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"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand"

UNEP/GEF
Project Coordinating Unit

WETLANDS BORDERING THE SOUTH CHINA SEA

UNEP/GEF
Regional Working Group on Wetlands

WETLANDS INTERNATIONAL

PERHILITAN

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First published in Bangkok, Thailand in 2004 by the United Nations Environment Programme.

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This publication has been compiled as a collaborative document of the Regional Working Group on Wetlands of the UNEP/GEF Project entitled *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand."*

For citation purposes this document may be cited as:

UNEP. 2004. *Wetlands Bordering the South China Sea.* UNEP/GEF/SCS Technical Publication No. 4.

FOREWORD

The South China Sea region has experienced high rates of economic growth and rapid coastal development in recent decades. Each country bordering the South China Sea has actively and in certain respects very successfully engaged in its economic development. This is a region where economic development has imposed, and will continue to place increasing stress on the ecological systems.

In 1981, under the sponsorship of UNEP, the East Asian Seas Action Plan was adopted by five Southeast Asian countries: Indonesia, Malaysia, Philippines, Singapore, and Thailand. At that time, obstacles to engaging all the South China Sea border countries in a single programme were seemingly insurmountable. Two decades after the adoption of East Asian Seas Action Plan, the region has witnessed a trend of deepening interdependence, integration, cooperation and prosperity. Despite the 1997-1998 financial crisis, the region remains the fastest industrializing area. However, economic development was not achieved without negative impacts. Fast economic development was accompanied by urbanization, population growth and deterioration of environment.

In 1996, realizing the urgency to collaboratively tackle regional marine environmental problems in the South China Sea, the countries bordering the South China Sea requested assistance from UNEP and the Global Environment Facility (GEF) in addressing the issues and problems facing them in the sustainable management of their shared marine environment. From 1996 to 1998 initial collection of data and information was conducted by each country to provide inputs for the development of a Transboundary Diagnostic Analysis, which identified the major water related environmental issues and problems of the South China Sea. In 1999 the governments, through the Coordinating Body for the Seas of East Asia endorsed a framework Strategic Action Programme that established targets and timeframes for action.

The endorsement of the UNEP/GEF South China Sea Project by all the major countries around the South China Sea ushered in a new era of environmental cooperation in the region. It demonstrates the determination of the littoral countries to take an holistic approach to addressing shared environmental problems, despite the continuing existence of certain political disputes or disagreements. Under the framework of the Project, the wetlands sub-component focuses its activities on five types of wetlands, i.e. intertidal flats, estuaries, lagoons, peat swamps and non-peat swamps. During the first phase of the Project, data and information have been collected and compiled for regional use, which provides baseline information for the operational phase of the project.

We are delighted to have been asked to write the Foreword to this booklet, and we consider this booklet a valid contribution to accumulate regional knowledge and understanding on wetlands bordering the South China Sea. It reflects the collective effort of the Regional Working Group on Wetlands in exchanging and sharing data and information. We hope it reaches the possible widest audience and inspires new political and financial contributions to promote the protection and sustainable management of wetlands in the global marine biological diversity centre—the South China Sea.

Dr. Sansanee Choowaew & Dr. Liwei Chen
Bangkok, Thailand
January 2004

INTRODUCTION

Wetlands are defined as "areas of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters" (Ramsar Convention, 1971). This definition encompasses reef flats and seagrass beds in coastal areas, mudflats, mangroves, estuaries, rivers, freshwater marshes, swamp forests and lakes, saline marshes and lakes as well as underground water resources.

Under the UNEP/GEF South China Sea Project, activities in the wetland sub-component are focused on five specific types of wetlands, namely intertidal flats, estuaries, lagoons, peat swamps and non-peat swamp, since mangroves, coral reefs and seagrass beds are the subjects of separate sub-components. Activities at national level include establishment or re-vitalisation of national committees or technical working groups; review of national data relating to wetlands; development of national meta database; development or update of national management plan. At the regional level, the Regional Working Group on Wetlands develops regional criteria and procedures in identifying, prioritising, and ranking the importance of sites by environmental and socio-economic indicators.

About 6% or 5.7 million square kilometres of the Earth's surface is wetlands. The greatest proportion is made up of bogs (30%), fens (26%), swamps (20%) and floodplains (15%), with lakes accounting for just 2% of the total. Mangroves cover about 240,000km^2 of coastal area and an estimated 600,000km^2 of coral reefs remain worldwide (WCMC, *Global Biodiversity*, 1992). About 56% of wetlands are found in tropical and subtropical regions and almost 1/3 are located in Asia (Mitsch and Gosselink, 2000).

Wetland ecosystems are cradles of biological diversity. Countless species of plants and animals depend on them for survival. Fishes in wetlands number around 20,000 species worldwide. Diversity amongst aquatic species groups is highest in the tropics: South America has the most species with 2,220 species, of which more than 1,000 are in the Amazon River basin; Africa has 2,000 species, with more than 700 occurring in the Zaïre River basin; Europe has about 200 species; and, Asia has an estimated 1,600 species but this number is increasing as additional research is undertaken [WCMC, *Global Biodiversity*, 1992].

The Southeast Asian Region is rich in marine biodiversity. Field records of hermatypic coral genera indicate that Indonesia, Malaysia and Philippines form the centre of coral diversity. Countries bordering the South China Sea largely depend on wetlands for their livelihood. In Cambodia, Over 30% of its territory is wetlands. Following internationally accepted criteria for wetland identification (defined by the Ramsar Convention), over 20 % (36,500 Km^2) of the Kingdom may be classified as wetlands of international importance (Cambodia Wetland Report, 2003).

Despite the importance of wetlands of high biodiversity in the South China Sea, loss and degradation of wetlands and their biodiversity have been continuing at a high rate due to the increasing human population size, particularly in coastal areas, poverty, and people's dependency on wetland resources. Actions are urgently needed to halt the degradation of coastal wetlands around the South China Sea.

Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand.
Cambodia, China, Indonesia, Malaysia, Philippines, Thailand, Viet Nam

In 1996, the countries bordering the South China Sea requested assistance from UNEP and the GEF in addressing the issues and problems facing them in the sustainable management of their shared marine environment. From 1996 to 1998 initial country reports were prepared that formed the basis for the development of a Transboundary Diagnostic Analysis, which identified the major water related environmental issues and problems of the South China Sea. Of the wide range of issues identified the loss and degradation of coastal habitats, including mangrove, coral reefs, seagrass and coastal wetlands were seen as the most immediate problem. Over-exploitation of fisheries resources and land-based sources of pollution were also considered significant issues requiring action.

In 1999 the governments, through the Co-ordinating Body for the Seas of East Asia endorsed a framework Strategic Action Programme that established targets and timeframes for action. In December 2000, the GEF Council approved this project with UNEP as the sole Implementing Agency operating through the Environmental Ministries in the seven participating countries and with over forty specialised Executing Agencies at national level directly engaged in the project activities.

Rate of Wetland Loss. It has been estimated that about 50% of wetlands have been lost worldwide since 1900. This has mostly occurred in the northern temperate zone, however, since the 1950s, tropical and subtropical wetlands especially swamp forests and mangroves have been rapidly disappearing (Stuip, *et al.*, 2002).

In Southern and Eastern Asia, wetland loss has been occurring for thousands of years. Lowland rice cultivation began in Southeast Asia about 6,500 years ago, and sophisticated drainage and irrigation systems had been developed in parts of the Middle East by the 4th millennium BC (Scott, 1993). Over the centuries, vast areas of wetland in Southern and Eastern Asia have been converted into rice fields or drained for agricultural use and human settlement. For example, no trace remains of the natural floodplain wetlands of the Red River delta in Vietnam, which originally covered 1.75 million hectares.

In China, during the period of 1966-1996, the total reclaimed area in the entire Pearl River delta was344km^2, which represents an average rate of 11.47 km^2 per year (China Wetland Report, 2003). It has been estimated that approximately 69% of the original mangrove forest area in the South China Sea was destroyed during the past century (Talaue-McManus, 2000). Logging and woodcutting affect about 30% of all wetlands sites in the Southeast Asian countries (ASEAN, 2001).

Dumping of waste in coastal wetland, Philippines

Agriculture is considered the principal cause for wetland loss worldwide. By 1985, it was estimated that 56%-65%, 27%, 6% and 2% of available wetlands in Europe and North America, Asia, South America and Africa, respectively, had been drained for agriculture (Stuip *et al.*, 2002). Scott (1993) quoted an overall wetland loss of 31%, 78%, and 22% in Indonesia, Philippines and Thailand, respectively. In their review, Immirzi *et al.* (1992) quoted peatland losses of 82%, for Thailand; 71% for West Malaysia; 18% for Indonesia; 13% for China; and, 11% in Sarawak in East Malaysia.

The Ramsar Site Database provides insight to the main threats to wetlands. In 1999, 84% of Ramsar-listed wetlands had undergone or were threatened by ecological change. The most widespread threats being drainage for agriculture, settlement and urbanization, pollution and hunting.

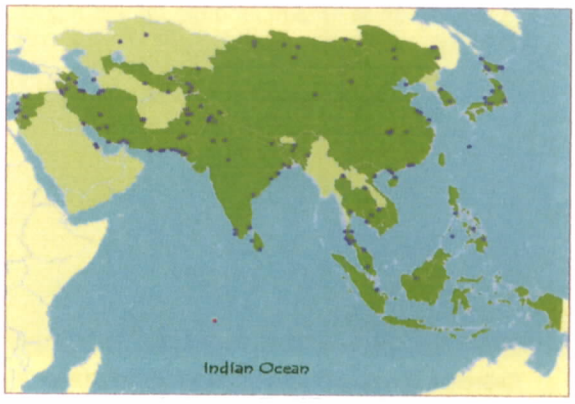
Global Importance of Wetlands in the South China Sea. The South China Sea is a strategic body of water, surrounded by nations that are currently at the helm of industrialization and rapid economic growth in the Asia-Pacific Region. It is bordered by China to the north; Philippines to the east; Malaysia, Singapore, Indonesia and Brunei to the south; and, Thailand, Cambodia and Vietnam to the west (Talaue-McManus, 2000).

The South China Sea has always been central to issues of economic and political stability in Southeast Asia and adjacent regions. Its richness in flora and fauna contributes to the area's high natural rates of primary and secondary production. Capture fisheries from the South China Sea contribute 10% of the world's total landed catch.

The South China Sea is a region of important interaction between extensive watershed areas and the marginal sea, where a large number of riverine systems discharge a globally significant and high volume of water and sediment into coastal waters.

About 40 marine protected areas have been established along the South China Sea coastline. Twelve wetlands sites, with a total area of 364,832 ha, have been designated as Ramsar sites around the South China Sea (Figure 1). The Ramsar sites bordering the South China Sea are Koh Kapik (Cambodia), Dongzhaigang (China), Huidong Harbor Sea Turtle National Nature Reserve (China), Mai Po Marshes and Inner Deep Bay (Hong Kong, China), Shankou Mangrove Nature Reserve (China), Zhanjiang Mangrove National Nature Reserve (China), Berbak National Park (Indonesia), Tasek Bera Peatswamp (Malaysia), Don Hoi Lot intertidal mudflats (Thailand), Thale Noi Wildlife Non-Hunting Area (Thailand), Phru To Daeng Peatswamp Wildlife Sanctuary (Thailand), and Xuan Thuy National Park (Viet Nam).

Figure 1 Distribution of Ramsar Sites in Asia.



Source: www.wetlands.org

WETLANDS DISTRIBUTION AND DIVERSITY IN THE SOUTH CHINA SEA

Southeast Asian countries have at least 334 wetland sites, with a total area of 192,363,601 ha, of which Indonesia has the greatest number, 129 sites scattered throughout the country (ASEAN, 2001). Along China's South China Sea coast, a total area of 15,333.35 hectares has been identified under the five types of wetlands with relevance to the UNEP/GEF South China Sea Project. These wetlands support local communities and habitats that are home to a variety of rare, endemic, endangered and threatened species of global significance.

Wetlands are dynamic and complex ecosystems. They exhibit enormous diversity in size and shape according to their origins and geographical location, their physical structure, as well as their chemical composition. The characteristics of the flora and fauna are largely defined by the water depth, current and intensity, underlying soil structure, sediment composition, and water temperature and, in coastal regions, influence of the tide. Levels of diversity vary between different wetland types--some exhibit high levels of diversity and endemism while others support little life.

Ecological Functions of Wetlands in the South China Sea. Wetlands are the ecotone and buffer zone for inland and marine habitats with great importance for their "ecological functions," that support economic activities of significant value. These ecological functions include regulation of water regimes; flood buffering and control; groundwater recharge and discharge; wind breaks and storm protection; shoreline stabilization and erosion control; retention of nutrients, sediments and contaminants; nutrient processing, provision of nutrient-rich and sheltered habitats, spawning and nursery areas for fish and aquatic organisms; retention of carbon dioxide and regulation of local and global climates.

Collection of molluscs from mudflats replanted with mangrove, Viet Nam

Khao Sam Roi Yot Marine National Park, Thailand

Coastal wetlands play a critical role in protecting coastal land from the influence of violent coastal weather by providing a buffer against storm surges and protecting coastlines from erosion. In Malaysia, it has been estimated that the economic gain is US$300,000 per kilometre from intact mangrove swamps for storm protection and flood control alone, which is the cost of replacing them with rock walls. This role of coastal wetlands may become even more important under conditions of changed climate over the next 50-100 years.

The UNEP/GEF South China Sea Project focuses its activities on five wetland types, namely: estuaries (including deltas), lagoons, intertidal mudflats, peat swamps, and non-peat swamps. Their functions, products and attributes are shown in Table 1.

Estuary. A wetland type where the river mouth widens into a marine ecosystem, the salinity of which is intermediate between salt and fresh water where tidal action is an important biophysical regulator.

Lagoon. A semi-enclosed coastal basin with limited freshwater input, high salinity and restricted circulation which often lies behind sand dunes, barrier islands or other protective features like coral reef of an atoll.

Intertidal mudflat. A wetland type that is usually an unvegetated area, dominated by muddy substrate.

Peat swamp. Under normal oxygen-rich conditions, dead plant matter decomposes eventually into carbon dioxide and water. When under low temperature, high acidity, low nutrient supply, water-logging, and oxygen deficient conditions, the process of decomposition is retarded and dead plant matter accumulates as peat.

Non-peat swamp. A wetland type having still water areas around lake margins, and in parts of floodplains such as oxbows, where the water rests for longer periods. Their precise characteristics vary according to geographical location and environment.

Table 1 Functions, Products and Attributes of Wetlands. (X = present; √ = common and important value)

	Estuaries	Lagoons	Intertidal Mudflats	Peatswamps	Non-peatswamps
Functions (Services)					
Groundwater recharge				X	X
Groundwater discharge	X	X		X	X
Flood control	X	X		X	√
Shoreline stabilization/ erosion control	X	X	X		
Sediment/toxicant retention	X	X	X	√	√
Nutrient retention	X	X	X	√	√
Biomass export	X	X	X		√
Storm protection	X				X
Water transport	X	X			
Recreation/tourism	X	X	X	X	X
Products					
Forest resources	√				X
Wildlife resources	√	X	X	X	X
Fisheries	√	X	X		X
Agricultural resources	X			X	
Water supply	X			X	X
Energy Resources				√	
Attributes					
Biological diversity	√	√	√	X	X
Uniqueness to culture/heritage	X	X	X	X	X

Source: Dugan, P.J. (eds) 1990

ENVIRONMENTAL IMPACTS CONSEQUENCES OF WETLAND LOSS

Causes of wetland loss. Wetlands have been lost or altered because of the disruption of natural processes by agricultural intensification, urbanization, pollution, water transfer, dam construction, and other forms of intervention in the ecological and hydrological systems.

Population growth remains high in the SCS countries (e.g. 2.6% in Cambodia and 1.7% in Vietnam, exceeding the East Asia/Pacific regional average of 1.6%). It is estimated that some 37% of the population in Vietnam, 36% in Cambodia, and 13% in Thailand live below the poverty line. These people in poverty are often those depending on wetland resources for their subsistence livelihoods. Wetland loss and degradation has led to loss of occupation and income.

Coastal pond development in Sembilang, Indonesia

Floods and storms. Loss of coastal wetlands and their ecological functions of storm and flood protection, and coastal erosion control leads to severe damage and loss of life and property among coastal communities. For example, between May and September 1994 Southeast Asia was devastated by 5 months of storms and floods that destroyed 220,000 houses in the Mekong Delta of Vietnam and caused major losses in the rice crop. Tropical storms battered and drenched southern China, Vietnam and Thailand during the period of June-November 1995.

In 2000, the Mekong River delta experienced the longest-lasting and most severe flooding to affect the area in 40 years. Floodwaters exceeded Alarm Level III (very dangerous flood conditions) and flooding was reported in Thailand, Cambodia and Laos (IRI Climate Digest, 2000). The floods affected almost 9 million people and killed 800. Damage was estimated at more than US$ 455 million. Without wetlands preventing such losses, investment in coastal and flood plain protection are required.

Erosion Prevention Dike in Ham Tien, Viet Nam

WETLAND LOSS AND DEGRADATION

Black Rivers. In 1979, 42 of the major rivers in Peninsular Malaysia were declared dead as a result of pollution, primarily from oil palm and rubber effluents, sewage and industrial wastes. These rivers no longer support fish, shellfish, or crustaceans, and are unfit for drinking or washing (Sababat Alam Malaysia – cited in Jayal, 1984; Dugan, 1990).

In the Philippines, the National Pollution Control Commission estimated that copper mining has severely polluted 14 rivers in Luzon, the Visayas, Palawan, and Marinduques. Where these rivers enter the sea, fishing yields have declined by 50% (Aditjondro, 1989 – cited in Dugan, 1990).

Wetland degradation. The following are further examples of wetland destruction or degradation and their economic, social or ecological consequences:

- In the Philippines, some 300,000 ha of the country's mangrove resources were lost in 60 years from 1920-1980, leading to a decline in marine fishery production.
- In Sumatra the average coastal fishpond produces 287 kg/ha/year of fish but the loss of one hectare of mangrove leads to a loss of approximately 480 kg/yr of offshore fish and shrimp.
- Local people of Samarinda (East Kalimantan) report that seawater formerly intruded upstream in the Makaham river as far as the town only in the very few years with a dry season of ten or eleven months. In 1991 saline water intruded upstream of Samarinda after only six months of the dry season. This had significant impact on agriculture, industry and the health of the community. It is believed that the salt-water intrusion was caused by decreased outflow from the lakes and rivers of the Makaham system as a result of extensive forestry clear felling in the catchment.
- In Malaysia and Indonesia, more than 1 and 3 million hectares of peatland respectively, have been converted into agricultural land. Such conversion destroys not only the developed peatland and its associated biodiversity but has flow-on effects on the remaining peatlands by enhancing drainage and loss from fire.
- An intensive eel aquaculture scheme has been set up in the South East Pahang Peat Swamp Forest on the east coast of Peninsular Malaysia. Huge quantities of groundwater have been extracted for the ponds, resulting in the drying up of wells used by local communities for their domestic needs.
- The Central plains of Thailand used to be swamp plains supporting populations of wetland dependent wildlife such as Schomburk's deer (*Cervus schomburgki*). Drainage of the plains for rice cultivation during the early 20th century destroyed most of the riverine wetlands and led to the extinction of the deer.
- Another consequence of wetland destruction is the increasing number of threatened species as seen from Table 2.

Within the framework of the UNEP/GEF South China Sea Project, 102 ecologically and socially important wetlands sites have been identified and characterized (Table 3). Among these, 58 wetland sites are already afforded some degree of protection.

Table 2 Numbers of globally threatened wetland Species in countries bordering the South China Sea. (Numbers in parentheses are species endemic to the country concerned)

	Mammals	Birds	Reptiles	Amphibians	Fishes	Invertebrates
Brunei	2-3	9-10	3-5	0	2 (1)	0
Cambodia	3	15-17	10-12	0	7	0
Indonesia	6 (1)	28-29 (8)	23 (3)	0	67 (54)	4 (2)
Malaysia	6-7 (2)	16-17	18-19	0	16 (10)	2 (1)
Philippines	1	16 (5)	7 (2)	26 (26)	30 (26)	4 (2)
Singapore	1-2	8	3-4	0	2	0
Thailand	5	22-29 (1)	17-20	0	19-20 (8)	1
Viet Nam	4	21-26	20-24	1 (1)	6	0

Table 3 Number and areas of important wetlands bordering the South China Sea.

	Cambodia	China	Indonesia	Malaysia	Philippines	Thailand	Viet Nam
No. of Wetlands Sites	3	6	40	9	16	13	15
Total Area (ha)	22,000	20,276	5,179,660	76,560	630,288	271,311	629,954
Range in Area (ha)	4500-13,000	218-12,783	7-1,000,000	348-35,750	420-193,195	140-65,000	16,000-160,000
No. of Sites with protection measures	1	6	24	4	12	6	5

COASTAL DEVELOPMENT AND WETLANDS LOSS IN CHINA'S PEARL RIVER DELTA

Since the late 1970s, the Pearl River Delta has been the fastest developing area in China, acting as an engine for the country's economic development. In the period 1978 to 1990, Guangdong's real gross domestic product (GDP) increased at an average annual rate of 12.3% while its real *per capita* GDP grew at 10.4%. Due to population increase, urbanization and industrialization, many wetlands in the Pearl River Delta have been destroyed and reclaimed for agriculture, aquaculture, and industrial or residential uses.

Large areas of wetlands have been exploited or converted for farming, or city expansion, resulting in the reduction of wetland area and decline of wetland functions. There were about 400,000 ha of mangrove in Guangdong in the 1950's, however, only 147,000 ha was left in the 1990s. The rate of mangrove loss has been especially high since the 1980s. A total of 7,911.2 ha of mangrove have been destroyed or occupied since 1980, most of which has been converted to aquaculture ponds (7,767.5 ha); reclaimed for construction projects (139.4ha), or converted to salt pans (5.3 ha). From 1966 to 1996, the total reclaimed area in the entire Pearl River delta is 344 km^2, an average annual rate of 11 km^2 yr^{-1} of reclamation, much greater than that experienced during recent historical times.

Wetland degradation and loss have resulted in the disappearance of coastal vegetation, reducing the effectiveness of coastal protection from typhoon winds and flood. In September 2003, Typhoon Dujuan, the strongest storm to hit the Pearl River delta since 1979, killed 38 people, injured more than 1,000 and up-rooted 30% of all trees in the area. The direct economic losses were estimated at US$ 242 million and the severe impacts of this typhoon can be partly attributed to the loss of natural coastal protection: coastal wetlands.

Guizhu Chen, China Wetland Focal Point

STATE OF WETLANDS AND PRESENT THREATS

The view that wetlands are wastelands, results from ignorance and misunderstanding of the value of the goods and services provided by wetlands, and has resulted in their conversion to intensive agricultural, industrial or residential uses. Driven by short-term economic gains and encouraged by government development policies, large coastal development projects, along with scattered individual excessive or inappropriate utilization of wetlands has contributed to the rapid loss and degradation of wetlands bordering the South China Sea.

Population growth and increasing demand for economic development place tremendous pressure on wetland ecosystems. The loss and degradation of coastal wetlands bordering the South China may trigger serious and long-term ecological, and socio-economic consequences. For example loss of coastal mangrove swamps in Viet Nam has resulted in increasingly severe coastal erosion, affecting, for example, at least 20% of Viet Nam's coastline, leading to the loss of agricultural land and even entire villages.

Major threats which are common to wetlands of all countries bordering the South China Sea include over-exploitation through over-fishing resulting in declining fish productivity; alteration of the hydrological regimes, through draining and wetland reclamation schemes; conversion to other use such as agriculture or urban expansion, aquaculture, agriculture, construction of coastal roads, and physical barriers for coastal protection against erosion.

Coastal wetlands continuously receive water, sediment, nutrient and contaminants via inflows from the inland catchment areas. Land-based pollution from industries, tourism, urban areas, agriculture, and aquaculture have impacts on noteworthy fauna, and reduce the value of the benefits and services derived from estuaries, mudflats, and other coastal wetlands. In the context of climate variability and change, the projected sea level rise and increases in storm surges are likely to affect coastal wetlands significantly. Such changes may cause substantial ecological, and economic losses.

Mui Ne Fishing Port, Viet Nam

Many wetlands bordering the South China Sea are protected as, national parks, wildlife sanctuary, wildlife non-hunting areas, and nature reserves. Many of them however, are not well managed and the lack of appropriate and efficient management and unsustainable use remain threats to wetlands in all countries.

USE AND VALUE OF WETLANDS BORDERING THE SOUTH CHINA SEA

The dependency of people on the coastal areas of the South China Sea can be shown by the high proportion of the total population living within 100 km of the coast: Cambodia, 24%; Indonesia, 96%; Malaysia, 98%; Philippines, 100%; Thailand, 39%; and Viet Nam, 83% (ASEAN, 2001). Whatever type of wetland, their processes are based on the interaction of the basic components of the natural system, the physical and chemical components including soil, and water, together with the biological components, the plants and animals. It is the wetland processes that generate the products, services and attributes that are valued by humans.

Values are realized when people decide that something is important to them. Human interactions with the environment are diverse and so there are many specific values that are applicable to individual sites and to different stakeholder groups. These can be categorized according to the principal types of use and non-use values.

Direct or extractive use values. The most tangible values, relating to the products and materials that can be derived from the wetland, such as food, and fibre.

Indirect or non-extractive use values. May be seen as the value of wetlands for recreational use, for tourism, or for research.

Service values. Reflect the services wetlands provide for flood control, or as a windbreak.

Existence value. The most difficult to determine, such values reflect the intrinsic value of individual species and systems.

Harvesting of mollusc *Solen regularis* at Don Hoi Lot, Thailand

Don Hoi Lot Inter-tidal Mudflats on the Gulf of Thailand is the only major productive area of *Solen regularis*, an economic, endemic mollusc species, which, unique to Thailand and to the region, is an important source of fisheries production, occupation and income. *Solen regularis* is harvested by 200-300 mollusc harvesters at 1,360-3,025 kg/day and sold at US$2.5/kg of fresh flesh. The site is famous and well-known as an attractive tourist destination. Attractions include the natural environment, traditional fisheries and fishing technologies, seafood and fishery products.

Harvesting the edible seaweed *Gracilaria tenuistipitata* var. *liui* in Shantou, China

Wetlands are of significant importance to subsistence communities in the South China Sea. For generations, a large proportion of the population of the South China Sea coastal area has depended on wetland ecosystems and their products for direct use, and as sources of trade goods and for cash income (see box on page 9).

The countries bordering the South China Sea are significant producers and consumers of captured and cultivated fish. In the coastal areas of the seven participating countries, the marine capture fisheries and culture production account for 8.2% and 54% respectively of the total world production. Globally, two thirds of all fish consumed are dependent on coastal wetlands at some stage in their life cycle.

Marine fishery aquaculture is mainly conducted in wetlands or areas associated with wetlands. Southeast Asia is the global centre of marine aquaculture. In 1994, six of the seven countries participating in this project accounted for 61% of shrimp imports by Japan, and 6 of the ten top shrimp producing countries border the South China Sea. This dominant role has grown rather than declined in recent years and the internal market within the region has also grown significantly as economic growth has lead to increasing levels of disposable income.

On average, people in ASEAN countries consume about 20 kg of fish *per capita* per year, which provides nearly half of their animal protein intake. The figure can be much higher in some low-income countries. For example, in Cambodia, fish and fish products are the single most important sources of protein, for the Cambodian population, representing 75% of the animal protein intake.

COMMUNITY LIVELIHOOD IN THALE NOI WILDLIFE NON-HUNTING AREA OF THAILAND

Thale Noi Wildlife Non-Hunting area, is a very important wetland site in the south of Thailand, covering approximately 45,700 hectares. It includes various ecosystems, a freshwater lake, swamp forests, inundated grassland, reed swamps and paddy fields. Phru Khuan Khi Sian, a permanently inundated swamp with *Melaleuca cajeputi,* and dense stands of *Cyperus imbricus*, *Scirpus mucronatus* and *Eleocharis dulcis* is a designated Ramsar site. This wetland is the nesting site of waterbirds such as the little cormorant, purple heron, cattle egret, little egret and black-crowed night-heron and provides important habitats to over 187 species of waterfowl. The area is also used by large groups of birds, estimated at over 10,000 individuals during the migratory season.

There are fifty villages in the wildlife non-hunting area, with 7,813 households and 37,662 individuals. Most of the population depends on farming for a living. Benefits of Thale Noi to local populations include its role as a transport route, for recreation and for fishing. The area also provides timber for household usage, reeds for handicraft, feed for livestock and sources of protein, including edible birds, reptiles and amphibians. The resident communities have depended on this wetland for resources to generate cash income. Of the households resident in the area, 4,771 households are engaged in rice farming, 1,073 households in rubber plantation, 1,579 households in reed harvesting, 2,894 households in handicraft production, and 41 households in tourist activities. The average annual income from reed harvesting and handicraft production is estimated at US$525.09 and US$462.67 per household, respectively (Office of Environmental Policy and Planning, 1999).

Narong Veeravaitaya, Thailand Wetland Focal Point

PURPOSE OF THE DEMONSTRATION SITES

As stated in previous sections, the coastal wetlands of the South China Sea have been suffering from serious degradation and rapid rates of loss over the recent past. Due to limited available financial resources, it is not possible to fund activities at all wetlands sites under severe threat. Sites therefore, should be selected with care according to agreed priorities in order to maximize the environmental and socio-economic benefits of the investment.

The primary goal of the demonstration sites within the context of the habitat component of this Project is to "demonstrate" actions that, either of themselves, "reverse" environmental degradation or, will demonstrate methods of reducing degradation trends if adopted and applied at a wider scale. Demonstration sites could be sites where actions are directed towards:

- Maintaining existing biodiversity; or,
- Restoring degraded biodiversity to former levels; or,
- Attempting to remove or reduce the cause, and hence reduce the existing rates of degradation; or,
- Attempting preventive actions that halt the adoption of unsustainable patterns of use, before it commence.

In the context of this Project, the demonstration site proposals need not only to consider the goals and purposes of the sites themselves but also what is being demonstrated, to whom is it being demonstrated, and how is it being demonstrated.
An initial consideration of **what** is to be demonstrated leads to three types of potential demonstration site:

- *function related sites* which might include existing sites that demonstrate sustainable use for specific purpose;
- *process related sites* which might include existing sites that demonstrate innovative management interventions and/or regimes at the site level;
- *problem related sites*, which might demonstrate new modes of managing specific problems or causes of environmental degradation.

Whilst all the participating countries have identified national priority wetlands for conservation action and sustainable management the determination of national priority has rarely included a consideration of transboundary, regional or global considerations, beyond the inclusion of their status or potential status under the RAMSAR Convention as one criterion amongst many. Since the present project takes a regional approach to intervention it was necessary to develop a process by which regional as opposed to national priority could be determined in as objective a manner as possible.

PROCESS OF SELECTING DEMONSTRATION SITES

The Project has undertaken a transparent, scientific and objective regional procedure to rank and select demonstration sites based on environmental and socio-economic criteria and indicators discussed and agreed at the regional level. To achieve maximum impact from a limited number of interventions, the Project Steering Committee adopted a three-step regional procedure to prioritise and select demonstration sites.

Full details of this procedure are contained in the reports of the Regional Working Group (RWG-W) meetings (UNEP, 2002a; 2002b; 2003a; in press) but it may be outlined as follows:

- Step 1. A cluster analysis was conducted to review the similarities and differences of all proposed sites, using data and information assembled at the national level that described the physical and biological characteristics of the systems under consideration. This analysis was used to group sites of high degrees of similarity within which priority could be determined.
- Step 2. The Regional Working Group on Wetlands developed a set of criteria and indicators with an associated numerical scoring system, encompassing environmental and socio-economic characteristics;
- Step 3. The proposed sites were scored according to the agreed system and ranked within each cluster. Rank order was considered to represent regional priority.

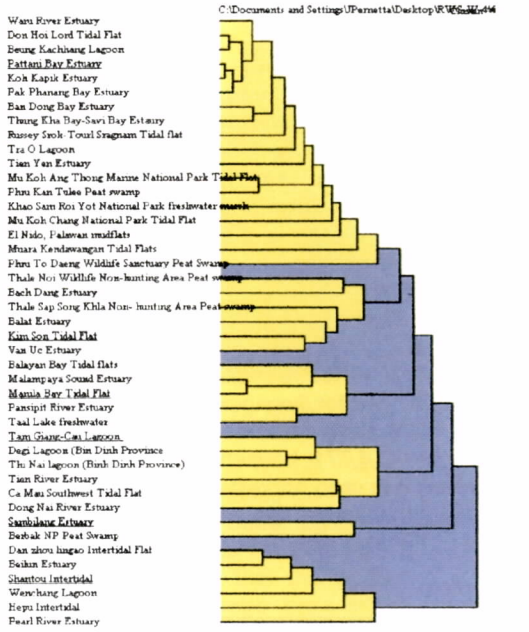
Site Characterization. The collection of data and information at the national level is critical and formed the fundamental basis for initiating the regional comparison. To ensure data compatibility and comparability, the Regional Scientific and Technical Committee (RSTC) provided initial guidance to the working groups on assembling regional level data and information; developing site characterisations; and commencing the process of prioritising or ranking sites. A total of forty-three sites were fully characterised and included in the raw data set for cluster analysis and prioritisation.

Cluster Analysis. To maximize the range of biological diversity covered by a limited number of demonstration sites, selected sites should represent the greatest range of conditions represented in the region as possible. The Clustan Graphic6 software programme was used to conduct the cluster analysis, the results of which are shown in Figure 2.

The RWG-W noted that the number of sites was not evenly distributed among the six clusters in the cluster analysis; the first cluster having many more sites (17) than any other cluster. It was decided therefore that three major groups should be considered, with the second and third clusters being grouped as one, and the fourth, fifth, and sixth groups being combined as a third cluster.

Site Prioritisation and Ranking. Two sets of indicators with assigned scores were developed and agreed by the RWG-W; environmental and biological criteria and indicators; and socio-economic criteria and indicators. Environmental criteria included specific measures of biological diversity, transboundary significance and regional/global significance. Criteria and indicators included area, number of fish, bird, plant, and mammal species, number of wetland types, number of migratory species, number of endemic species and number of endangered species. Priority for development of demonstration site proposals was based on the total score and assigned to sites with higher ranking in each of the identified groups of sites.

Figure 2 Results of Cluster Analysis of Wetlands Sites.



It was agreed to use socio-economic indicators in ranking of those sites with proposals. The socio-economic indicators include threats, national significance, financial considerations and level of local stakeholder involvement. reversibility of threats, national priority, level of stakeholder direct involvement in management, potential for co-financing The scoring system developed for the socio-economic characteristics indicates a stronger weight for a site with stronger commitment from the government and other stakeholders, in terms of co-financing and level of involvement.

Final rank scores for an individual site were determined using a combination of the environmental and socio-economic criteria and indicators in a 7:3 ratio. The combined scores and final ranking are presented in Table 4.

Table 4 Ranking Proposed Demonstration Sites.

	Environ. Score	Socio-econ Score	Weighted Total
Cluster 1			
Vietnam Tra O Lagoon	46	62	51
Cambodia Koh Kapik	26	69	39
Cambodia Beung Kachhang	15	50	26
Cluster 2			
Vietnam Balat Estuary	68	90	75
Thale Noi Non-hunting Area	56	70	60
Malampaya Sound	46	76	55
Pansipit River	42	66	49
Cluster 3			
China Pearl River	94	82	90
China Shantou	80	72	78
China Hepu	86	48	75
Vietnam Ca Mau	69	67	68

REFERENCES

Aditjondro, G. 1989. Irian Jaya: Copper Mining Boom Endangers River Systems. *World Rivers Review* 4: 8.

ASEAN. 2001. *Second ASEAN State of Environment Report 2000.* Jakarta: ASEAN Secretariat.

Chan, S., Benstead, P., Davies, J. and Grubh, R. 2001. *The Wetland Management Handbook for South East Asia*. Ministry of the Environment, Japan.

Davies, J. and Claridge, C.F. (eds.) 1993. *Wetland Benefits, The Potential for Wetlands Support and Maintain Development.* Asian Wetland Bureau Publications No. 87. IWRB Special Publication No. 27. Wetlands for the Americas Publication No. 11.

Dugan, P.J. (ed.). 1990. *Wetland Conservation: A Review of Current Issues and Required Action.* IUCN, Gland, Switzerland.

International Research Institute for Climate Change (IRI). 2000. *IRI Climate Change Information Digest September 2000* (http://iri.Columbia.edu/climate/cid/) accessed 12 January 2004.

Immirzi, C.P. et al. 1992. *The Global Status of Peatlands and their Role in Carbon Cycling.* Department of Geography. University of Exeter. Friends of the Earth. London.

Jayal, N.D. 1984. *Destruction of Water Resources – the Most Critical Ecological Crisis of East Asia.* Paper presented at the 16th IUCN General Assembly, 5-14 November 1984. Madrid, Spain.

Mitsch, W.J. and Gosselink, J.G. 2000. *Wetlands.* 3rd edition. John Wiley & Sons. http://www.ramsar.org

Moser, M., Prentice, C. and Frazier, S. 1996. *A Global Overview of Wetland Loss and Degradation.* 6th Meeting of the Conference of the Contracting Parties to the Ramsar Convention in Brisbane, Australia.

Office of Environmental Policy and Planning. 1999. *The Conservation and Protection of the Important Wetland namely Thale Noi Non-Hunting Area, Phatthalung Province*. Bangkok, Thailand.

Ramsar Convention Bureau. 1971. *Convention on Wetlands of International Importance especially as Waterfowl Habitats*. Gland, Switzerland.

Ramsar Convention Bureau. 1996. *Wetlands and Biodiversity.* 3rd Meeting of the Conference of the Parties to the Convention on Biological Diversity in Buenos Aires, Argentina.

Ramsar Convention Bureau. 2000. *Wetlands Values and Functions.* Gland, Switzerland.

Scott, D.A. (ed) 1993. *Wetland inventories and assessment of wetland loss: a global overview.* Proceeding of the IWRB Symposium St. Petersburg, Florida, November 1992. IWRB Special Publication 26.

Stuip, M.A.M., Baker, C.J. and Oosterberg, W. 2002. *The Socio-economics of Wetlands.* Wetlands International and RIZA, The Netherlands.

Talaue-McManus, L. 2000. *Transboundary Diagnostic Analysis for the South China Sea.* EAS/RCU Technical Report Series No. 14. UNEP, Bangkok, Thailand.

UNEP/GEF South China Sea Project. 2003. *National Reports from Wetland Subcomponent.* UNEP, Bangkok, Thailand.

UNEP, 2002a. First Meeting of the Regional Working Group for the Wetland Sub-component of the UNEP/GEF Project *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand".* UNEP/GEF/SCS/RWG-W.1/3. 44 pp In: UNEP, *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand"*, report of the First Meetings of the Regional Working Groups on Marine Habitats. 179 pp. UNEP, Bangkok, Thailand.

UNEP, 2002b. Second Meeting of the Regional Working Group for the Wetland Sub-component of the UNEP/GEF Project *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand".* Report of the meeting, UNEP/GEF/SCS/RWG-W.2/3. 25 pp. In: UNEP, Report of the Second Meetings of the Regional Working Groups on Mangrove & Wetlands. UNEP, Bangkok, Thailand.

UNEP, 2002b. Third Meeting of the Regional Working Group for the Wetland Sub-component of the UNEP/GEF Project *"Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand".* Report of the meeting, UNEP/GEF/SCS/RWG-W.2/3. 38 pp. UNEP, Bangkok, Thailand.

WCMC. 1992. Global Biodiversity. in Moser, M., Prentice, C. and Frazier, S. 1996. *A Global Overview of Wetland Loss and Degradation.* 6th Meeting of the Conference of the Contracting Parties to the Ramsar Convention in Brisbane, Australia.

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