity building of staff in the warnings and forecast climate change impacts. 3. Investment in material and equipment for the environmental monitoring, meteorology, hydrology.	CC related monitoring systems need to be improved	Identify suitable long-term monitoring plots to monitor ecosystem responses to CC in key ecosystems such as mangroves (include upstream hydrological and sediment transport changes) Establish the monitoring sites and develop monitoring methods and protocols Link these monitoring sites to the development of conservation areas – see Project 11 below
Project 4 1. Assessing the current state of economic, social, environmental and operations management of coastal areas. **2. Assessing and predicting the damage environmental resources at study area and set up a vulnerability map of environmental resources at study area due to the impact of climate change and sea level rise.** 3. Develop database on natural resources and environment of coastal areas in Soc Trang province. **4. Develop solutions for integrated management of coastal areas in Soc Trang to respond to climate change and sea level rise.** 5. Building international cooperation programs, improving coastal zone management.	Capacity building in vulnerability assessments and adaptation plans (From feedback meeting) Can BCR provide a consultant to implement this Project?	BCR funds are not sufficient to employ a consultant to implement this project entirely. BCR can only partly contribute to this Project by providing ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below ToT training to develop adaptation plans out of the VAs and identify suitable pilot activities for implementation

Project 8 1. Building models of water use efficiency for coastal crop irrigation to adapt climate change, increasing income for the community, creating sustainable ecosystems	(From feedback meeting) Conservation of underground water and improve efficiency of water use for livelihoods	ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below ToT training to develop adaptation plans out of the VAs and identify suitable pilot activities for implementation
Project 9 1. Accessing potential impacts of SLR and saline intrusion to ecological environment and agricultural locations 2. Proposing adaptation solution 3. Improving ecological economic models that adapt with SLR and CC	Capacity building in vulnerability assessments and adaptation plans	ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below ToT training to develop adaptation plans out of the VAs to identify pilot adaptation activities to reduce vulnerably in both ecosystems and livelihoods.
Project 11 1. Control the exploitation of rare aquatic species, of economic value that are in danger of extinction. 2. Restore habitat, environment of aquatic species, particularly the spawning grounds, where the concentration of baby aquatic organisms or residents or areas of rare marine species, which have high value in economy and science in the context of climate change. 3. **Building** fish **conservation areas** for black fish, on Mekong River that flows through territory of Soc Trang **and clam growing areas in the coastal districts of Vinh Chau, Cu Lao Dung.**	(From feedback meeting) Develop regulation on marine management and exploitation. Help to carry out livelihood assessment and vulnerability assessment The fish species that the “Action Plan”	The World Bank Coastal Resources for Sustainable Development project may have better resources to address the need for a marine regulation. Demonstrate the use of VAs to assess coastal aquatic resources that takes into account livelihood and ecosystem vulnerabilities Establishing conservation areas with the dual purpose of using them as long-term monitoring plots for particular ecosystems

	mentioned are not present in Soc Trang. Therefore, this project will not be implemented or done later.	and species
Project 14 1. Restoring and developing the system of coastal mangrove forests to enhance adaptation to climate change and sea level rise.	Supplement priority reforestation sites in the three coastal districts	Demonstrate the use of VAs to identify priority areas for restoration and development Demonstrate multi-species mangrove reforestation techniques.
Project 16 1. Identify risky areas affected by climate change and sea level rise. 2. Assess the impact on the lives of people in these areas. 3. Propose solutions for social security in order to effectively stabilize the lives of people.		ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below
Project 23 1. Assessing the current state of river dikes and breakwaters in Soc Trang province. **2. Identify areas for new construction or upgrades.** 3. **Calculating, designing dike system towards response to climate change and sea level rise.** - Building and upgrading perimeter dike for the whole province, especially sea dykes in Vinh Chau, Cu Lao Dung, Tran and the river dykes, to ensure high safety for the production and life from time to time in accordance with climate change.		Demonstrate the use of VAs in the planning of dykes that takes into account ecosystem vulnerabilities
	Exchanging CC information and experience with other Mekong Delta Provinces	Establish a Mekong Delta Provincial government coastal climate change network to enable governments to exchange information and experience.

		Once experience has been built, this group could provide useful advice for national level policy. International exchanges with BCR partners in Thailand and Cambodia
	Linking the outcomes of the VAs and adaptation options assessment to Provincial development and sectoral plans	Assist with the formulation of short and long-term adaptation options that are locally appropriate and can be integrated into Provincial development and sectoral strategy/plans
KIEN GIANG		
The Climate Change Action Plan for Kien Giang Province is not scheduled for completion until June 2012.		
	Dyke reinforcement	Infrastructure development is not within the objective or scope of the BCR project to fund. BCR can assist with a Vulnerability Assessment that may be able to inform the dyke planning process in a way that would consider impacts to ecosystems as well as human safety and livelihoods.
	Capacity building of government technical staff at all levels on vulnerability assessments – technical staff have not received any capacity building on VAs through the MRC project.	ToT training on vulnerability assessments and adaptation approaches and on-the job training to implement VAs in 1 pilot commune or hamlet – See Section 4.3 below ToT training to identify pilot adaptation activities to reduce vulnerably in both

		ecosystems and livelihoods.
	(from feedback meeting) Build a monitoring system to monitor SLR on coastline	Install and provide training to demonstrate the use of a Surface Elevation Table (SET) device to monitor coastal wetland elevation changes accounting for sub-surface processes (subsidence), surface accretion/erosion, and SLR.
		Assist with the formulation of short and long-term adaptation options that are locally appropriate and can be integrated into Provincial development and sectoral strategy/plans
		Establish a Mekong Delta Provincial government coastal climate change network to enable governments to exchange information and experience. Once experience has been built, this group could provide useful advice for national level policy. International exchanges with BCR partners in Thailand and Cambodia

3.3 Partner Recommended Localities and Significance for Vulnerability Assessments

This section presents our analysis of the socio-economic and ecosystem contexts and issues of the recommended localities to carry out a vulnerability assessment and to develop adaptation plans and activities. Greatest capacity building benefit will be achieved if the location provides a wide range of socio-economic and ecosystem contexts

and issues to test the application of a vulnerability assessment and the development of adaptation plans. Where we consider a location does not have good diversity of contexts and issues, we make a recommendation for an alternative site.

	Socio-Economic Context			Ecosystem and Environmental Context					
Locality	**Poverty**	**Ethnicity**	**Livelihood diversity**	**Ecosystem diversity**	**SLR threat**	**Salinity**	**Water scarcity / quality**	**Upstream threats**	**Significance and Recommendation**
Ben Tre Province									
Thanh Phu Wetland Nature Reserve area including coastline of 3 communes: An Dien, Thanh Phong, and Thanh Hai, Thanh Phu District, Ben Tre Province	Poverty rate is fairly high: - An Dien: poor 22,21%, medium: 5,74%; - Thanh Phong : poor 28,08%, medium 8,29%; - Thanh Hai : poor 25,85%, medium 10,29%)	No significant Khmer population.	Livelihood diversity is slightly higher than An Dien. The major agricultural crop grown in the dry season is extensive Giant Tiger Prawn (*Penaeus Monodon*) alternating with rice in the wet season.	High biodiversity Estuarine ecosystem with alternating fresh water (wet season) and brackish water (dry season) seasons. *Sonneratia sps.* occupies all of the coastal ecosystem down to the low water mark. The mangrove backs up against the coastal dyke. There is no mudflat ecosystem.	Relatively low lying topography. The coastline is protected by a low compacted-earth coastal dyke which is experiencing high rates of erosion but is well protected by an intact mangrove. Poor build quality is more likely a cause of erosion	Salinity intrusion is a growing problem and the brackish water season is becoming longer. Farmers were able to grow two crops of shrimp in the 2011 dry season. Adaptation is taking place with more salt tolerant rice varieties	Fresh water scarcity is an issue in the commune which has relied on rain water harvesting for the majority of its household fresh water needs.	The commune is exposed to upstream CC induced changes in the hydrology of the Mekong River as well as changes in sediment transport dynamics that result from the construction of mainstream Mekong Dams.	Thanh Phu Wetland Nature Reserve area is an appropriate site for implementing pilot site because this area has high biodiversity. Beside, livelihoods also have many issues need to be solved. Mangrove and mudflat area in An Dien is using to cultivate Ben Tre clam by Thanh Phu clam cooperative with MSC criteria In addition, near shore fishery in Thanh Phong is also important, and the DARD has introduced co-management for the near shore fishers here. An Dien, Thanh Phong and Thanh Hai, are facing with fresh water scarcity

Soc Trang Province									
An Thanh Nam Commune, Cu Lao Dung District Cu Lao Dung District is located on the island of Cu Lao Dung at the mouth of the Hau River.	Relatively high level of poverty. 23% are classified as poor HHs (near-shore fishers and land-less HHs).	Relatively large population of Khmer who make up 23% of the population of 8000 residents.	High livelihood diversity. Sugarcane is the major agricultural crop utilising 2/3 of the 1500 ha of agricultural land. The other third consists of rice, vegetable and fruit growing areas. The majority of the poor are near shore fishers or exploiting the coastal mangroves. The An Thanh Nam clam cooperative grows Ben Tre white clams on the coastal mudflat and has 520 investors	High ecosystem diversity. The commune has an estuarine ecosystem with alternating fresh water wet season, and brackish water dry season. The combined area of mangrove forest is 1076 ha for An Thanh Nam and An Thanh III. A breakdown for the commune is not available. The mangrove backs up against the coastal dyke. There is an extensive	The low lying coastline is protected by a low compacted-earth coastal dyke. The dyke was reportedly breached in November 2011 by the Mekong River floods causing substantial damage to the sugarcane crop.	Its location in the estuary of the Hau River exposes the island's ecosystems and livelihoods to changes in coastal salinity levels as a result of SLR. This will reduce the availability of freshwater to irrigate agriculture on the island and may affect the clam growing livelihoods.	Fresh water scarcity is an issue, though not an urgent one, in the commune which has relied on rain water harvesting for the majority of its household fresh water needs.	The commune is exposed to upstream CC induced changes in the hydrology of the Mekong River as well as changes in sediment transport dynamics that result from the construction of mainstream Mekong Dams.	The locality consists of a good diversity of eco-systems and livelihoods including a near shore fishery and clam cooperative. There is a sizeable proportion of Khmer most of whom are classified as poor and engaged in the near shore fishery and are particularly vulnerable to CC impacts because of the lack of livelihood options. They are heavily reliant on the coastal mangroves for their livelihoods. A VA in this location would consider the effects of SLR in combination with lowered sediment transport and hydrological changes as a result of mainstream dam developments, basin wide climate change, and their impacts on the local mangroves, clam farming livelihoods, and near shore fishery. The locality would

			including poor households.	and dynamic mud and sand flat system that is accreting at more than 45 meters per year in some locations.					also make a good site to establish a long term monitoring plot (using SET installation) to monitor the mangrove response to SLR and Mekong mainstream sediment dynamics.
Trung Binh Commune, Tran De District Tran De District is located on the mainland side (Soc Trang) of the Hau River estuary.	Relatively high level of poverty. 25% are classified as poor HHs (near-shore fishers and land-less HHs).	Relatively large population of Khmer who make up 38% of the population of 14,700 residents.	Relatively high livelihood diversity. Mix of vegetable farms (20 ha), intensive and extensive shrimp farms (1000 ha). Disease is present in the shrimp crops – 2011 loss was high at 40 billion VND. Vegetable farms are in need of assistance – poor irrigation system and salinity	The commune has an estuarine ecosystem with alternating fresh water wet season, and brackish water dry season. The Commune has a large variation in mangrove cover from 1 km deep protected areas to thin strips of just 200m. Total of 615 ha presently. Mangrove reforestation	Extremely vulnerable to SLR. The extremely low lying coastline is protected by a poorly constructed, low, compacted-earth coastal dyke. An area of 20ha of vegetable growing land is threatened with inundation during high tides. The coastal dyke is poorly	Its location in the mouth of the estuary of the Hau River exposes the island's ecosystems and livelihoods to changes in coastal salinity levels as a result of SLR. This will reduce the availability of freshwater to irrigate agriculture.	Pumping of underground water to compensate for an inadequate irrigation system is a growing problem.	The commune is exposed to upstream CC induced changes in the hydrology of the Mekong River as well as changes in sediment transport dynamics that result from the construction of mainstream Mekong Dams.	**During the feedback meetings, this location arose as an additional pilot location to the Cu Lao Dung site**. The government points to the urgent need to address the threat to the vegetable growing areas, need for mangrove reforestation and protection, and the high pressure coming from the poor exploiting the mangroves and near shore fishery. The locality consists of a good diversity of eco-systems and livelihoods including a near shore fishery. There is a sizeable proportion of Khmer

			affected. Exploitation of the coastal mangroves and near shore fishery is the major livelihood for the poor. There is no co-management system to protect the mangrove and this is a high priority need. There are approx 180 boats exploiting the near shore fishery.	is an ongoing need in the Commune to protect some areas of coastline. A target of 50 ha for 2011 was not reached because there is no budget. The mangrove is mono-species *Soneratia sp.* The mangrove backs up against the coastal dyke. There is approx 5000 ha of unexploited dynamic mudflats that are accreting in some areas and eroding in others.	constructed and low. It is being overtopped during high tides. Dyke design revisions from the GIZ project in Kien Giang could be of use.				most of whom are classified as poor and engaged in the near shore fishery and are particularly vulnerable to CC impacts because of the lack of livelihood options. They are heavily reliant on the coastal mangroves for their livelihoods. A VA in this location would consider the effects of SLR in combination with lowered sediment transport and hydrological changes as a result of mainstream dam developments, basin wide climate change, and their impacts on the local mangroves, and near shore fishery. The locality would also make a good site to establish a long term monitoring plot (using SET installation) to monitor the mangrove response to SLR and Mekong mainstream sediment dynamics.

Kien Giang Province									
Vam Ray Hamlet, Binh Son Commune, Hon Dat District Binh Son Commune is located to the North of Rach Gia City	Extremely high level of poverty in Vam Ray Hamlet. 95% of the population classified as poor.	No significant Khmer population. The hamlet consists of 45 HHs the majority of which are Kinh. There are only one or 2 Khmer HHs.	Livelihoods are relatively diverse and based on the near shore fishery, mangrove exploitation, and agriculture. The inland areas are irrigated to grow rice and the coastal strip is dominated by sugar cane, fruit orchards and extensively grown Giant Tiger Prawn. There is a small off-shore fishing fleet located in Binh Son Commune	Relatively low diversity of ecosystems. The coastline consists of a narrow 50-100 m strip of mangroves. There is no significant mudflat ecosystem outside of the mangrove.	Binh Son Commune is one of three most vulnerable localities to SLR in Kien Giang because of its low lying topography. The coastline is protected by a narrow 50-100 m strip of mangroves and a coastal dyke that is already experiencing significant erosion problems. The mangroves are receding in some areas which is exposing the dyke to wave action. It is not clear whether this is occurring as a result of	Salinity intrusion into agricultural land on the coastal strip and the groundwater aquifer is a significant issue.	Coastal underground water is saline. Coastal community reliant on surface water (affected by salinity) or rain water harvesting. In the inland areas of Hon Dat District, over pumping for agricultural needs is leading to over-extraction of the groundwater aquifer.	A major drainage canal discharges significant amounts of flood water from the Mekong into the coastal waters of Binh Son Commune. This canal is part of a network of drainage canals designed to control the floods in what was the Plain of Reeds in the upper Vietnamese Mekong Delta. Flooding and coastal water quality changes could be issues resulting from	This locality, while not having a wide diversity of ecosystems does have diverse livelihoods and faces a diversity of CC related challenges. The location makes for a useful pilot site to conduct a VA and to develop adaptation plans. The relatively high level of poverty in this locality engaged in the near shore fishery, but predominantly made up of Kinh ethnicity, provides a contrast to the localities in Soc Trang where the poor are predominantly Khmer. This could provide a useful study of differences in adaptive capacity between the Kinh and Khmer under similar environmental changes.

					SLR, coastal sediment dynamics, or subsidence. The dyke is poorly constructed and a SLR of just 20cm will overtop the dyke.			upstream hydrological changes in the Mekong.	

3.4 Consolidated Recommendations and Strategic Links

This section consists of a summary of the recommended project activities that are identified in 4.2. We also identify potential external partners from our analysis in 4.1 that could result in greater synergies for the BCR project and its government partners.

	RECOMMENDATIONS	EXTERNAL STRATEGIC LINKS
1	Design and convene a series of workshops to introduce the BCR VA methodology to government partners. Begin with provincial level and move down to commune level using a ToT approach	WWF, Can Tho University, Oxfam GB are involved in VAs and have experience to share with BCR
2	Carry out ToT communications training for government managers and staff on CC impacts and adaptation awareness raising. Involve Women's Union as a primary partner to ensure women are being informed.	Can Tho University has CC awareness raising training materials already developed for different levels of government.
3	Carry out ToT training with government partners at Provincial, District, and Commune levels on vulnerability assessments and adaptation strategies/approaches. Reinforce capacity building through on-the job training for government partners to implement VAs in 3 selected pilot communes or hamlets – See Section 4.3 above	Can Tho University has capacity to provide training in VA and identification of adaptation options
4	Develop adaptation plans in the 3 selected pilot communes or hamlets as an output of the vulnerability assessments. Identify and select a number of adaptation options for funding and implementation.	Can Tho University has capacity to provide training on identification of adaptation options.
5	Identify and implement dual purpose conservation and long-term monitoring plots of vulnerable ecosystems/species following the outcomes of the VAs in the different VA project sites. This includes demonstration of the use of a Surface Elevation Table (SET) device to monitor coastal wetland elevation changes accounting for sub-surface processes (subsidence), surface accretion/erosion, and SLR. (Soc Trang and Kien Giang)	IUCN, ITB, WWF, Can Tho University have an interest and some capacity to design and develop long-term monitoring plots
6	Linking the outcomes of the VAs and adaptation options assessment to Provincial development and sectoral plans/strategies	Danida, World Bank – agencies involved in assisting provinces with development planning
7	Collaborate with and support the formalisation of the CTU initiated Mekong Delta Inter-Provincial CC Action Network with human resources and funding (see Annex 2 for Concept Note). Help to support the initiative develop and deliver a Program with a policy advocacy objective, for example, engagement with the Mekong Delta Master Plan process (see Section 1.4.3 and 2.2.4).	WWF and GIZ (Bac Lieu) have indicated an interest to support a network initiative.

	Support international exchanges with BCR partners in Thailand and Cambodia.	
8	Utilise an expert advisory body for the BCR project whose members are primarily drawn from the working group of the CTU based MD Inter-Provincial CC Action Network to review project interventions, design, and results, and to provide recommendations to strengthen the interventions. The advisory body could also directly engage the BCR government partners on conceptual issues and the results of project interventions on an as needs basis and/or through the Mekong Delta Inter-Provincial CC Action Network.	Members are expected to consist of well-known and respected Vietnamese scientists. Expertise of the members should cover the range of BCR interventions such as VA methods (CTU), biodiversity/ecosystem long-term monitoring plots (ITB), livelihood adaptation (CTU), coastal forests (FORWET), coastal fisheries (?).

References

ADB. 2010. *Ho Chi Minh City Adaptation to Climate Change*. Manilla, Phillippines.

Albers, T. and von Lieberman, N.. 2011. *Current and Erosion Modelling Survey*. GIZ, Soc Trang.

Anh, V.T.,Diep, N.T.H., Hoa, P.T.T, Tho, D.V., Tromp, M., Vo, Q. M.. 1999. Mekong Delta mangrove forest changes over the last five years monitored by remote sensing. FAO.

Baird, I.G., M.S. Flaherty & B. Phylavanh. 2004. Mekong River Pangasiidae catfish migrations and the Khone Falls wing trap fishery in southern Laos, *Natural History Bulletin of the Siam Society* 52(1): 81-109

Bezuijen, M.R. 2011. Rapid Assessment of Potential Climate Change Impacts to Coastal Habitats and Selected Species in the Study Area of the Project 'Building Coastal Resilience in Vietnam, Cambodia and Thailand', IUCN Southeast Asia.

Birkmann, J., Garschagen, M., Tuan, V. V., Binh, N. V. 2011. Vulnerability Profiles with Respect to Present and Future Water-Related Hazards in the Vietnamese Mekong Delta: Providing the Information-Base for Successful Coping and Adaptation within the Framework of Integrated Water Resources Management. WISDOM. (Accessed 30 November, 2011. http://www.wisdom.caf.dlr.de/sites/wisdom/files/images/results/101007_wisdom-va-proifles_new_map_compressed_names_new.pdf)

Blum, M.D., Roberts, H.H. 2009. Drowning of the Mississippi Delta due to insufficient sediment supply and global sea-level rise. *Nature Geoscience*; 28 June 2009

Cat, N. N., Tien, P. H., Sam, D. D., Binh, N. N. 2005. Status of coastal erosion of Vietnam and proposed measures for protection. (Accessed 23 January, 2012. http://www.fao.org/forestry/11286-08d0cd86bc02ef85da8f5b6249401b52f.pdf)

Chu Hoi, N. 2009. The State Management of Seas and Islands in Vietnam: Issues and Approaches. *Journal on Natural Resources and Environment*, 6/09, Hanoi.

Chu Hoi, N. 2011. *Integrated Coastal Management in Vietnam: Initiatives and Challenges*. Paper presented at a workshop on Integrated Coastal Area Management (ICAM), Ho Chi Minh City, 24, November, 2011.

Cong Van, T. 2009. *Identification of Sea Level Rise Impacts on the Mekong Delta.* Hydraulic Engineering Consulting Corporation No. 2. HCMC, Vietnam

Deltares. 2011. *Towards a Mekong Delta Plan*. Vietnam – Netherlands Cooperation.

DERG and CIEM. 2010. The Fisheries Sector in Vietnam: A Strategic Economic Analysis. Royal Embassy of Denmark in Vietnam. Hanoi.

Dinh, T. D. 2009. *Assessment of Communities' Awareness of Fisheries Resources Protection*. GIZ, Soc Trang.

DRST. 2011. Technical Report: Land use/ land cover change assessment in Mekong river delta from 2004-2005 to 2009- 2010. Department of Remote Sensing Technology, Space Technology Institute, Vietnam Academy of Science and Technology.

FAO. 2011. Cultured Aquatic Species Information Programme. Penaeus monodon. Cultured Aquatic Species Information Programme. Text by Kongkeo, H. In: *FAO Fisheries and Aquaculture Department* [online]. Rome. Updated 29 July 2005. [Cited 23 December 2011]. http://www.fao.org/fishery/culturedspecies/Penaeus_monodon/en

Garschagen, M. 2010. Challenges and Opportunities of Climate Change Adaptation in High Risk Areas Using the Example of the Mekong Delta, Vietnam.- In: Dölemeyer, A., Zimmer, J. & Tetzlaff, G. (eds.): *Risk and Planet Earth. Vulnerability, Natural Hazards, Integrated Adaptation Strategies*. Stuttgart: 56-65.

Hawkins, S. et al. 2010. *Roots in the Water: Legal Frameworks for Mangrove PES in Vietnam*. Katoomba Group's Legal Initiative Country Study Series. Forest Trends: Washington, DC.

Hoanh, C.T. 2009. Impacts of Upstream Developments and Climate Change in the Mekong Delta. IWMI.

Hogan, Z.S., P.B. Moyle, B. May, M.J. Vander Zanden and I.G. Baird. 2004. The Imperiled Giants of the Mekong. Ecologists struggle to understand – and protect – Southeast Asia's large migratory catfish. *American Scientist* 92 (May-June): 228-237

Hogan, Z., I.G. Baird, J. Vander Zanden & R. Radtke. 2007. New evidence for long distance migration and marine habitation in the Asian catfish *Pangasius krempfi*. *Journal of Fish Biology*;

IPCC. 2000. *IPCC Special Report – Emission Scenarios: Summary for Policy Makers*. A Special Report of IPCC Working Group III Published for the Intergovernmental Panel on Climate Change.

IUCN. 2011. *Groundwater in the Mekong Delta: Issues Paper (Draft, 18 April, 2011)*. IUCN, Hanoi, Vietnam.

Luu, T. T., Holt, T., Hough, A. 2009. *Ben Tre Clam Fishery, Draft*. Moody Marine, Derby, UK.

MoF and World Bank. 2005. Fisheries and Aquaculture Sector Study. Ministry of Fisheries and World Bank. Hanoi.

MONRE. 2009. *Climate change, sea level rise scenarios for Vietnam*. Vietnam Ministry of Natural Resources and Environment (MONRE), Hanoi, Viet Nam.

MONRE. 2012. Call for Expressions of Interest for study of 'The Impacts of Mainstream Hydropower on the Mekong Delta'. Ministry of Natural Resources and Environment, Government of Vietnam.

Morgan, C. 2011. A Vulnerability Assessment of commercially important fish and shellfish species in wild capture fisheries and aquaculture systems. IUCN.

MRC. 2011. Impacts of climate change and development on Mekong flow regimes: First assessment – 2009. *MRC Management Information Booklet Series, No. 4*.

MRC. Undated. 301CS River Basin Organisation Establishment, Module 3: Institutions and Organisations. The Establishment of River Basin Organisations – Experiences from Viet Nam. [Cited 29 December 2011]. http://wiki.mekonginfo.org/index.php/301CS_River_Basin_Organisation_Establishment_Vie

Pomeroy, R., Nguyen, K. A. T., Thong, H. A. 2009. Small-scale marine fisheries policy in Vietnam. *Marine Policy* 33 (2009) pp. 419-428.

Schmeier. S. 2011, Resilience to Climate Change – Induced challenges in the Mekong River Basin: The Role of the MRC*. World Bank Water Papers*, May 2011, 61810

Sinh, L.X. and Long, N.T.. 2011. Status and perception of coastal small-scale trawling fishers in the Mekong Delta of Vietnam. *International Journal of Fisheries and Aquaculture* Vol. 3 (2), pp. 27-35, February 2011

Syvitski, J.P.M., Kettner, A.J., Overeem, I., Hutton, E.W.H., Hannon, M.T., Brakenridge, G.R., Day, J., Vörösmarty, C., Saito, Y., Giosan, L., and Nicholls R.J. (2009). *Sinking Deltas due to Human Activities.* Nature Geoscience, Vol 2, 681 - 686.

Todt, A. 2006. *Traditional utilisation of natural resources in the coastal wetlands in the Lower Mekong Delta, Vietnam*. University of Greifswald, Germany.

Tuan, L.A. and Du, L.V. 2011. Ecosystem based adaptation to Climate change: Rapid Integrated Vulnerability and Adaptation Assessment (RIVAA) for: *Thua Duc commune, Binh Dai district; An Thuy commune, Ba Tri district; Thanh Phu natural reserve, Thanh Phu district, Ben Tre province, Vietnam.* WWF, Vietnam

UNEP. 2007. *National Reports on Coral Reefs in the Coastal Waters of the South China Sea.* UNEP/GEF/SCS Technical Publication No. 11.

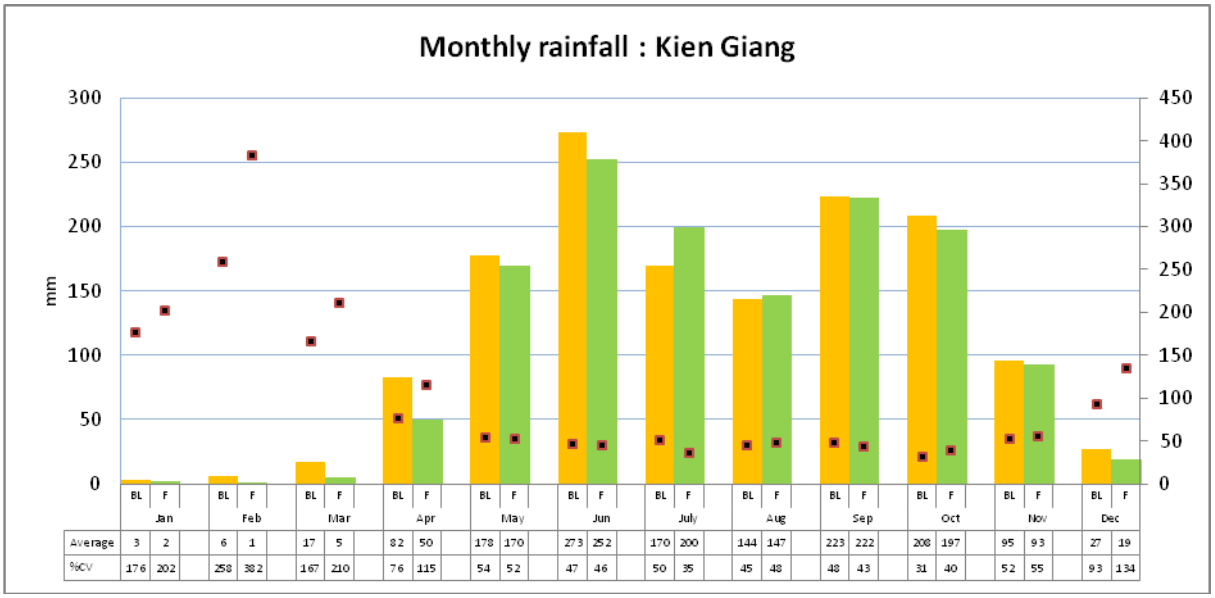
Van, M.V.,Phuong, N.T., Dinh, T.D., Villanueva, M. and Moreau, J.. 2010. A Mass-Balance Ecopath Model of Coastal Areas in the Mekong Delta, Vietnam. *Asian Fisheries Science* 23(2010):208-223

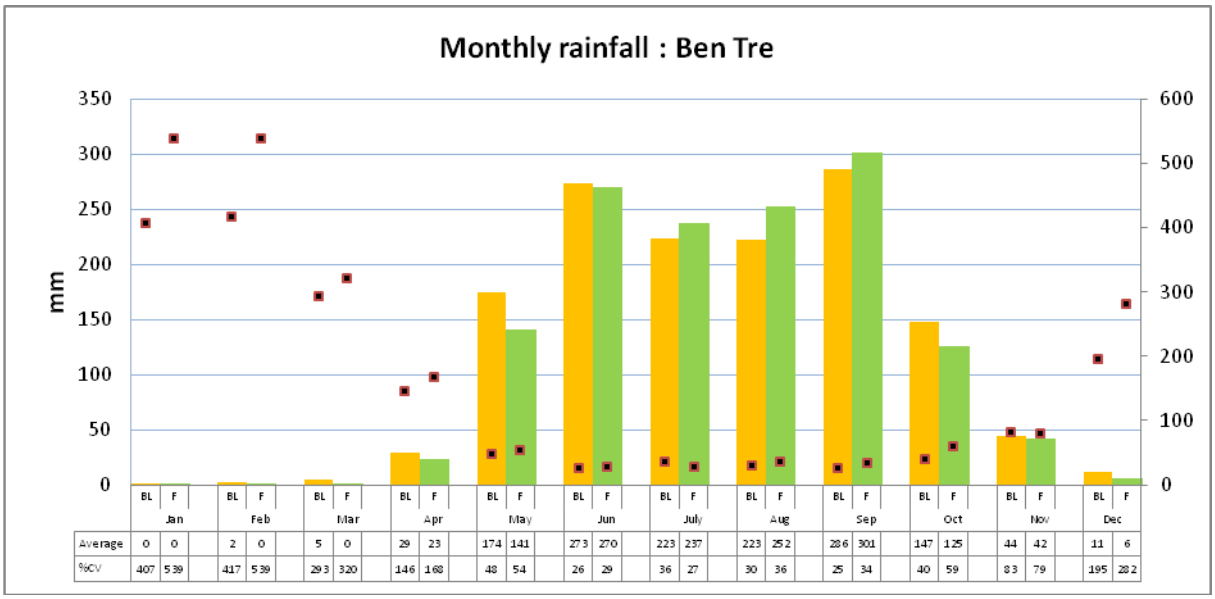
Wolanski, E. & Nhan, N.H. 2005. Oceanography of the Mekong River Estuary. in *International Conference on DELTAS (Mekong venue*): Geological Modelling and Management. Sub-Institute of Geography, Vietnam Academy of Science and Technology, Ho Chi Minh City.

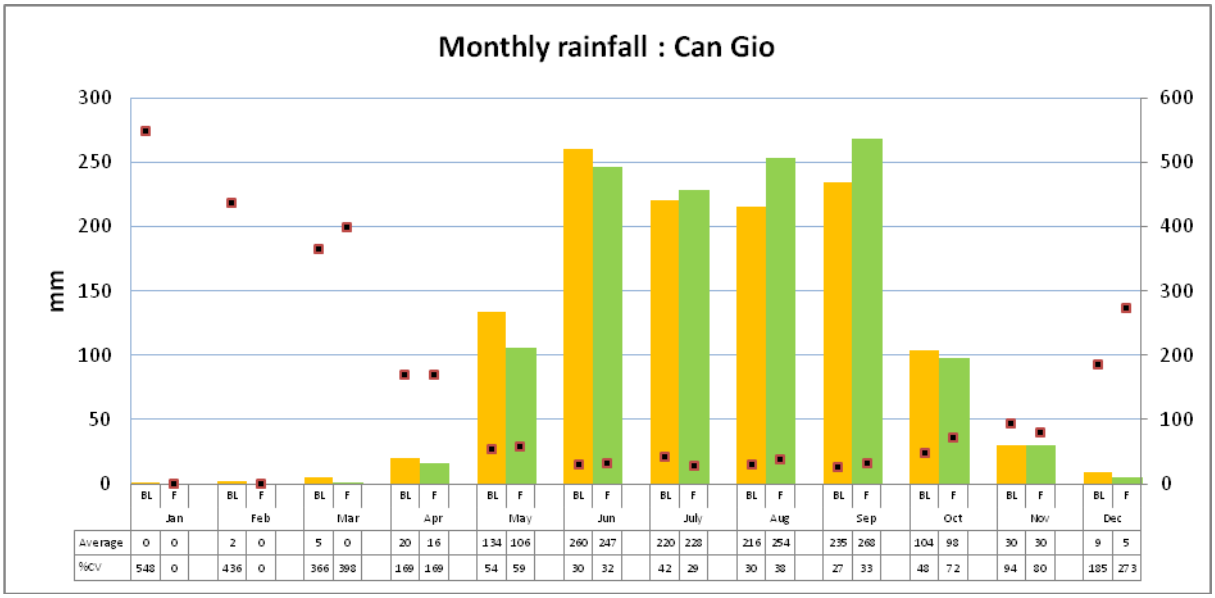
World Vision. 2004. *Mekong Delta Poverty Analysis*. AusAid*,* Canberra, Australia.

Annex 1. Downscaled CC scenarios for the BCR Provinces (SEA START, 2011)

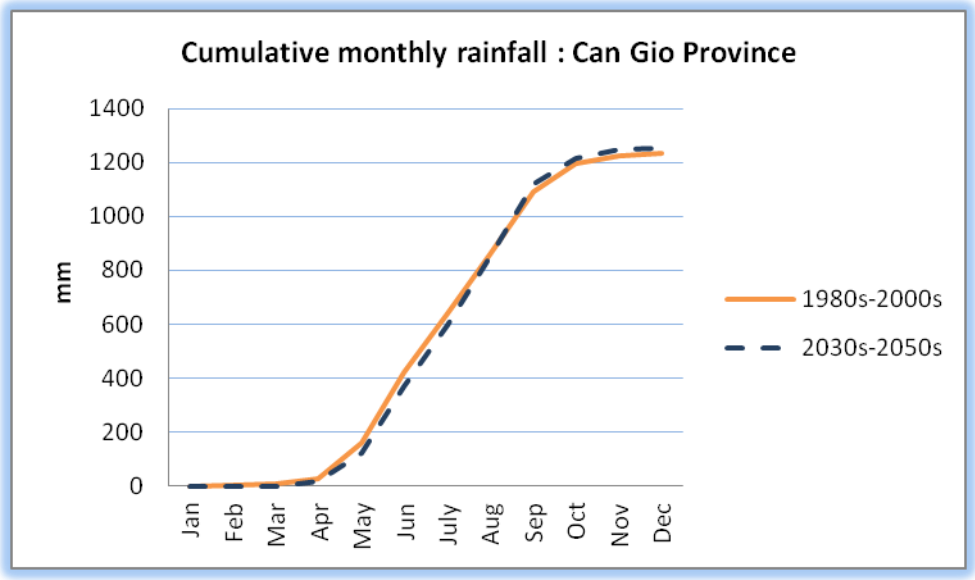
Monthly Rainfall

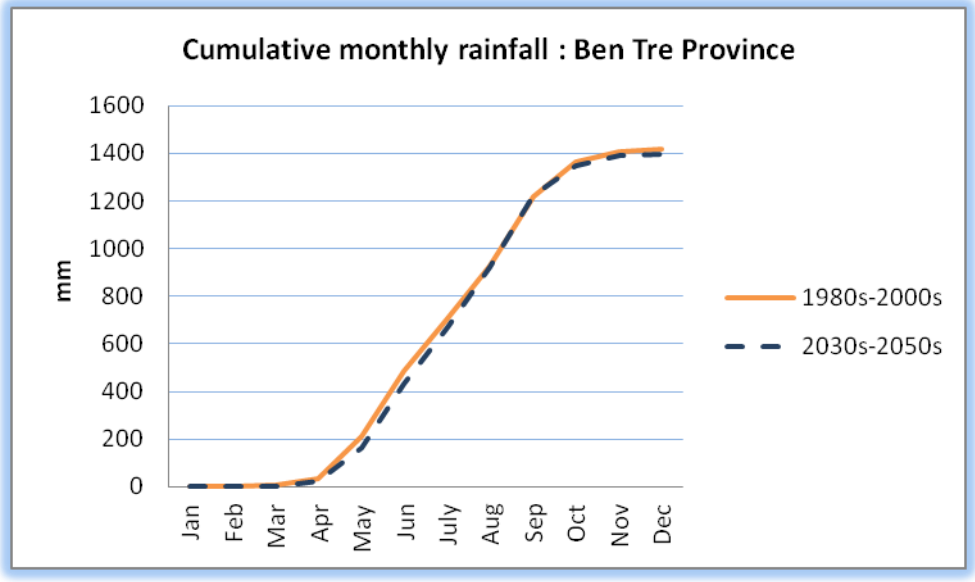


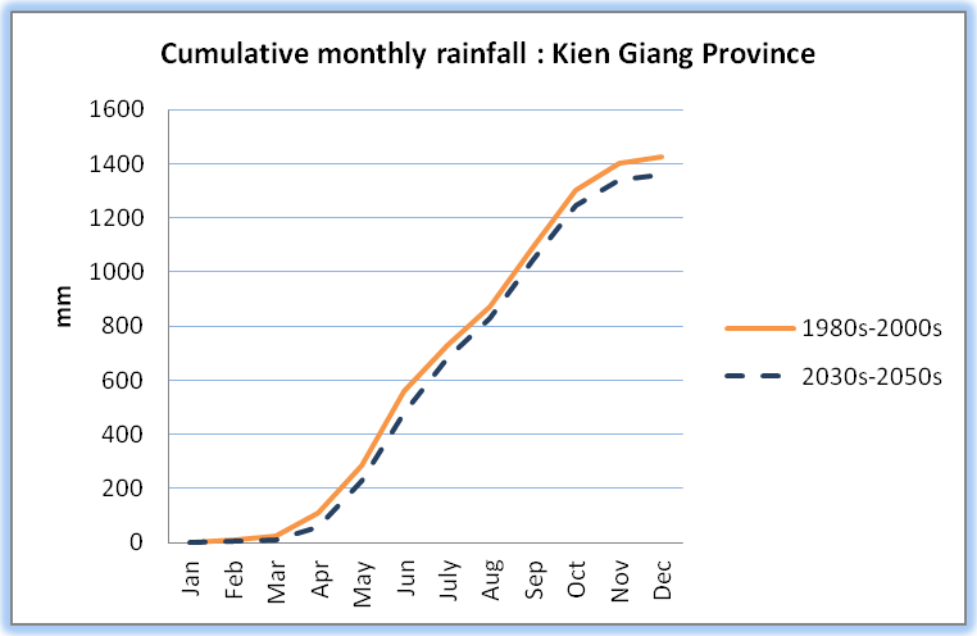




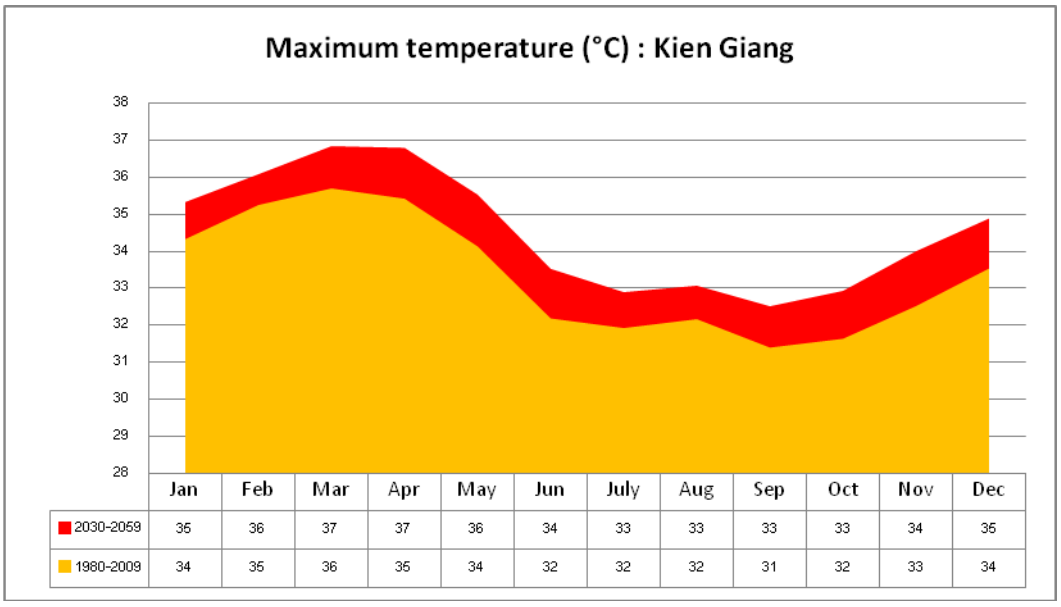
	Jan		Feb		Mar		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec	
	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F	BL	F
Average	0	0	2	0	5	0	20	16	134	106	260	247	220	228	216	254	235	268	104	98	30	30	9	5
%CV	548	0	436	0	366	398	169	169	54	59	30	32	42	29	30	38	27	33	48	72	94	80	185	273



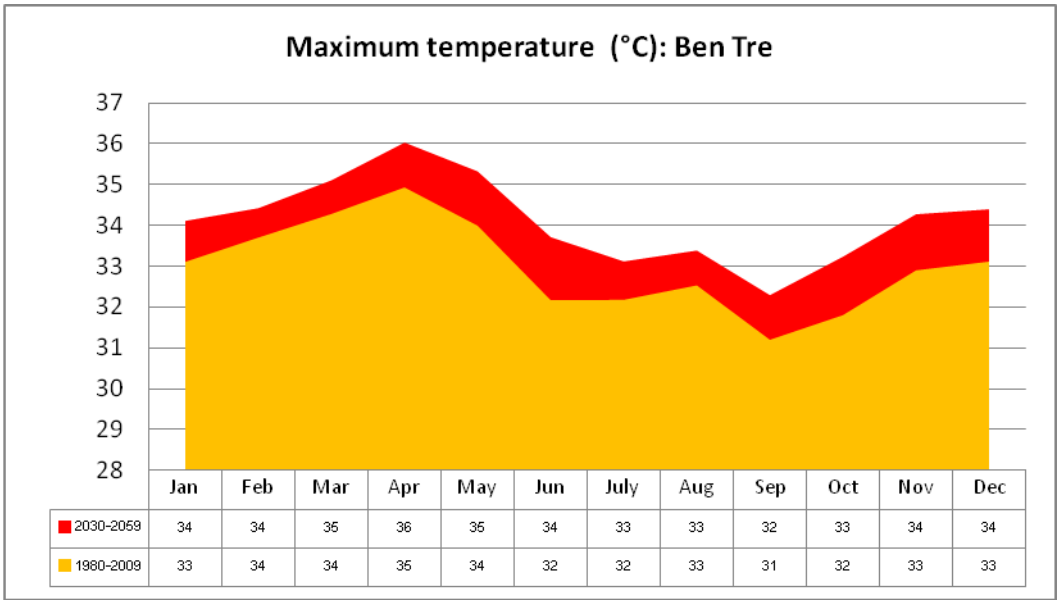




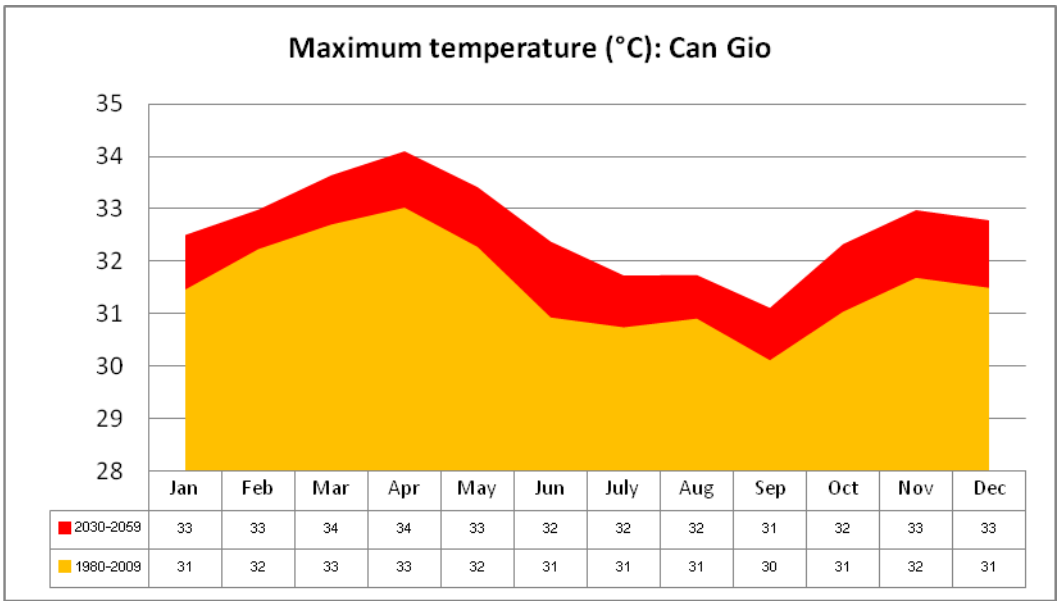
Monthly maximum temperature



	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
2030-2059	35	36	37	37	36	34	33	33	33	33	34	35
1980-2009	34	35	36	35	34	32	32	32	31	32	33	34

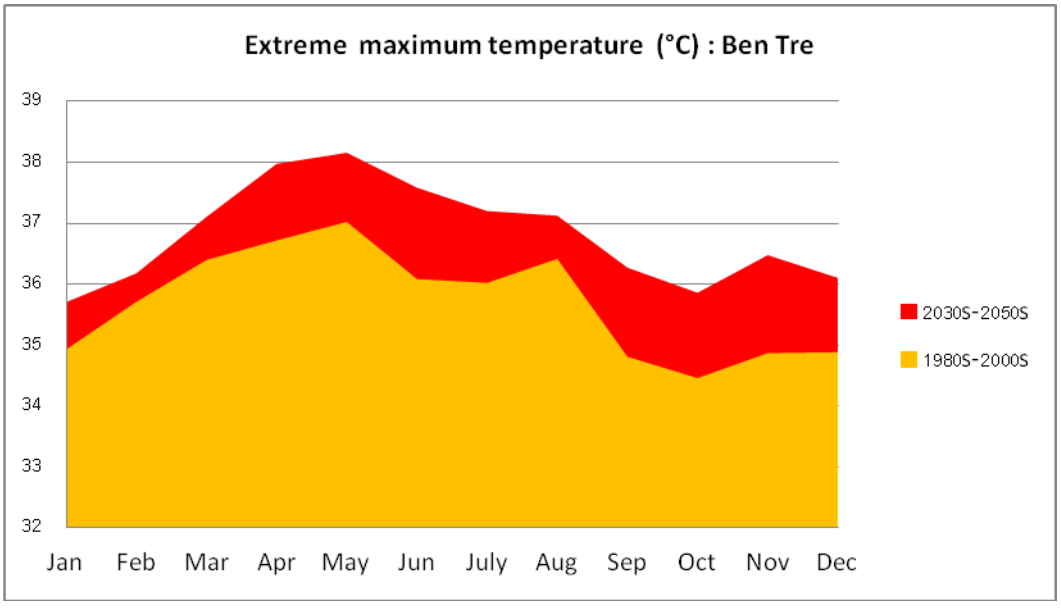


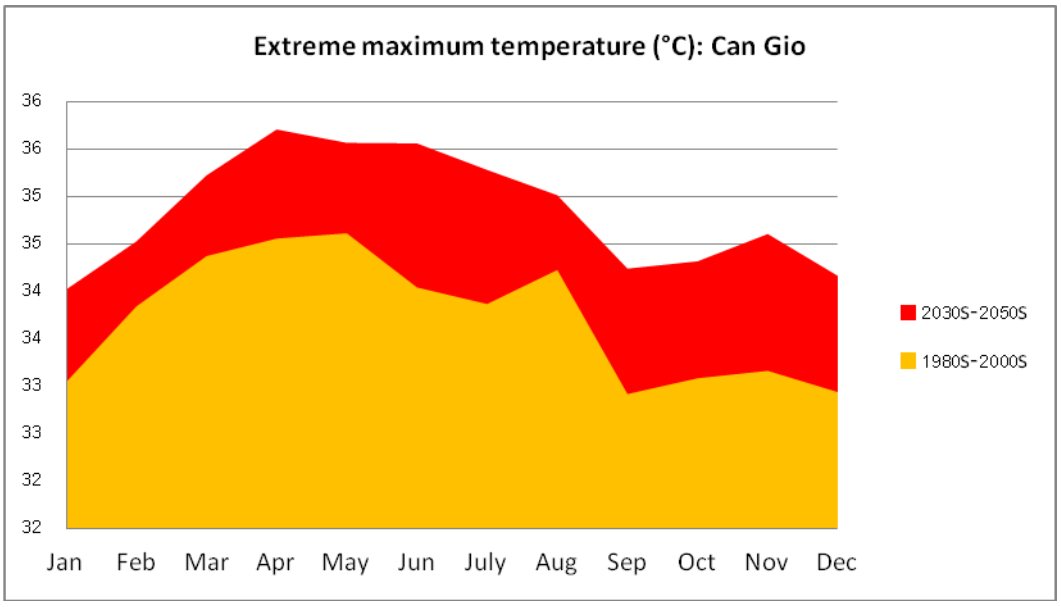
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
2030-2059	34	34	35	36	35	34	33	33	32	33	34	34
1980-2009	33	34	34	35	34	32	32	33	31	32	33	33

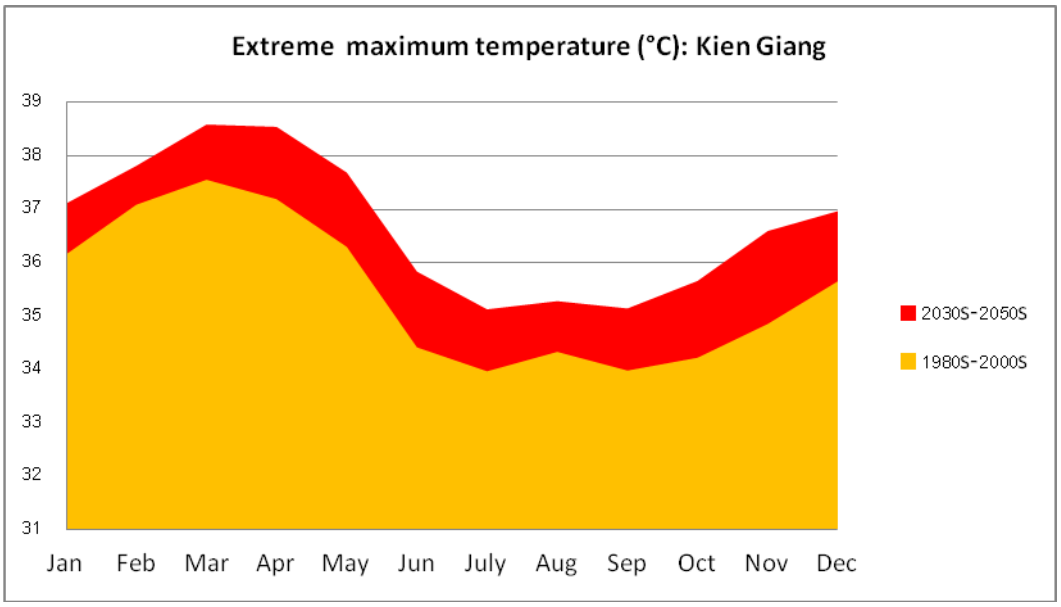


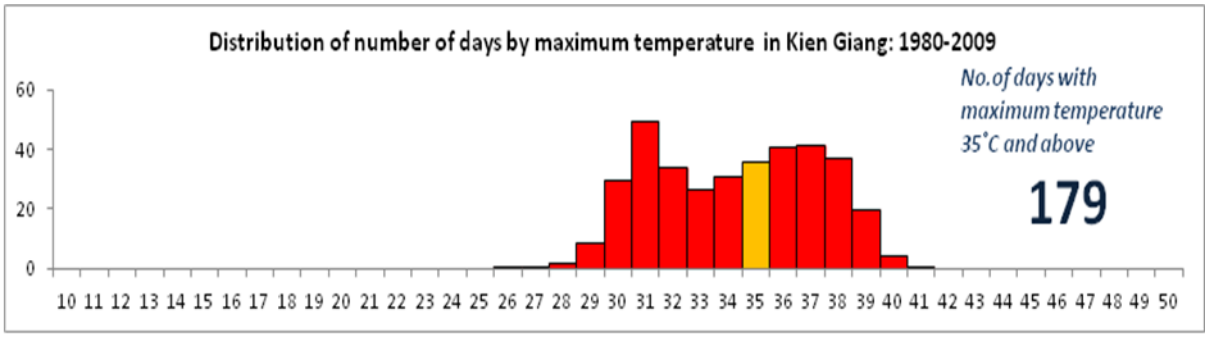
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
2030-2059	33	33	34	34	33	32	32	32	31	32	33	33
1980-2009	31	32	33	33	32	31	31	31	30	31	32	31

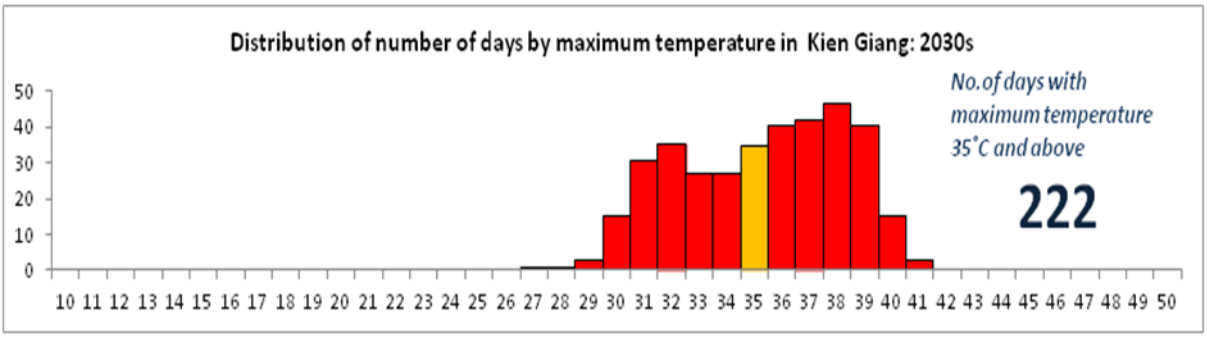
Extreme maximum temperature

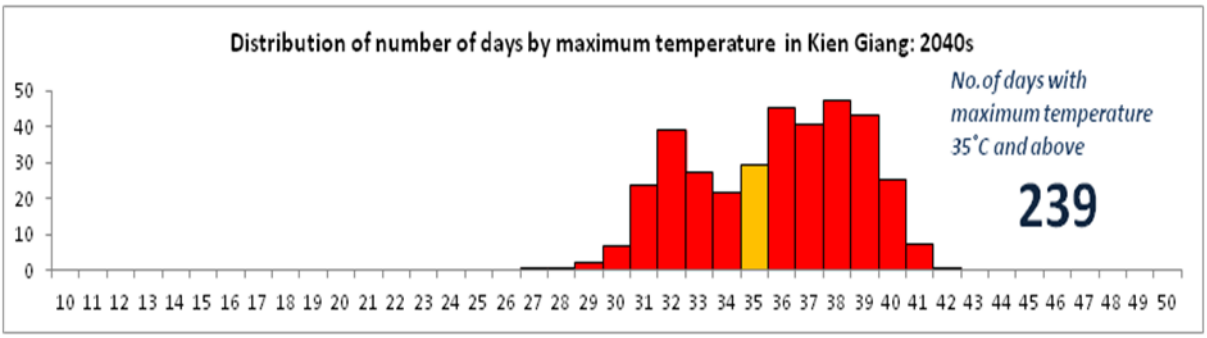


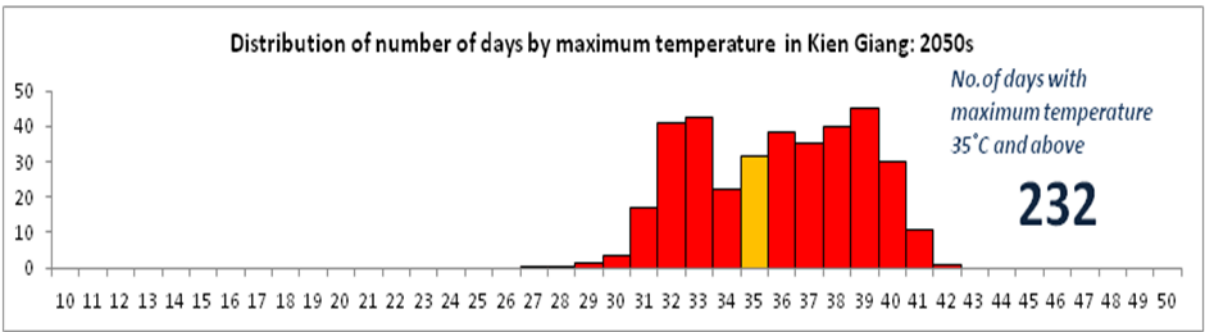

Extreme maximum temperature (°C): Can Gio
36
36
35
35
34
34
33
33
32
32
Jan
Feb
Mar
Apr
May
Jun
July
Aug
Sep
Oct
Nov
Dec
2030S-2050S
1980S-2000S

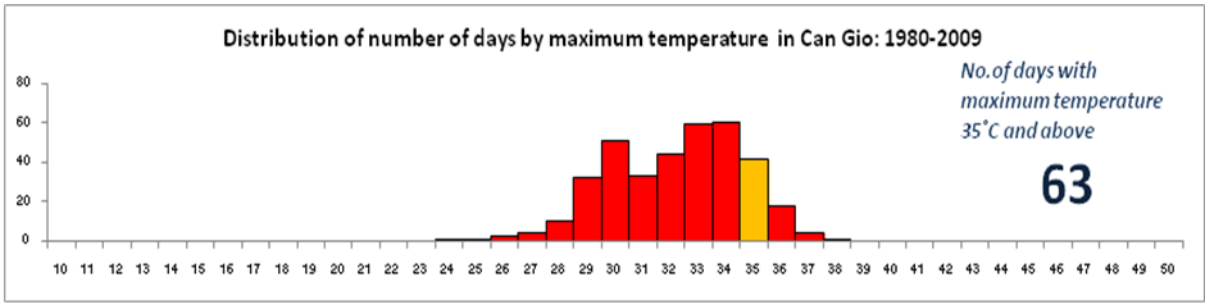

Extreme maximum temperature (°C): Kien Giang
39
38
37
36
35
34
33
32
31
Jan
Feb
Mar
Apr
May
Jun
July
Aug
Sep
Oct
Nov
Dec
2030S-2050S
1980S-2000S

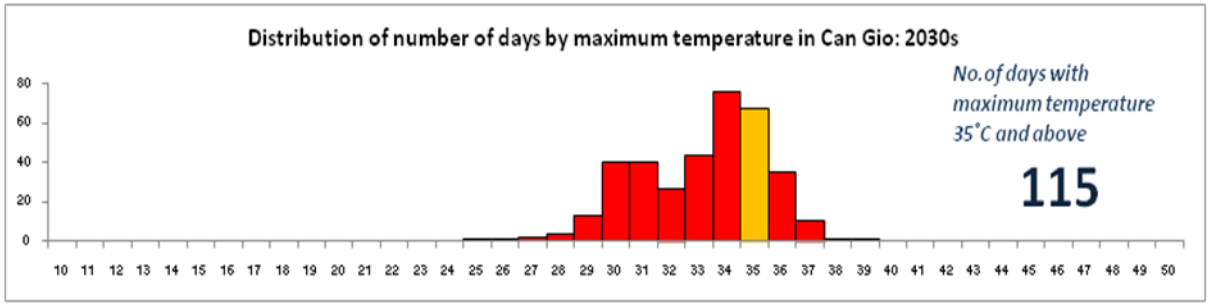

Distribution of number of days by maximum temperature in Kien Giang: 1980-2009
No.of days with maximum temperature 35˚C and above
179
0 20 40 60
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

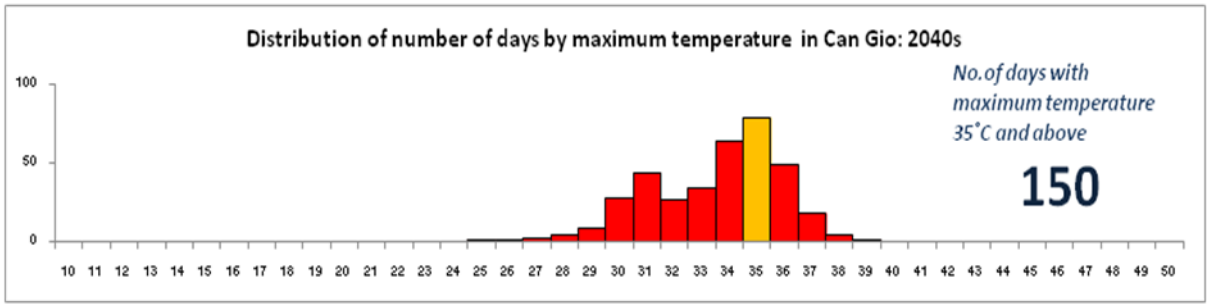

Distribution of number of days by maximum temperature in Kien Giang: 2030s
No.of days with maximum temperature 35˚C and above
222
0 10 20 30 40 50
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

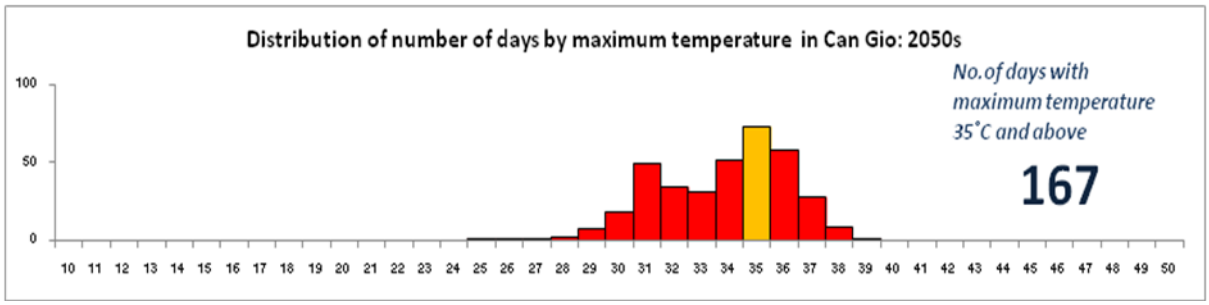

Distribution of number of days by maximum temperature in Kien Giang: 2040s
No.of days with maximum temperature 35˚C and above
239
0 10 20 30 40 50
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

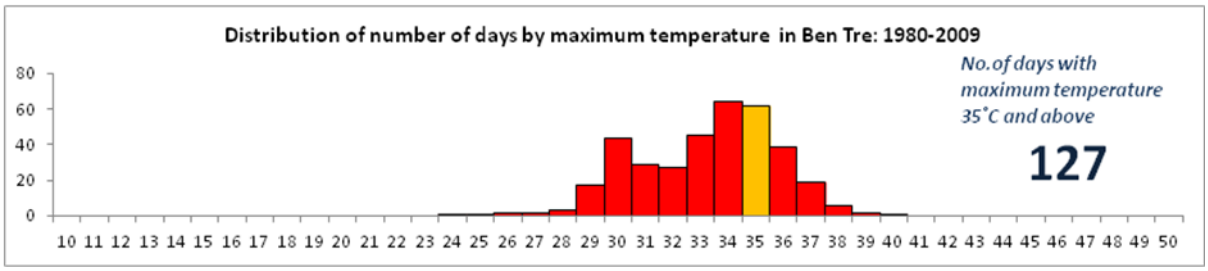

Distribution of number of days by maximum temperature in Kien Giang: 2050s
No.of days with maximum temperature 35˚C and above
232
0 10 20 30 40 50
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

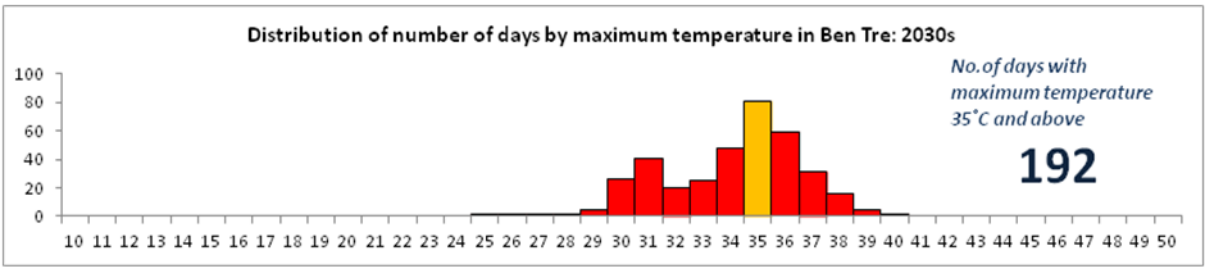

Distribution of number of days by maximum temperature in Can Gio: 1980-2009
No. of days with maximum temperature 35°C and above
63

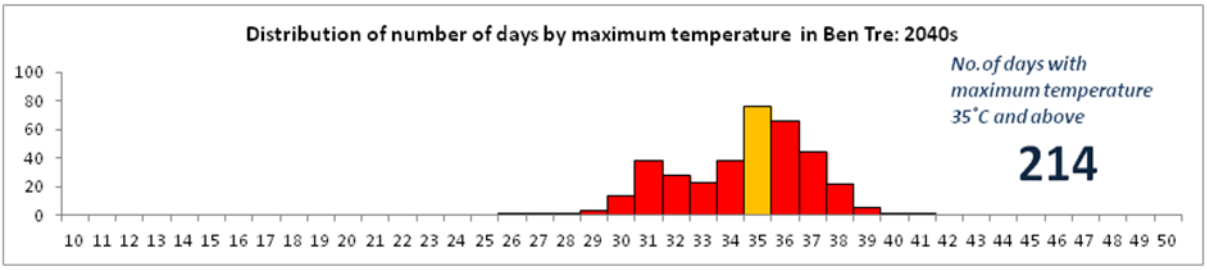

Distribution of number of days by maximum temperature in Can Gio: 2030s
No. of days with maximum temperature 35°C and above
115

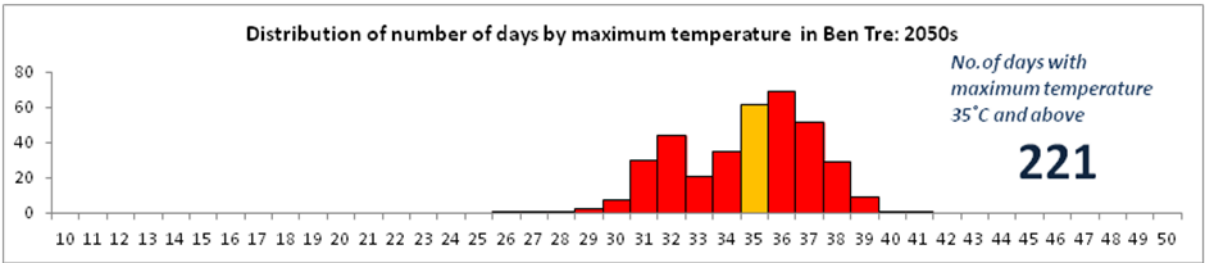

Distribution of number of days by maximum temperature in Can Gio: 2040s
No. of days with maximum temperature 35°C and above
150


Distribution of number of days by maximum temperature in Can Gio: 2050s
No. of days with maximum temperature 35°C and above
167

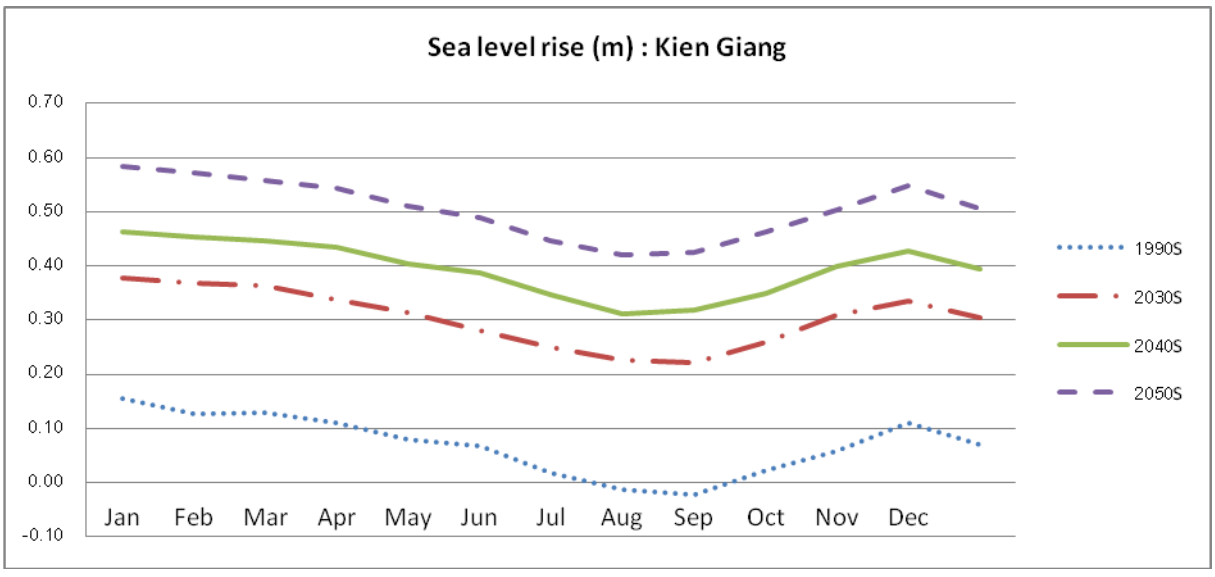


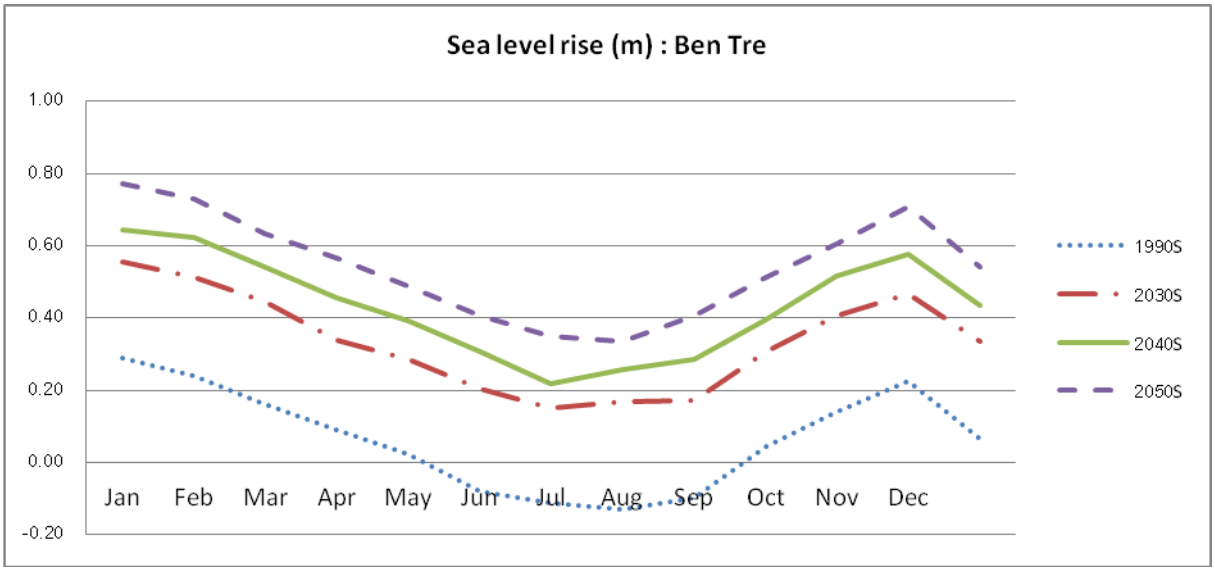


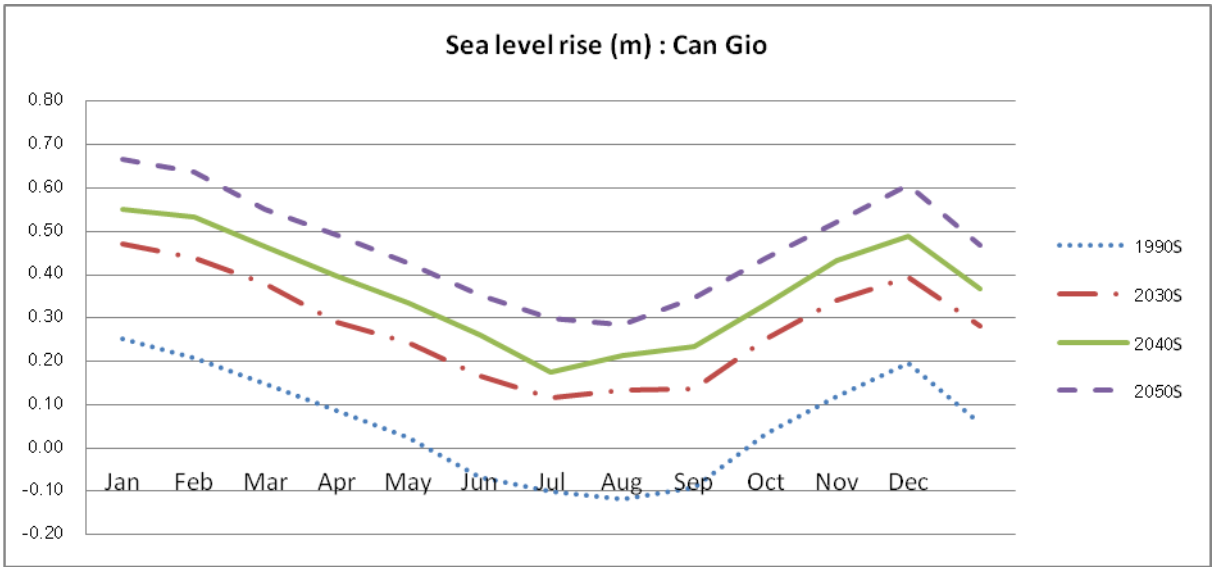




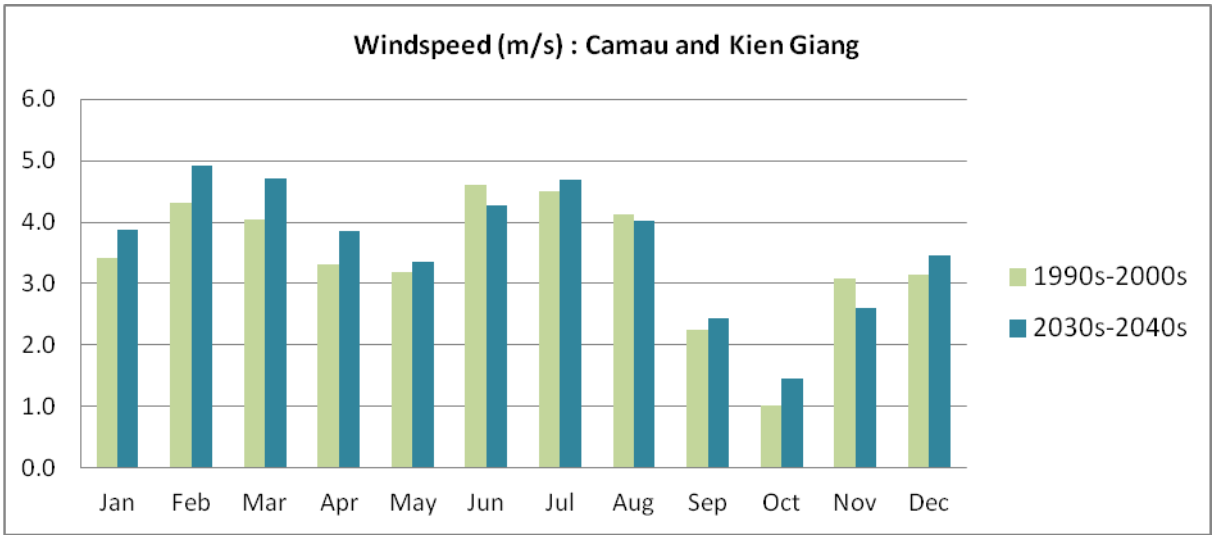
Sea level rise

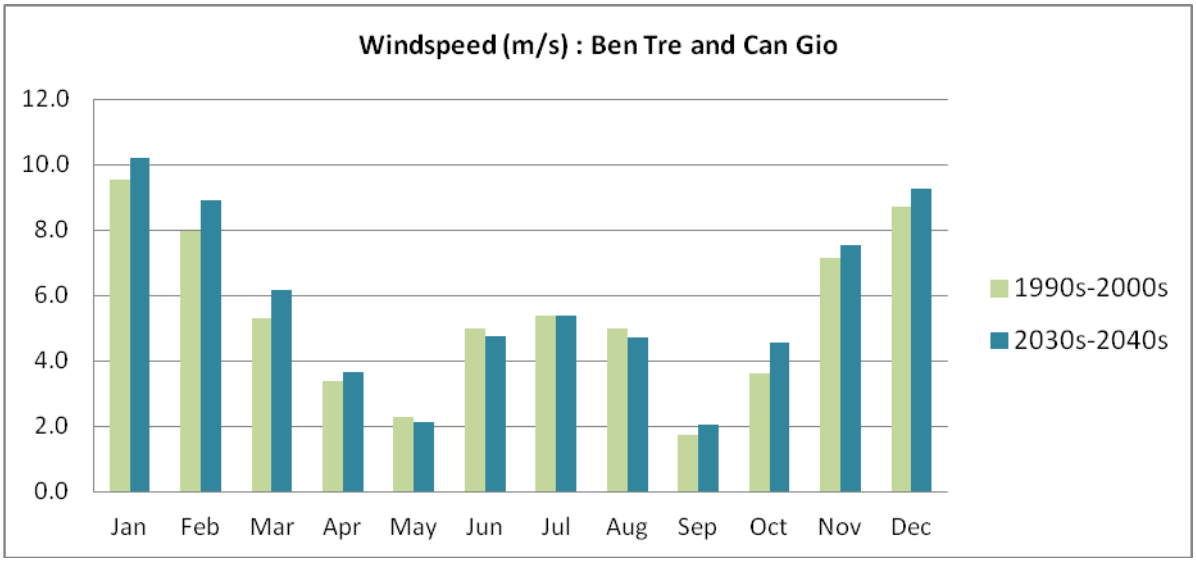


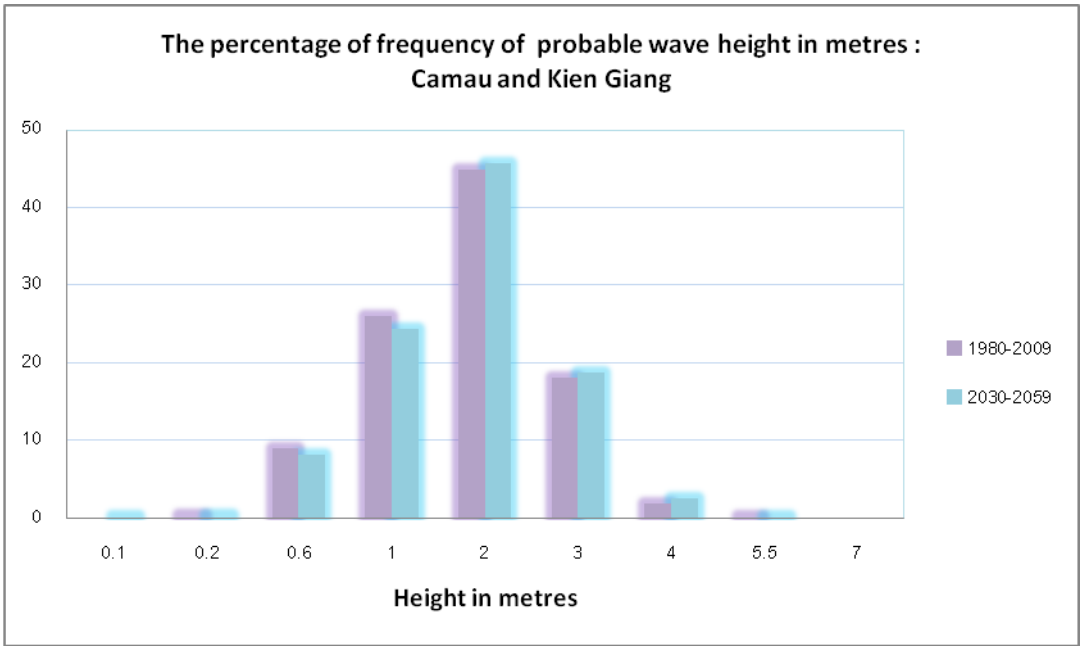

Sea level rise (m) : Ben Tre
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1990S
2030S
2040S
2050S

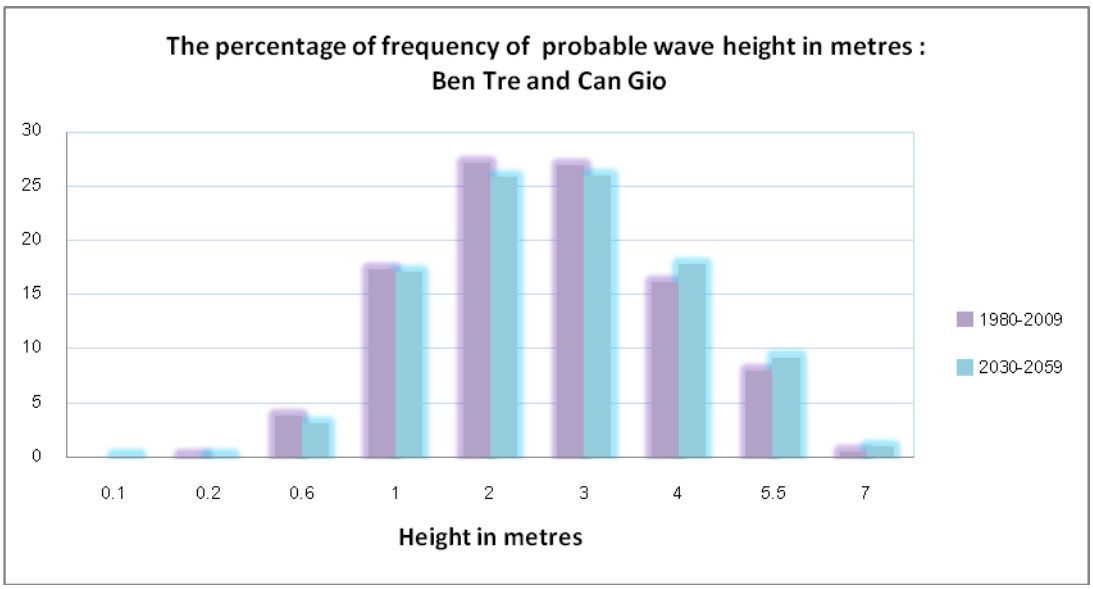

Sea level rise (m) : Can Gio
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1990S
2030S
2040S
2050S

Wind


Windspeed (m/s) : Camau and Kien Giang
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1990s-2000s
2030s-2040s


Windspeed (m/s) : Ben Tre and Can Gio
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
1990s-2000s
2030s-2040s


The percentage of frequency of probable wave height in metres :
Camau and Kien Giang
50
40
30
20
10
0
0.1
0.2
0.6
1
2
3
4
5.5
7
Height in metres
1980-2009
2030-2059


The percentage of frequency of probable wave height in metres :
Ben Tre and Can Gio
30
25
20
15
10
5
0
0.1
0.2
0.6
1
2
3
4
5.5
7
Height in metres
1980-2009
2030-2059

Annex 2. A Mekong Delta Provincial Climate Change Action Network

CONCEPT NOTE

MEKONGNET: BUILDING CLIMATE CHANGE AND ENVIRONMENTAL POLICY ANALYSIS CAPACITY IN THE MEKONG DELTA

Draft

1. THE CHALLENGE

Work by IUCN and other organizations over the last 10 years in the freshwater and coastal areas of the Mekong Delta have highlighted several barriers to the more sustainable use of land and water:

- The delta is a highly dynamic hydrological unit. Consequently, changes in land and water use in one part of the delta invariable result in changes downstream, or in adjacent coastal areas. These "unexpected outcomes" can prove costly and exceed the economic benefits of the original manipulation.
- While the 13 provinces that cover the delta share many environmental problems, the fragmentation of management authority and even competition between provinces precludes a response that takes into account that the delta functions as a system.
- As in many countries, environmental problems are ultimately driven by the unequal distribution of costs and benefits. A few politically influential groups can, in effect, set policy that negatively affects the lives of millions. Addressing the political economy of land and water use is sensitive.
- Climate change models show higher maximum temperatures, more intense rainfall, and higher sea levels. By disrupting ecosystem processes, development trends are putting more and more people in harm's way and increasing the vulnerability of the delta to climate change.

There is a large and growing body of evidence to substantiate all four propositions. For example, it is evident that the construction of high ring dykes as part of the government's three rice crops a year policy has resulted in the collapse of wild fisheries (on which the landless population depends disproportionately) and the diversion of flood waters into urban areas. There is also a correlation between the intensification of rice production upstream and increased saline intrusion downstream.

However, making use of this information to promote policy reform faces several problems. First, the information is dispersed and needs to be compiled. This means cooperating with a wide range of researchers and data holders. Second, this information needs a set of evidence-based policy messages. This means building capacity to analyze policy, a capacity that is poorly developed. Third, to secure provincial understanding and support, this process cannot be an "ivory tower" exercise but must actively engage the provinces.

2. MEKONGNET

In response to this challenge, IUCN has discussed with CTU the possibility of supporting MekongNet, an initiative launched in 2010 by CTU at the request of four provinces (An Giang, Can Tho, Kien Giang, and Ca Mau) to facilitate discussions between provinces on climate change and related environmental issues. As a national university, CTU has the mandate to respond to such requests from provincial governments.

MekongNet is run out of CTU's Research Institute for Climate Change (CTURICC), also known as the DRAGON Institute. With funding from local NGO WARECOD, CTURICC organized two meetings and several training workshops for all 13 provinces with a focus on awareness raising and capacity building. CTU sent invitation letters to all relevant provincial government departments. This is a standing letter that enables their on-going participation. The current provincial contacts for MekongNet are:

Province	Name	Position
1. An Giang	Trần Anh Thư	Vice Director DONRE
2. Bạc Liêu	Khưu Lễ	Vice Director DONRE
3. Bến Tre	Đoàn Văn Phúc	Head Environmental Protection Division
4. Cà Mau	Huỳnh Kim Duyên	Vice Directory Women's Association
5. Cần Thơ	Cao Thị Minh Thảo	Head Environmental Protection Division
6. Đồng Tháp	Vũ Thị Nhung	Head Environmental Protection Division
7. Kiên Giang	Lương Thanh Hải	Director DOST
8. Hậu Giang	Hoàng Minh Châu	Head Environmental Protection Division
9. Long An	Huỳnh Thị Phép	Vice Director DOST

10. Sóc Trăng	Trần Văn Thanh	Vice Director DONRE
11. Trà Vinh	Nguyễn Thanh Liên	Vice Director DONRE
12. Tiền Giang	Trần Xuân Thành	Director DONRE
13. Vĩnh Long	Ngô Thị Bích Đào	Head Environmental Protection Division

However, since this initial phase there has been little further activity because of the lack of funding.

3. MEKONGNET 2.0

Rather than establish a new network, IUCN would prefer to build on MekongNet because it has the authority to convene all the delta's provinces to discuss climate change and related environmental issues. Because so many provincial leaders are CTU graduates, it also has the professional and personal links that allow politically sensitive issues, such as the government's rice intensification policy, to be safely discussed.

CTU graduates are also members and staff of the Southwest Steering Committee (SWSC). In recent years, CTU has convened and delivered provincial government workshops on climate change and water management at the request of the SWSC. Established in 2002 and based in Can Tho, SWSC is a powerful party-affiliated agency headed by the Deputy Prime Minister, Vu Van Ninh. It oversees implementation of national plans and policies in the delta and advises the politburo on emerging issues. SWSC supported local NGO FORWET's campaign to raise the awareness of provincial governments of the potential impacts of Mekong mainstream dams and involve them in advocacy opposing the Xayaburi dam. SWSC is independent of any ministry. This is critical because MARD and MONRE face capacity gaps and conflicts of interest that limit their ability to objectively assess policy options.

To develop MekongNet into an effective network that builds policy analysis and advocacy capacity in provincial governments, a support program has been proposed. With or without the program, MekongNet will remain an initiative owned and run by CTU and its provincial government partners. On March 29, 2012 IUCN and GIZ met CTU's Vice-Rector and his senior staff to discuss what MekongNet could become. This summary is based in part on that discussion.

We envision that the support program would assist MekongNet to achieve four outputs:

1. In consultation with IUCN, GIZ, and other partners, prepare a policy research agenda that tackles some of fundamental drivers of unsustainable land and water use in the delta.
2. In cooperation with provincial governments, collect, review, and synthesize existing data and information in support of policy research.
3. Review of provincial development plans to ensure that they integrate delta-wide environmental processes and climate change-related risks .
4. Produce a set of print and video products that convey the key policy messages and organize events to advocate policy reforms to decision-makers.

While some targeted data collection may be required, most of the necessary data and information already exist. The emphasis would therefore be on the analysis of this data and information as the basis for formulating evidence-based policy recommendations. Mekong Net would focus on "big picture" issues. Thus while local conditions may be relevant to these issues, MekongNet would not be a community development initiative. Similarly, while MekongNet would build capacity of provincial government to ensure effective uptake, this would be done strictly in support of the policy research agenda via analysis of development planning.

Within three years, we would expect that MekongNet would achieve the following outcomes:

- Regular policy dialogue established with SWSC on the costs and benefits of the third rice crop and other major policies.
- Continued provincial and central government opposition to the Xayaburi and other Mekong mainstream dams.
- Provincial development plans explicitly address delta-wide environmental processes and climate change-related risks (the latter is an objective of the DANIDA supported NTP to respond to Climate Change).

4. SUPPORT PROGRAM

A MekongNet support program would be designed to deliver these outputs and outcomes. MekongNet would continue to be run out of CTURICC under the direction of a MekongNet Steering Committee (MSC)

consisting of representatives from support agencies, e.g., CTU, IUCN, GIZ, WWF, WARECOD, FORWET, SWSC. The secretariat would need funding for human resources, a core program of work, and events. CTU will provide an office for the secretariat and communications infrastructure.

The secretariat would be jointly managed by one international and one national coordinator who report to the MSC. The role of the international coordinator is to provide intellectual leadership and facilitate communications and access to international agencies and research. This position could initially be part-time. The role of the national coordinator is to facilitate communications with provincial partners and facilitate access to national agencies and research.

It is proposed that international partners fund MekongNet for an initial 1-year proof-of-concept phase. The cost of a half-time international coordinator and full time national coordinator, operating costs, and events would be about $75,000.

Annex 3. Economically valuable fish species in the coastal capture fishery of Bac Lieu (Long et al, 2010, p. 9)

No.	Common names	Scientific names
1	**Family Stingrays**	***Dasyatidae***
1	White-rimmed stingray	*Himantura signifer* Compagno & Roberts, 1982
2	**Family Pike congers**	***Muraenesocidae***
2	Yellow pike conger	*Congresox talabon* (Cuvier, 1849)
3	**Family Snake eels**	***Ophichthidae***
3	Rice-paddy eel	*Pisodonophis boro* (Hamilton, 1822)
4	**Family Sardines**	***Clupeidae***
4	Sumatran river sprat	*Clupeichthys goniognathus* Bleeker, 1855
5	Borneo river sprat	*Clupeoides borneensis* Bleeker, 1851
5	**Family Anchovies**	***Engraulidae***
6	Scaly hairfin anchovy	*Setipinna taty* (Valenciennes, 1848)
6	**Family Giant catfishes**	***Pangasiidae***
8	Sadarin	*Pangasius polyuranodon* Bleeker, 1852
7	**Family Sea catfish**	***Ariidae***
9	Engraved catfish	*Arius caelatus* Valenciennes, 1840
10	Spotted catfish	*Arius maculatus* (Thunberg, 1791*)*
11	Soldier catfish	*Osteogeneiosus militaris* (Linnaeus, 1758)
8	**Family Eeltail catfishes**	***Plotosidae***
12	Eel sea catfish	*Plotosus canius* Hamilton, 1822
9	**Family Lizardfishes**	***Synodontidae***
13	Bombay-duck	*Harpadon nehereus* Hamilton, 1822
10	**Family Swamp eel**	***Synbranchidae***
14	Bengal mudeel	*Ophisternon bengalensis* Mc Clelland, 1844
11	**Family Flatheads**	***Platycephalidae***
15	Bartail flathead	*Platycephalus indicus* (Linnaeus, 1758)
12	**Family Seaperches**	***Centropomidae***
16	Giant seaperch	*Lates calcarifer* (Bloch, 1790)
13	**Family Grunters**	***Teraponidae***
17	Jarbua terapon	Terapon jarbua (Forsskăl, 1775)
14	**Family Sand whitings**	**Sillaginidae**
18	Silver sillago	Sillago sihama (Forsskăl, 1775)
15	**Family Ponyfishes**	**Leiognathidae**
19	Common ponyfish	Leiognathus equulus (Forskăl, 1775)
16	**Family Snappers**	**Lutijanidae**
20	Russell's snapper	Lutjanus russellii (Bleeker, 1849)
21	Mangrove red snapper	Lutjanus argentimaculatus (Forsskăl, 1775)
17	**Family Silver-biddies**	**Gerreidae**
22	Whipfin silver-biddy	Gerres filamentosus Cuvier, 1829
18	**Family Grunts**	**Haemulidae**
23	Saddle grunt	Pomadasys maculatus (Bloch, 1793)
19	**Family Porgies**	**Sparidae**
24	Picnic seabream	Acanthpagrus berda (Forskăl, 1775)
20	**Family Croakers**	**Sciaenidae**
25	Soldier croaker	Nibea soldado (Lacépède 1802)
26	Chinese bahaba	Bahaba taipingensis (Herre, 1932)
21	**Family threadfin**	**Polynemidae**

27	Fourfinger threadfin	Eleutheronema tetradactylum (Shaw, 1804)
28	Paradise threadfin	Polynemus paradiseus Linnaeus, 1758
22	**Family Butterfishes**	**Stromateidae**
29	Chinese silver	Pampus chinensis (Euphrasen, 1788)
23	**Family Grey mullets**	**Mugillidae**
30	Common grey mullet	Mugil cephalus Linnaeus, 1758.
31	Longarm mullet	Vagamugil cunnesius
32	Tade gray mullet	Liza tade (Forsskăl, 1775)
24	**Family Sleepers**	**Eleotridae**
33	Marble goby	Oxyeleotris siamensis (Guenther, 1861)
25	**Family Gobies**	**Gobiidae**
34	Golden tank goby	Glossogobius aureas Akihito & Meguro, 1975
35	Slender mudskipper	Pseudapocryptes elongatus (Cuvier, 1816)
36	Slender mudskipper	Pseudapocryptes borneensis (Bleeker, 1855)

Vinh Trach Dong Commune, Bac Lieu Province © Tang Phuong Gian, IUCN Vietnam

INTERNATIONAL UNION
FOR CONSERVATION OF NATURE

VIET NAM COUNTRY OFFICE
1st floor, 2A Building,
Van Phuc Diplomatic Compound
298 Kim Ma, Ba Dinh District
Hanoi city, Viet Nam
IPO Box 60
Tel: +844-37261575/6
Fax: +844-37261561
www.iucn.org/vietnam