



***“Reversing Environmental Degradation Trends
in the South China Sea and Gulf of Thailand”***

**NATIONAL REPORTS
on
Wetlands in the South China Sea**



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



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UNEP/GEF
Project Co-ordinating Unit,
United Nations Environment Programme,
UN Building, 2nd Floor, Block B, Rajdamnern Avenue,
Bangkok 10200, Thailand.
Tel. +66 2 288 1886
Fax. +66 2 288 1094
<http://www.unepscs.org>

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Cover Photo: A vast coastal estuary in Koh Kong Province of Cambodia, by Mr. Koch Savath.

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**NATIONAL REPORTS
on
Wetlands in the South China Sea**



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NATIONAL REPORT

on

Wetlands in the South China Sea

CAMBODIA



Mr. Koch Savath

Focal Point for Wetlands

Department of Nature Conservation and Protection, Ministry of Environment

48 Samdech Preah Sihanouk

Tonle Bassac, Chamkarmon, Phnom Penh, Cambodia

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1. INTRODUCTION

The Kingdom of Cambodia is rich in wetland environments. Over 30 percent of the country is considered wetlands (according to the wetlands inventory and management project). Following internationally accepted criteria for wetland identification (defined by the Ramsar Convention) over 20 percent (36,500km²) of the country may be classified as wetlands of international importance. This represents over 5 percent of Asia's total area of wetlands of international importance.

Wetland areas support rice and fish production – the primary sources of food for the vast majority of the population and currently Cambodia's most economically productive sectors. Fish and fish products are the single most important sources of protein for the Cambodian population, representing 75 percent of the animal protein intake. Wetlands provide nutrient-rich and sheltered habitats for fish (breeding, spawning and nursery areas or habitats for adults) and therefore they play a central role in the supply of animal protein in Cambodia. Agriculture is supported by water from wetlands. Wetland water may be stored for use in the dry season or withdrawn for irrigation purposes. Other economic activities utilising wetland resources include aquaculture, tourism, inland transport, and energy (hydro-electricity).

Wetlands serve a wide variety of ecological functions that support economic activities or are of economic value. In addition to supporting agriculture and fisheries, they play a vital role in maintaining the water cycle and protecting inland areas from flooding. Coastal wetlands act as barriers against storm surges and protect the coastline from erosion. Many wetlands are important as filtering systems – cleaning up polluted water and removing silt, encouraging plant growth, and further improving water quality. Cambodia's wetlands are important sanctuaries for birds and other species of wildlife not commonly found in other countries in the world. They are also important for research and educational purposes.

2. COASTAL WETLAND ECOSYSTEM

The Cambodian coastline extends along 435km of some of the least populated areas in all of tropical Asia. The coastal region features a number of closely interrelated ecosystems, embracing beach forest and strand vegetation, mangroves (including a *Melaleuca* dominated swamp forest referred to as "rear mangrove," estuarine ecosystems, seagrass, coral reef and the unstudied marine ecosystems of the gently sloping, relatively shallow seabed (only 80 metres of water depth at the outer limit of the 200 nautical mile Executive Economical Zone), and of the water column above.

Estuaries are semi-enclosed bodies of water that are connected to the sea and in which salt water is diluted by fresh water from land drainage. Estuaries are often highly productive areas due to the nutrients they receive from the land and the sheltered environments that they provide.

The major estuarine areas in Cambodia occur in the region around Koh Kong Province and near Kampot province. The Stung Koh Pao and Stung Kep estuaries are recognised as wetlands of international significance. Both rivers originate in the Cardamom range and discharge their flow into Koh Kong Bay. The Bay is protected from southwest storms by the large island of Koh Kong. The estuarine system is "a complex of channels and creeks, low islands, mangrove swamps, tidal mudflats and coastal lagoons."

Mudflats occurs when sediment settles out of the water due to a decrease in current and/or wave action. Mudflats are often associated with estuaries, but also occur in low-energy, coastal environments, such as in large bays or in the lees of islands. They are commonly continuous with mangrove areas. Mudflats can be very productive system as a result of nutrients recycling through the sediments. Typically there are high diversities of invertebrates living in and on the mud, and as a result, the mudflats provide rich feeding grounds for vertebrates such as fish and waterbirds.

Mudflats adjacent to the mangroves and in natural mangrove streams are exploited for cockles, although this is generally an unrewarding activity practiced only by those with no alternative form of income.

The productivity of estuaries and mudflats is threatened by pollution from a range of sources, e.g., construction activities outside mudflats can have adverse effects by causing the inflow of water, which either erodes the mudflats or prevents further deposition. The location, extent, and significance of mudflat areas in Cambodia have not been adequately studied.

3. CURRENT WETLAND SYSTEMS

3.1 Wetland Classification System

In the Cambodian Wetlands Inventory, for a site to be classified as a wetland, it must meet one of the following criteria:

- Plants able to tolerate inundation by water for a period of greater than six weeks (hydrophilic plants);
- Soils are classified as hydric soils; and
- The area is inundated by water for a period on an annual and periodic basis (see below for further explanation).

A system for the classification of wetlands has been developed for Cambodia since 2000. This system provides for the classification of wetlands based on a number of functional characteristics. These characteristics allow for the classification into systems, categories, sub-categories, and modifiers that describe the wetland sites (Figure 1). This classification system proposes to describe the important characteristics of particular wetland sites. It considers the wetlands in terms of water regime, substrate, vegetation type, etc. In combination, these definable characteristics should be able to provide a clear categorisation of each wetland type.

This system can be called a "Hierarchical approach" to the classification of wetlands. This is a process to evaluate a particular set of characteristics through a series of levels related to the characteristics of each particular site. At each step of this process more detailed information is gathered to refine the description of the area. At the end of this process, the unique characteristics to identify the wetland habitat will have been identified.

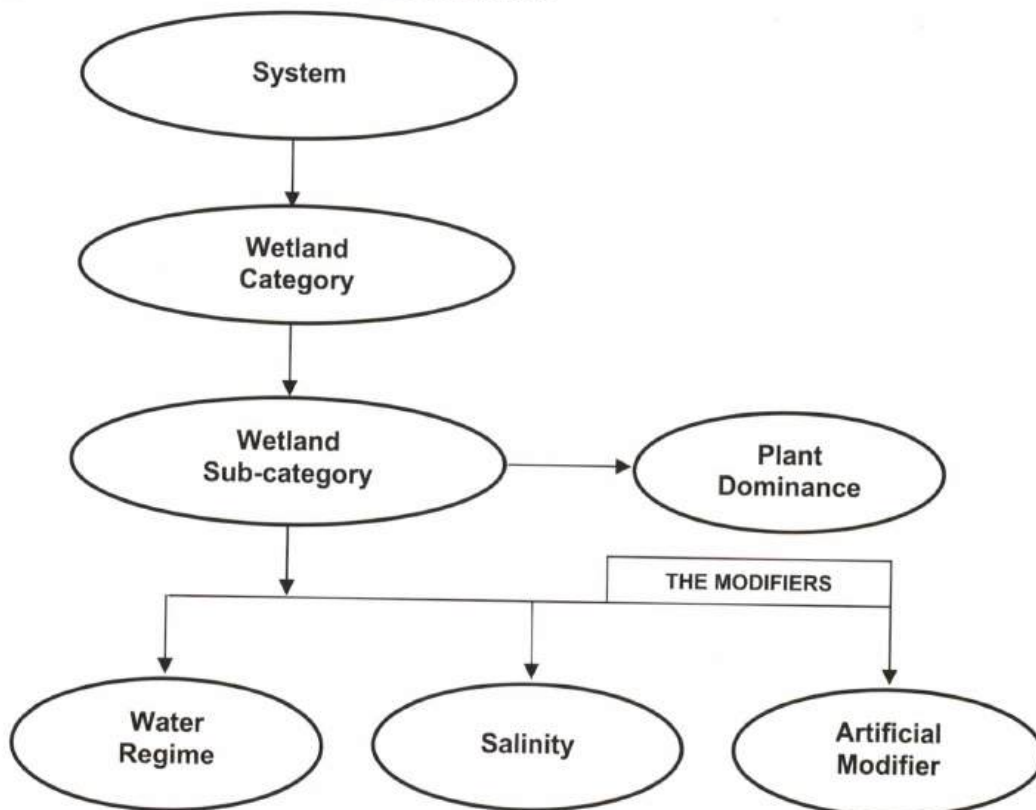


Figure 1 System for the Classification of Wetlands.

The first level of classification is the system. The system level allows for the classification of wetland habitats into broad functional ecosystems. The system is classified into Saltwater Wetland Systems and Freshwater Wetland Systems. Saltwater Wetland Systems are classified into Marine and Estuarine. Freshwater Wetland Systems are classified into Riverine, Lacustrine and Palustrine. Figure 2 represents the classification of the wetland system of Cambodia.

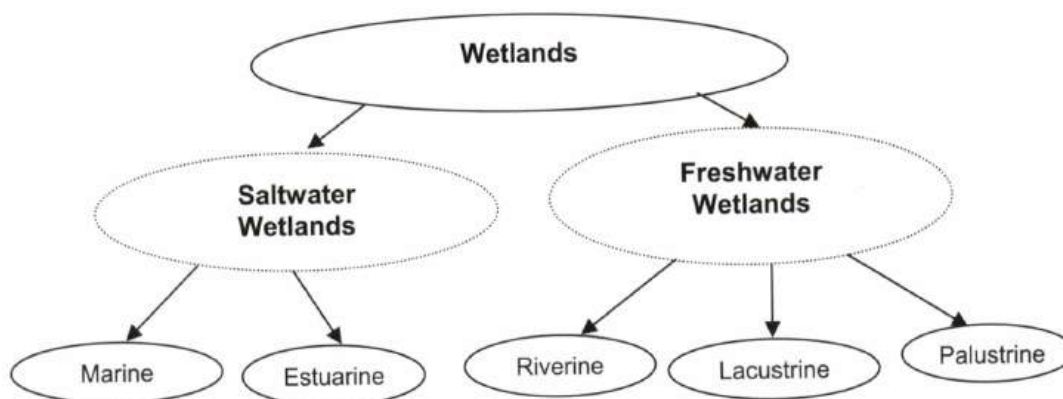


Figure 2 Description of the Classification of Wetland Systems.

3.2 Coastal Wetland Types

3.2.1 Marshes

Marshes have a number of specific characteristics: they are usually dominated by reeds, rushes, grasses and sedges. These plants are commonly referred to as emergents since they grow with their stems partly in and partly out of the water. Marshes are sustained by water sources other than direct rainfall. They can vary a lot in response to often-subtle hydrological and chemical differences. Marshes include some of the most productive ecosystems in the world.

Dominant plants in most freshwater marshes include species of reeds (*Phragmites*; traing), bulrush (*Typha*), club rush (*Scirpus*; kok), spike rushes (*Eleocharis*) and grasses such as paragrass (*Brachiaria mutica*; smau barang). In Cambodia a good example of a marsh can be found close to Phnom Penh in the Bassac marshes, which is an area between the Mekong and Bassac Rivers that floods very year.

3.2.2 Swamps

Swamps are often confused with marshes. They are, however, very different. Swamps generally have saturated soil or are flooded for most, if not all of the growing season. They are often dominated by a single emergent herb species or are forested (e.g., the Plain of Reeds in the Mekong Delta). The Tonle Sap lake, for example, was until recently surrounded by a belt of freshwater swamp forest (the flooded forest).

According to a study by the Mekong Secretariat in 1991, there are 1.2 million ha of grassland and other swampy areas associated with the flooded forests in Cambodia (MRC, 1997).

3.2.3 Peatlands

Peat is formed when decomposition fails to keep up with the production of organic matter. This is a result of water logging, a lack of oxygen or of nutrients, high acidity or low temperatures. Peat can be found in many types of wetland, including floodplains and coastal wetlands such as mangroves. Where the peat deposits are deeper than 300 to 400mm, they create a variety of distinctive wetland ecosystem such as bogs and fens.

- **Bogs** from where a high water table, fed directly by rain, results in waterlogged soil with reduced levels of oxygen. Rainfall leaches out nutrients in the soil, and the slow fermentation of organic matter produces acids. Bogs are characterised by acid loving vegetation, including mosses. Sphagnum bog mosses are likely sponges and can hold more than ten times their dry weight of water. Bogs are not very common in Cambodia, but some have been reported from Bokor.
- **Fens** are fed by ground water rather than by rain. They produce wetlands higher in nutrient content than bogs, but still able to accumulate peat. The combination of more nutrients and low acidity results in very different vegetation, often a species rich cover of reeds, sedges and herbs.

3.3 Internationally Significant Wetland Sites

Totally, 29 wetland sites were identified as significant habitats, or internationally important sites for migratory birds. These sites have been classified into freshwater, brackish or marine wetlands. The identification of these wetlands are based on the criteria of size, habitat, biodiversity richness, distribution of species and cultural, landscape, and recreational values.

3.3.1 Brackish Water Wetland Sites

These types of coastal wetlands are located on the coastal plain and are linked to the sea. The water component seasonally changes into brackish during the rainy season and saline during the dry season. The main vegetation types in these wetlands are mangroves and rear mangroves, which support reptiles, small mammals, and aquatic species. There are two brackish water wetland sites:

(1) Stung Metoek Mangrove and Creek System

Co-ordination:	11° 32' 00" – 11° 51' 00" N 102° 51' 00" – 103° 06' 00" E
Location:	About 1km north of Koh Kong Provincial town
Total Area:	22,500ha - Water surface: 10,000ha - Marshes: 12,500ha
Altitude:	Average: 116.6m Maximum: 153m
Wetland Types:	Mangrove, creek systems, rear mangrove and shrimp ponds
Soil Types:	Coastal complex

(2) Prek Piphot Creek System and Swamp Mangroves

Co-ordination:	11° 04' 30" – 11° 19' 00" N 103° 18' 30" – 103° 36' 30" E
Location:	10km north of Sre Ambel, Koh Kong Province
Total Area:	21,250ha - Water surface: 12,750ha - Marshes: 85,000ha
Altitude:	Average: 62m Maximum: 262m
Wetland Types:	Mangrove, creek systems, mud, sand and a little rear mangrove
Soil Types:	Acid lithosol and alumisol

3.3.2 Marine Wetland Sites

Marine wetlands are located in coastal areas similar to the brackish wetlands, however the water regime is permanent although the water table can move with the start of the rainy season.

Six sites have been identified as internationally important habitats for migratory birds or marine aquatic species:

(1) Kampong Trach Marshes and Salt Ponds

Co-ordination:	10° 24' 30" – 10° 33' 30" N 104° 24' 00" – 104° 36' 00" E
Location:	About 2 km east of Kep town
Total Area:	7,500ha - Water surface: 2,500ha - Marshes: 15,000ha
Altitude:	Average: 89.7m Maximum: 144m
Wetland Types:	Salt ponds, marshes, mangrove swamps, sand and seagrass
Soil Types:	Coastal complex

(2) Prek Kampong Bay, Creek System, Mangrove and Marshes

Co-ordination: 10° 30' 00" – 10° 41' 00" N
104° 08' 30" – 104° 18' 00" E

Location: Kampot Provincial town

Total Area: 16,250ha
- Water surface: 7,500ha
- Marshes: 8,800ha

Altitude: Average: 94m
Maximum: 351m

Wetland Types: Mangrove, swamps, sand and creek systems

Soil Types: Coastal complex and red-yellow podzol

(3) Prek Toek Sap Creek System, Mangrove and Marshes

Co-ordination: 10° 24' 00" – 10° 37' 30" N
103° 40' 00" – 103° 59' 00" E

Location: 15km east of Ream Navy Base, Sihanoukville

Total Area: 21,250ha
- Water surface: 12,250ha
- Marshes: 8,750ha

Altitude: Average: 328m
Maximum: 564m

Wetland Types: Mangrove, creek systems, coral reef, seagrass and rear mangrove

Soil Types: Acid lithosol and red-yellow podzol

(4) Chhok Veal Rin

Co-ordination: 11° 05' 00" – 11° 15' 00" N
103° 47' 30" – 103° 58' 30" E

Location: 170km southwest of Phnom Penh

Total Area: 14,900ha
- Water surface: n/a
- Marshes: n/a

Altitude: Average: 3m
Maximum: 5m

Wetland Types: Mangrove, marshes, rear mangrove and rice fields

Soil Types: Peat, mud and sand

(5) Koh Kapik Ramsar Site

Co-ordination: 11° 24' 00" – 11° 32' 00" N
102° 59' 10" – 103° 09' 45" E

Location: Koh Kong Province

Total Area: 12,000ha
- Water surface: n/a
- Marshes: n/a

Altitude: Average: 3.3m
Maximum: 5m

Wetland Types: Estuary, mangrove, creek and tidal mudflats

Soil Types: Mud, sand and peat

(6) Prek Kampong Som Mangrove, Swamp and Marshes

Co-ordination: 11° 01' 30" – 11° 09' 00" N
103° 37' 30" – 103° 45' 15" E

Location: About 52.5km north of Sihanouk Ville

Total Area: 10,800ha
- Water surface: 3,300ha
- Marshes: 7,500ha

Altitude: Average: 2.5m
Maximum: 10m

Wetland Types: Mangrove, swamps, marshes and rice fields

Soil Types: Mud, sand and brown soil

4. WETLAND RESOURCES AND ECONOMIC VALUATION

4.1 Coastal Wetland Resources

There is a 435km-long strip of coastal wetlands stretching from the border with Thailand eastwards to the border with Viet Nam. Several areas of mangrove and *Melaleuca* forest are of potential international importance. In addition, there is one large estuarine system with about 16,000ha of mangrove forest near Koh Kong in the north. Smaller areas of mangrove are found along the shores of the Veal Renh and Kampong Som Bays. It may be assumed that over 20 percent of Cambodia is one or another type of wetland.

Some areas, such as Prek Kaoh Pao, are formed mainly by two communities, namely: mangrove and *melaleuca*. In most places, the mangrove fringe is narrow, but contains a variety of species. Many epiphytes including orchids and *Asplenium nidens* are found in mangrove forest. Immediately behind the mangrove fringe, *Melaleuca* occurs, either as a monoculture or in a mixed assemblage. This assemblage has often been called the rear mangrove formation. *Melaleuca* occurs above tidal influence at an elevation around two metres above sea level, where there is the possibility of seasonal freshwater inundation. The monoculture is due to repeated burning. The mixed assemblage consists of *Melaleuca* with *licualaspinosa*, *Pandanus*, *Acrosthicum aureum*, *A. speciosum*, *Hibiscus tiliaceus*, *Xylocarpus granatum*, *Heritiera littoralis*, and *Phoenix paludosa*. However, some areas, such as Koh Kapik, are formed by three main communities, namely: Mangrove forest, *Melaleuca* forest, and Beach strand vegetation. Beach strand vegetation is dominated by *Casuarina equisetifolia*.

The coastal zone is composed of alluvial islands, river estuaries, creeks, sand flats, rivers with brackish water influence, rivers with tidal influence, mixed *Melaleuca* woodland, freshwater-influenced mangrove, mangrove and *Melaleuca*, shrimp ponds, and mudflats. The catchments are comprised mainly of the southern slopes of the Cardamom Mountains, which are mainly forested.

Mangrove: Most of the mangrove communities are characterised by areas that are inundated only at some high tides, and where there is a large degree of freshwater influence. The islands and creeks are typically fronted by *Rhizophora apiculata*, one of the most common of the mangrove species present, and stands of *Nypa fruticans*. Immediately behind this fairly narrow strip of *Rhizophora* there is an interesting mixture of other mangrove species, of which the following are most common: *Brugiera gymnorhiza*, *B. sexangula*, *Ceriops tagal*, *Lumnitzera littorea*, *Heritiera littoralis*, *Xylocarpus granatum*, *Hibiscus tiliaceus*, *Phoenix paludosa*, *Acrosthicum speciosum*, *Aegialitis* sp., and *Acanthus* sp. *Avicennia* and *Sonneratia* are relatively infrequent in Koh Kapik.

Rear mangrove community: On some of the islands and on the mainland between Prek Khlang Yai and Prek Thngo, the mangrove community is only a narrow band and is replaced by a community which is above the high tide mark and is probably only subject to freshwater inundation during the wet season. This community is dominated by *Melaleuca leucadendron*. In many places, there is an almost pure stand of this tree, but this may be due to repeated burning rather than it being a layer of humus. Other plants typical of this community are: *Pandanus*, *licuala spinosa*, *Acrosthicum aureum*, *A. speciosum*, *Hibiscus tiliaceus*, *Xylocarpus granatum*, *Heritiera littoralis*, *Phoenix paludosa*, *Melostoma* sp. (in more distributed areas), and *Scleria* sp. This is found together with several rattans and epiphytes such as orchids and the bird nest fern *Asplenium nidens*.

Beach strand vegetation: At the southwest side of Koh Kapik and on sandy areas of some of the islands, there are small areas of typical beach strand vegetation dominated by *Casuarina equisetifolia*, with some *Terminalia catappa*.

Fisheries resources: Common fisheries include: fish (grouper and sea bass), wild shrimp, crabs (mostly mangrove mud crabs), and squid. Some aquatic fauna migrate depend on the season. There is no exact data about the aquatic fauna in this area yet. However, the research conducted at Peam Krasop Wildlife Sanctuary showed that this area is rich in aquatic fauna including the Dolphin and Sea Cow.

Wildlife: The research conducted in Peam Krasop Wildlife Sanctuary, Koh Kong Province, showed that more than 190 species of birds have been identified. Some are present over the whole year, but some use this area as a migration place. There are also 29 species of reptiles that are present in the Peam Krasop Wildlife Sanctuary. Some species are rare species such as *Dermochelys* sp, *Eretmochelys* sp, and *Scaly anteater*. In addition, around 10 species of mammals have been found. This number has decreased because of destruction of the mangrove habitat.

Corals: Little data exists for coral within the mangrove ecosystem. Local Cambodian coral experts have identified 56 different types of hard and soft corals within wetlands in Peam Krasop. This area is a good habitat for *Greasy grouper* and *Yellow grouper*, and the habitats have been disturbed by fishing.

The land and water is state owned, but some land may be privately leased. The water and mangrove areas are under the jurisdiction of the Fishery Department, while the *Melaleuca* areas beyond the tidal influence are under the jurisdiction of the Department of Forestry and Wildlife. Some areas, such as Peam Krasop, along with much of the catchments, have recently been designated as the Wildlife Sanctuaries.

4.2 Economic Valuation of Wetlands

Koh Kapik Ramsar Wetland Site

In 1997, a case study was conducted to find out the socio-economics of protected areas provided a short data of logging activities including Peam Krasop, where Koh Kapik is located. Both Khmer and Thai logging companies are operating in the upland areas in Koh Kong. The logs are typically sold directly to Thailand. Companies employ 200-300 workers. In addition, many workers from Peam Krasop are involved in the collection of timber from nearby Koh Kong Island, which is under the control of the navy. It is estimated that more than 100 electric saws are in use on the island (one owner may have 2-3 saws). One machine can cut 1-2m³ wood per day. Soldiers are paid 10,000 Baht/month (US\$400) per machine. Anyone can cut wood provided they pay the soldiers. The workers, who carry wood from the island, can earn 400-1,000 Baht per m³ depending on the distance the wood is carried. A worker can transport on average 2-3m³ per day, thereby earning between 800-2,000 Baht per day (US\$32-80). Workers operating cutting machines are paid between 500-700 Baht (US\$20-28)/m³ (i.e., US\$40-56 per day including food). Trees are reportedly cut indiscriminately, often on steep slopes.

Commercial Shrimp Farms

Investment at the construction stage includes the cost of a license and expenditure on farm construction and equipment (e.g., dike construction, gates, fan for aerating water). The average expenditure at the construction stage was estimated to be US\$28,662 per hectare.

Only 25 percent of farms surveyed were operating under licenses. Licenses are valid for the lifetime of the farm and cost between US\$800-1,200. Technically, the fisheries department needs to be informed each year of the farm's intention to continue its operations.

Productivity per harvest ranges from 3-16 tonnes per hectare, with an average of five tonnes per hectare. Sixteen tonnes per hectare is very high and represents the first harvest of a newly constructed farm. Excluding this figure, productivity per harvest ranges from 3.1-4.4 tonnes per hectare, with an average of 3.6 tonnes per hectare. Relationship between shrimp farm productivity and shrimp age is shown in Table 1.

Table 1 Relationship between Shrimp Farm Productivity and Shrimp Age.

Age of farm/ years	Yield/ha/Harvest	Gross value US\$ per hectare/ harvest @120Baht/kg	Gross value US\$ per hectare/ harvest @35Baht/kg	Gross value US\$ per hectare/ harvest @185Baht/kg
1	16	76,800	22,400	118,400
2	3.78	18,144	13,230	27,972
3	3.26	15,648	4,564	24,124
4	3.12	14,976	4,368	23,088

The price of shrimp ranges from 30-185 Baht/kg depending on size and quality. The shrimp are sold to Thailand. Prices are dependent on the international market and have fallen over recent years from a high of 210 Baht. Using a price of 120 Baht/kg (weighted average) and using the average productivity of 5.1 tonnes/hectare/harvest, the average gross income from shrimp production per harvest can be estimated at US\$24,480 per hectare.

Assuming a five-year productive life of a shrimp farm, and two successful harvests per year at 5.1 tonnes/hectare/harvest, net income per farm is estimated at US\$4,451 per hectare. If however, one harvest fails because of disease or technical problems (very common), the farm will lose US\$20,029 per hectare. A year of loss in which both harvests fail means losses of US\$44,509. At 120 Baht/kg, productivity has to be at least 4.7 tonnes/kg to break even. At a productivity rate of 3.6 tonnes per harvest, a loss of US\$9,949 per hectare is incurred.

Given the risks facing shrimp farming, it is becoming increasingly rare for farms to have two successful crops a year. Half of the farms surveyed have incurred losses ranging from 1-6 million Baht (US\$40,000-240,000).

The calculations for each of the eight farms surveyed revealed that 50 percent of farms are making profits of between US\$17,508-100,880 (US\$1,782-100,880 per hectare), and 50 percent to be incurring losses of between US\$3,602-162,216 (US\$1,125-20,481 per hectare).

Excluding the farm with the unrealistically high productivity rate of 16 tonnes/harvest, profits range from US\$74,658-17,508 per farm (US\$11,109-1,782 per hectare). Overall, the farms are incurring a loss of US\$8,826, or US\$1,103 per hectare.

Calculations for individual farms are based on the investment, operating and productivity figures, and selling price of shrimp of the individual farms covered in the survey. Shrimp prices ranged from 98-158 Baht/kg and obviously affected profit margins.

Therefore the TEV of the Koh Kapik can be calculated and mentioned as important in reference to the general studies of Peam Krasom, where Koh Kapik is located within this area. There have been no specific research studies on the economic valuation of the site yet, due to the lack of financial and technical support. Even though it is fair enough to show the general picture of the economic, social, and cultural values that come purely from the wetland site.

Table 2 Price of Charcoal Production from 1997-2000.

Year	Price	Cost per kg in Thai Baht	Price per kg in \$US
1997	2.15	Baht	US\$0.05
1998	2.4	Baht	US\$0.05
1999	2.55	Baht	US\$0.06
2000	4.16	Baht	US\$0.01

Source: PMMR (2000).

Sragnam-Russey Srok Wetland Site

In the actual case of the Russey Srok-Tourl Sragnam Site, not every household earns income from the mangrove forest. The forest is not as productive as it was before it was degraded, although it is recovering. The case of Russey Srok-Tourl Sragnam represents villages that are mangrove, salt farm and fishing dependent. Since there is no real data on the case, the assumption was made that every household earns the same average net annual return per household as in the case for a sustainable basis. The local use value per ha/year has been calculated (Table 2). The local use value is per hectare/year in the case with charcoal production has been calculated and shown in Table 3.

Table 3 Direct Use Value per ha of the Mangrove by the Local Populations.

Cases	Direct use value per ha/year (baht)
The Case of a Mangrove without Charcoal Production	1,937.98
The Case of a Mangrove with Charcoal Production	4,237.16
Total	6,175.14

The total value of the economic valuation of wetlands, as well as others, is indicated below in US\$ and illustrates in Table 4.

Table 4 Indicative Economic Value of Major Coastal Ecosystems¹.

Ecosystem	Estimated Net Annual Benefits (US\$/ha/year)	Estimated Existing Area in Cambodia (ha)	Total Estimated Net Annual Benefits (million US\$/year)
Mangrove Forest	183	26,650	4.9
Coastal Wetlands	130	54,500	7.1
Coral Reefs	300	476	0.14
Seagrass	300	175	0.05
Total		81,801	12.19

Source: ADB (1996).

Based on the table referenced above, the direct use value of the three wetland areas per year can be computed in.

Table 5 Total Value within the Three Wetland Sites per Year.

No.	Site	Cost (US\$)
1	Koh Kapik Wetland Site	1,755,000
2	Beung Kachhang	585,000
3	Tourl Sragnam-Russey Srok	650,000

5. CAMBODIAN DATA AND INFORMATION ON WETLANDS

5.1 General Data

The general data provides a description of the existing situation that excludes the data depicted above, and is not mappable data. This includes the biodiversity, socio-economic, and education data.

1. Biodiversity data: this database covers all the natural resources, as well biodiversity that includes the fauna and flora explored during the past. It was set up by the Support Programme to the Environment Sector in Cambodia, European Union in 1998, and the direct collaboration with the Ministry of Environment, especially the department of Nature Conservation and Protection. It accounts totally for more than 3,000 species. And it includes some site surveys at Bokor National Park, and Tonle Sap areas.

2. Socio-economic data: this section logically came from the Cambodian National Census in 1998 that was supported by the UNFPA programme (National Institute of Statistic 1998). The database includes four systems:

- Pop Map: this is a population map;
- Priority Data: this is a table with the priority data for Cambodia;
- Village level: this is the detail for the village level; and
- WinR+: the system of database that was set up for using multi-purposes and facilitation for the easy extraction of data with many compatible formats.

3. Education: The school census is a database system that was created by the EMIS, Ministry of Education, Youth and Sport and supported by the UNESCO and UNICEF. It includes all the information and data related to Cambodia's education statistics and indicators from preschool until the university degrees. It is an annual census for Cambodian education that comprises the number of students (enrolment, drop-out, repeater), teachers, schools, classes, and its facilities in all grades.

¹ These economic valuations simply measure the annualised Net Present Value of some goods and services provided by these ecosystems. A comparison of different types of uses for these ecosystems (e.g., shrimp farm conversion, agriculture, etc.) could show even higher economic values for existing ecosystems (e.g., Sathirathai, 1998 estimates that the economic value of mature mangrove ecosystems increases to about US\$250/ha/year when compared to shrimp farming).

Overall, the quality of physical, biological, environmental, and socio-economic data and information for the coastal and marine areas of Cambodia is inadequate for good planning and management:

5.2 Information Related to Wetlands

The information collected relates purely to environment, natural resources and wetlands within Cambodia. It is mainly focusing on the coastal areas in Cambodia. Furthermore, the information includes the report formats written in different reports for each activity, research project, or programme in the Cambodia's Coastal zone (see the meta-database for Cambodian Wetlands in spreadsheet as attached).

Referring to this meta-database, the information can be seen as made up of different parts, where each part represents different areas, scales, and subjects. However the information generally represents the Nation, the entire coastal zone, each protected area (such as Bokor National Park, Ream National Park, Peam Krasop, Dong Peng) and/or each province as indicated as the whole image. Most information was produced by the Coastal Zone Management Project supported by DANIDA since 1997, and the Participatory Management of Mangrove Resources Project that has been supported by IDRC since 1997 (IRIC and IDRC, 1997). The information basically describes the physical infrastructures in place, water quality, some sources of pollution, mangrove plantations, tourism issues, source of mangrove destruction and fishing activities.

Despite a great deal of information, it has only been interpreted and analysed from community approaches. This means that approaches to evaluate and assess it were through the consultations, meetings, discussions and interviews. This is good in some ways, however it is not scientifically based. The information is just the vision of the people involved. Moreover the information indicated the holistic management issues for the whole nation or coastal zone.

On the other hand, the coastal wetland classification has not yet been planned or considered. In order to maximize the use of the existing data and information, we need to adjust the information to focused areas. This is the main challenge and sometimes is not feasible. There is not any specific research yet on wetland areas and the issues in coastal areas.

5.3 Mapping Data Related to Wetlands

The mapping data refers to the data that can be produced in a GIS map. The mapping data is from different sources of databases in Cambodia, such as the Department of Geography, Support Unit of the MRC, DoF/LUMO/MAFF, JICA/MPWT, MoE/GIS/RS Unit, MoP/NIS, MoEYS/EMIS, WFP/UN and EU projects/programmes (please see the Cambodian Wetland Meta-database that was produced in the spreadsheet).

After reviewing all these data, there are five main parts including:

1. **Administrative data:** This includes information on national boundaries, provinces, districts, communes' polygon as boundaries, and central points with the points of the villages. These data are updated annually and managed by the Department of Geography, Ministry of Land Management, Urbanisation and Construction. There is collaboration between the department with the Ministry of Public Works and Transport that is supported by JICA.
2. **Infrastructure:** this includes information on all roads (national roads, main roads, secondary, paved roads), all the railways (two lines, 1st to Sihanoukville and the 2nd to Battambang/Banteay Meanchey), all rivers (entire the main rivers, 2nd rivers, 3rd rivers, up till to the small streams), Oceans and lakes (Tole Sap, all other lakes). These maps were produced from the Ministry of Public Works and Transport, in collaboration with the JICA project. There are two phases, the 1st phase was already finished in 2000, and the 2nd phase began, and is nearly finished.
3. **Physical and chemical condition of the land:** this includes information on watershed classes, contour lines, soil, climate, catchment's areas, geology, landforms, hydrogeology, and landscape conditions. These data were produced from the MRC, FAO, JICA, and collaborations with the national institutions such as the Ministry of Agriculture, Forestry and Fisheries, Ministry of Environment, Ministry of Land Management and Ministry of Public Works and Transport.
4. **Land Use, Land Cover and Forest Cover:** these data came from different sources at various times, including the FAO, UNEP, Department of Forestry, Land Use Management Office of the

Ministry of Agriculture and the MRC. The data was found in 1971 for vegetation, then 1992-93 and 1996-97 for forest and land cover of Cambodia (MRC, 1997).

5. **Population:** there is a population density map that was produced from the National Institute of Statistics, Ministry of Planning (National Institute of Statistic, 1998). Its source is mainly based on the data from the National Census in 1998 and using the PopMap application that is more or less similar to the MapInfo application. The data within the application not only produced the population density, but also the distribution of population activities, of education, of age groups, households, gender, and utilisation of water, light and cooking. This map can be produced at the commune, district, and provincial scales. Moreover, there was an old map of the Ethnic distribution that describes the different ethnic groups in Cambodia.

6. CONCLUSION AND RECOMMENDATIONS

According to the descriptions above, the data and information is still very limited, especially for the specific issues such as Wetlands in local areas. Most of the supports are likely to work at this stage on the national level. In other words, nobody takes care yet for the local level, even though Cambodia is in the process of decentralisation. Regarding the local data and information, it mostly focuses on the socio-economic and health issues, which are the immediate objectives to help people to survive, maintain, and develop their own life. Environmental issues are the secondary or long-term objectives.

Therefore, the national self-management of the data and information is the key issue. Concerning its management, there are a lack of knowledge and skills in information and data management and its supporting infrastructures. People do not appropriately consider the data and information for decision-making, planning, and monitoring as well as evaluation. The principle causes are lack of mechanisms for data and information sharing among other people, and lack of dissemination, which would allow people to understand its importance, and to use and manage it effectively.

In order to maintain and keep records up-to-date, the key issue is to compile and manage the existing data and information in a national database system that can be used by other people. As Cambodian human resources are very limited, thus the capacity building in data and information use and management is a pre-requisite as an immediate objective.

Gathering and giving data and information are the principle issues to promote and maximize its sharing and dissemination. There needs to be established the co-ordination for data and information management with the enhancement of flow mechanisms with its free access.

Good information is crucial for sound coastal and marine environmental management and, by and large, this good information does not yet exist in Cambodia. There has been a lack of data and information, especially for coastal and marine resources, throughout the history of Cambodia. Although the DANIDA coastal zone project prepared coastal resource profiles and mapping, as well as community socio-economic survey reports, more information, and more up-to-date information, especially data and information relevant to the biophysical characteristics of the natural resources, is required for proper coastal and marine zone planning and management. Because of this, one of the first items of work in the coastal and marine zone has to be basic gathering and assembly of data and information.

The collection of data in and of itself should not be the goal. Resources are too scarce in Cambodia for collecting data and information that do not meet practical needs. It is also impossible to substitute for local knowledge of coastal conditions and resources. Sometimes dismissed with regards to essentially anecdotal, unsystematic, or unverifiable, local knowledge may represent the distillation of the experience of generations of those who have had "hands-on" knowledge of a particular matter with a particular issue.

There is an important institutional issue with respect to the sharing of information. Coastal and marine environmental management is: (i) always multi-sectoral, meaning that many different types of information are needed, and (ii) should be integrated, meaning that institutions often need information collected by other institutions to provide a necessary and useful contribution. Overcoming this barrier requires particular effort on the part of the practitioners of coastal and marine environmental management.

Finally, coastal and marine environmental management cannot wait for perfect information. In fact, not all of the scientific and technical issues pertaining to many of the proposed programmes have been resolved. For example, feasible farm models may not yet be perfectly tested, or the best method of rehabilitating abandoned shrimp ponds may not be well known. This must be balanced against the need to take steps quickly in some cases and locations to halt or reverse natural resource degradation. Coastal and marine environmental projects in Cambodia will have to be implemented with incomplete knowledge. This reality demands an adaptive approach to programme implementation and delivery. This adaptive approach will require environmental monitoring so that unanticipated effects can be detected quickly, and lessons learned can be used to quickly modify and re-design investments and technical assistance.

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NATIONAL REPORT

on

Wetlands in the South China Sea

CHINA



Ms. Chen Guizhu
Focal Point for Wetlands
Institute of Environmental Sciences
Zhongshan University, 135 West Xingang Road
Guangzhou 510275
Guangdong Province, People's Republic of China

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1. INTRODUCTION

China has 6,888 kilometres of coastline along the South China Sea (including 403 kilometres of coastline in Hong Kong and Macau) from Raoping County in Guangdong Province, to the Beilun Estuary in the Guangxi Zhuang Autonomous Region. There are five administrative regions located along the coast of the South China Sea: (1) Guangdong Province, (2) Hong Kong Special Administrative Region, (3) Macau, (4) the Guangxi Zhuang Autonomous Region, and (5) Hainan Province.

The majority of relevant data was totalled from the county to the city level, from the city to the provincial or autonomous region level and finally to the national level. Therefore, the analysis of China's coastal area along the South China Sea is divided into five sub-regions, which are: (1) Guangdong, (2) Hong Kong, (3) Macau, (4) Guangxi, and (5) Hainan.

2. REVIEW OF CHINA'S WETLAND RESOURCES

2.1 General Status of Wetlands in China

China is located in the southeastern part of the Eurasian mainland. Its territory spans 9,600,000km² and extensive territorial waters. China is a large country with diverse physical characteristics, geography, and environmental and climatic conditions that also contains large numbers of varied wetlands.

2.1.1 China's Wetland Resources

Characteristics of China's Wetlands

There are many types of wetlands in China. They span large areas, appear in large numbers, and are widely distributed. Differences among regions are notable and biodiversity is plentiful.

- (1) **Types of Wetlands:** According to the Ramsar convention, there are 31 types of natural wetlands, and 9 types of artificial wetlands in China. The primary types include marsh wetlands, lake wetlands, river wetlands, estuary wetlands, coastal wetlands, wetlands in the neritic zone, reservoirs, garden ponds, and paddy fields.
- (2) **Expansive area:** The area of wetlands in China is approximately 65,940,000hm² (not including rivers, garden ponds etc.). This represents 10 percent of the total global wetlands, the largest amount in Asia, and the fourth largest in the world. Chinese wetlands include 25,940,000hm² of natural wetlands and 40,000,000hm² of artificial wetlands.
- (3) **Wide distribution:** In China, wetlands extend from the frigid-temperate region to the tropics, from coastal to inland areas, from plain to altiplano. Many types of wetlands exist in the same region and one type of wetland can exist in many regions. This high degree of variation makes for a colourful composition of different types of wetlands.
- (4) **Notable differences among regions:** There are many river wetlands in eastern China, many marsh wetlands in north-eastern China, few wetlands in the west, and abundant lake wetlands in the middle and lower reaches of the Yangtze River and Qingzang Altiplano. Many salt lakes and saline lakes exist in the Qingzang Altiplano and the arid area of northwest China. Special mangrove forests and tropical and subtropical artificial wetlands spread from Hainan Island to the foreland of northern Fukien. The Qingzang Altiplano has the highest altitude and amplitude marshes and lakes, forming a particular habitat.
- (5) **Rich biodiversity:** China has many wetland habitat types with numerous species. Not only are the number and quantity of species large, but many of them are endemic to China. Thus, the wetlands are important to science, research, and the economy. According to recent statistics, there are approximately 172 families (15.5 percent), 495 genera (48.7 percent), and 1,642 species (5.5 percent) of national plants found in Chinese wetlands. More than 100 species are endangered. There are 770 species or sub-species of freshwater fish, including many migratory fish stocks whose reproduction depends on wetland ecosystems. There are numerous waterfowl in Chinese wetlands, amounting to

² 1 square hectometer = 0.01 square kilometre.

280 species, including crane, umbrettes, wild geese, gulls, and storks. There are many rare or endangered waterfowl found in Chinese wetlands, including 15 national Class-A protected rare birds, such as the Red-crowned Crane, and 45 Class-B protected rare birds, such as swans, Black-faced Spoonbill, and *Tringa guttifer*. There are 57 species of endangered birds in Asia, out of which 31 species of endangered birds are present in Chinese wetlands, accounting for 54 percent of the total. There are 166 species of wild geese in the world, with 50 species present in Chinese wetlands, accounting for 30 percent of the total. There are 15 species of cranes, and nine of them are found in China. Moreover, China is home to many migratory birds. Several Chinese wetlands provide the only wintering grounds for some species along their migratory routes.

Status of Primary Types of Chinese Coastal Wetlands

Coastal wetlands and wetlands in the Neritic Zone: Coastal wetlands in China are primarily distributed among 11 littoral provinces and districts, and the Hong Kong-Macau-Taiwan area. There are approximately 1,500 rivers flowing into oceans in China. They form 6 types of coastal/marine wetlands with more than 30 types of ecosystems.

The northern section of Huangzhou Bay consists of sandy and silty beaches, except for the rocky beach of the Shandong Byland and sections of the Liaodong Byland. Wetlands in the Huanbohai Sea and Jiangsu littoral area have the same composition. The Yellow River delta and Liaohe River delta are important littoral wetlands in the Huanbohai Sea. The Huanbohai Sea littoral area also contains the Laizhou Bay Wetland, Mapengkou Wetland, BeidaGang Wetland, and Beitang Wetland. The total area is 6,000,000hm². The Jiangsu littoral wetland is made up of sections of the Yangtze River delta and Yellow River delta. The total beach area amounts to 550,000hm², including the Yancheng Wetland, Nantong Wetland, and Lianyungang Wetland.

The southern part of Huangzhou Bay primarily consists of rocky beach. The major estuaries and gulf are located at the mouth of the Qiantangjiang – Huangzhou Bay, Jinjiangkou – Quanzhou Bay, Pearl River, and North Gulf.

2.1.2 Chinese Wetlands on the Ramsar Convention List of Wetlands of International Importance

There are 21 Chinese wetlands included on Ramsar Convention list of Wetlands of International Importance. The Chinese wetlands of international importance are: (1) Zhalong Nature Reserve; (2) Xianghai Nature Reserve; (3) Dongzhaigang Nature Reserve; (4) Qinghai Birds Island Nature Reserve; (5) East-Dongting Lake Nature Reserve; (6) Poyang Lake Nature Reserve; (7) Mipu and Back Gulf; (8) Dongtan Nature Reserve; (9) Dalian National Harbour Seal Nature Reserve; (10) Dafeng Elk Nature Reserve; (11) Inner-Mongolia Dalai Lake Nature Reserve; (12) Zhanjiang Mangrove Nature Reserve; (13) Honghe Nature Reserve; (14) Chelonian Nature Reserve; (15) *Larus Relictus* Nature Reserve; (16) Sanjiang National Nature Reserve; (17) Sankou National Mangrove Nature Reserve; (18) Wetland and Waterfowl Nature Reserve; (19) Westdongting Lake Nature Reserve; (20) Xingkai Lake National Nature Reserve; and (21) Yancheng Nature Reserve.

2.2 Distribution of Wetlands in China along the South China Sea

(1) **Estuary Waters:** These wetlands include the river water areas from the non-tidal reach to the division of saltwater and freshwater. The estuarine waters are mainly distributed in the reaches of tidal flats, which meets the mouth of the river, such as the reaches from the Xijiang River, Dongjiang River and Beijiang River to the Pearl River Estuary (Lingdingyang Estuary) in the Pearl River Delta in Guangdong; the estuary reaches of the Ganjiang River and Rongjiang River in the east of Guangdong; the estuary reaches of the Moyangjiang River, Loujiang River and Zhanjiang River in the west of Guangdong; the estuary reaches of the Kangjiang River in Beihai in Guangxi; the estuary reaches of the Qingjiang River in Qingzhou, Guangxi; the estuary reaches of the three river systems of Hainan, that is the Wanquanhe River, Nanduhe River and Changhuajiang River.

(2) **Intertidal Flats:** These wetlands lie from the shoreline to the lowest low water limit that is the beach land which comes out when the seawater falls to the lowest low water limit. The intertidal flats include sandy gravel beaches, sands beaches, mud beaches, grass beaches, and mangrove

swamps. Most of the mud beaches, mangrove swamps, and grass beaches are distributed in the estuaries, both sides of the bays or the bay heads. The sandy gravel beaches are mostly distributed on the rocky shores.

(3) **Coastal Lagoons:** These wetlands are mostly formed in bays with a narrow mouth. When a sand bank, sand spit, or sand bar appears in the bay mouth resulting from a washed deposit, a lagoon will form – a salt water lake with one or more outlets, such as the Pinqing Lake in Shanwei, Guangdong, the Dazhou Bay in Huidong, Guangdong, the Qingzhou Bay in Guangxi, the Dongzai Port, the Gangbei Port and the Qinglan Port in Hainan.

(4) **Shallow Marine Waters:** These wetlands cover the area between the depths of 0m to 6m at low tide, which can be determined with reference to charts. Another method is to obtain the tidal levels corresponding to the imaging time of the satellite images, and the depths of 0m to 6m can be determined roughly through image processing.

(5) **Rocky Marine Shores:** Because the shoreline of the South China Sea is meandering with a large number of ports, rocky marine shores are distributed in each province, especially in the Guanghai Bay in the west of Guangdong, and the Daya Bay, Dapeng Bay and the Dapeng Island in the east of Guangdong. These wetlands also exist in the Pearl River delta, the Tieshan Port in Beihai, Guangxi, the Qingzhou Port in Qingzhou, Guangxi, and the Yulin Port, Sanya Port and Yazhou Port in Sanya, Hainan.

Based on the data from Remote Sensing, Geographic Information Systems, and Global Positioning Systems, the resources of the coastal wetlands in China are shown to be plentiful. The statistics show that there are: (1) estuarine waters with a total area of 4,550.12km²; (2) intertidal flats with a total area of 2,824.71km²; (3) coastal lagoons with a total area of 365.83km²; (4) shallow marine waters with a total area of 6,908.15km²; and (5) rocky marine shores with a total area of 666.55km². Figure 1 shows Map of Coastal Wetland Types along the South China Sea based on Remote Sensing Images.

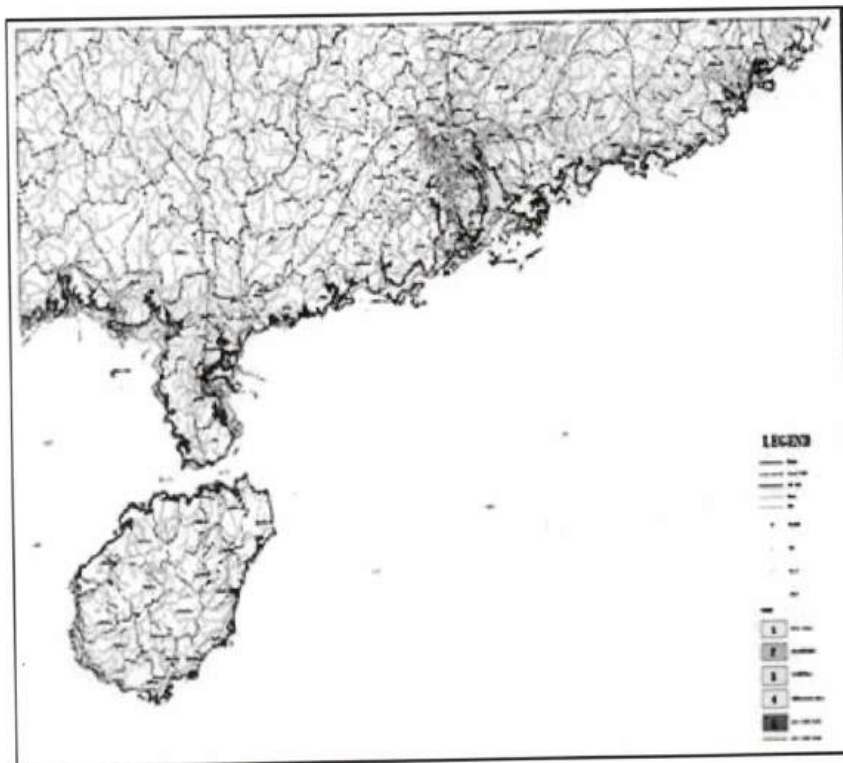


Figure 1 Map of Coastal Wetland Types along the South China Sea based on Remote Sensing Images.

2.3 Total Areas of Wetlands in China

Based on the above map of the coastal wetland classification at a scale of 1:250,000, the area of the map polygons of each type of wetland was measured by GIS software (Arc/info) and summarised according to the district divisions of the UNEP/GEF project, county, city, and province respectively. Thus, the statistics of the coastal wetlands in the South China Sea have been obtained (Table 1). In the tables, the data are area statistics from 2002 obtained from the remotely sensed images as described above.

Table 1 Total Area of Coastal Wetlands of the South China Sea (km²).

	Guangdong	Hong Kong	Macau	Guangxi	Hainan	Total
Estuary Waters	3,974.56	28.08	11.97	403.31	160.28	4,578.20
Intertidal Flats	1,582.03	11.10	0.00	853.72	392.73	2,839.57
Coastal Lagoons	119.67	20.25	0.00	0.00	245.29	385.21
Shallow Marine Waters	4,502.66	295.59	61.24	1,390.87	933.13	7,183.49
Rocky Marine Shores	374.63	17.37	0.00	2.30	12.98	407.29
Total	10,553.55	372.39	73.21	2,650.20	1,744.41	15,393.76

3. UTILISATION OF, AND THREATS TO, WETLANDS

3.1 Utilisation of Wetlands

3.1.1 Land-use Resources

1. *Enclosing Beaches for Fisheries and Aquaculture in Shallow Seawater*

The total aquaculture products from the South China Sea over the period from 1999 to 2001 were 44,570 thousand tonnes. In Guangdong Province from 1999-2001, beach enclosure and land reclamation created 40,683ha for aquaculture, and the total aquaculture products was 24,110 thousand tonnes. These areas became important sites for fisheries and aquaculture production.

2. *Coastal Mangrove Swamp Wetlands*

Mangrove swamp wetlands are important resources that are mainly distributed in estuaries. They provide many important ecosystem functions, such as shielding against wind and erosion, maintaining banks, enduring huge waves, providing reproduction sites for fish, shrimp, crabs, and shellfish, and providing nesting grounds for water birds. The area of coastal mangrove wetlands in the South China Sea (including Hong Kong and Macao) was 22,121hm² during the period from 1950-1959. From 1990-1999 the area of coastal mangrove wetlands fell to 14,567hm², and 7,554hm² currently. Land reclamation is the primary cause of wetland loss. Land reclamation of these mangrove swamps has provided the land to develop the Guanghai Farm in Taishan, Niutianyang Farm in Shantou, the Huanggang tax-free Industrial Park in Shenzhen, the Mawan Oil Dock in Shenzhen, the Huangtian Airdrome in Shenzhen, and the Aotou Industrial Park in Dayawan.

3. *Land Resources for Coastal Salt Fields*

The natural conditions in the South China Sea are very advantageous for the salt industry, especially in western Guangdong Province and in western Hainan Province. The salinity of the South China Sea is 33 percent. The area of salt fields in the South China Sea was 21,613hm² in 1992, including 11,656.92hm² in Guangdong, 4,512.64hm² in Hainan, and 5,444.16hm² in Guangxi; the original output of salt was 659,100 tonnes, including 351,700 tonnes in Guangdong, 152,000 tonnes in Hainan, and 155,200 tonnes in Guangxi. Over the period from 1996 to 1999, the economic value of salt industry production was 0.6 billion, and the annual mean was 0.15 billion.

4. *Delta Low Plane Land Resources*

The important delta wetlands in the South China Sea include the Pearl River Delta, Hanjiang Delta, Jianjiang Delta, Nanliujiang Delta, and Nandu River Delta. These areas have mainly been used for

agriculture and aquaculture in the past. Today, these areas have become developed industrial areas. In Wanqingsha of Panyu, a new town named Xinken was reclaimed in ten years; other areas that have been reclaimed from deltas include the town of Maofengwei in Zhongshan, Baitenghu in Zhuhai, the Yanan Farm in Xinhui, the Huangtian Airdrome in Shenzhen, the Zhuhai Airdrome, and the Yantian Port in Shenzhen amation.

3.1.2 Coastal Beach Wetland Resources

The total area of coastal beach wetlands in the South China Sea is 3,535.7hm², which is mainly used for aquaculture, the salt industry, enclosing beaches for land reclamation, and building mangrove wetlands. Through remote sensing and GIS techniques, it has been determined that 210km² of beaches were enclosed for land reclamation from 1978 to 1997 in the Pearl River Estuary. Of the 210km², 160km² occurred in the western Pearl River Estuary, and 50km² in the eastern Pearl River Estuary. In the eastern Pearl River Estuary, land reclamation in the south was mainly used for urban development, industrial development, and establishment of foundations, while land reclamation in the north was mainly used for agriculture and aquaculture. In the western Pearl River Estuary, land reclamation was mainly used for agriculture and aquaculture. In recent years, land reclamation of wetlands was mainly conducted to develop cities, transportation networks, airports, harbours, industrial lands, and aquaculture.

Over the past 100 years, the siltation rate of the delta and evolution of the coastline has increased rapidly, especially over the past 30 years. The natural rate of beach formation was approximately 1,000hm²/year, while the enclosure rate of beaches for land reclamation was approximately 1,100hm²/year.

Wetland Utilisation in the South China Sea region mirrors that in the Pearl River Delta estuary as described below:

The Pearl River Delta estuary is one of the largest estuaries in the world, which was densely covered by networks of rivers. The beach resources were mainly distributed along the coast of the Lingdingyang and Huangmaohai Districts, while the shallow areas were distributed in the Modaomen and Jitimen districts. The pushing rate of Xijiang and Beijing delta was increased to 4,050m/year. Delta pond wetlands are very famous in China. In this ecosystem, mulberry, fruit, sugar cane, and other economic crops were planted along the banks, fish were cultivated in the ponds, and the leaves of the mulberry gave birth to the silkworm.

In the Pearl River Delta Estuary, land reclamation is a serious problem. At the present time, the proportion of enclosing and silting is three to five. There is a delay in construction of the protected zone.

The Pearl River empties into the South China Sea through eight outlets in the delta. The evolution of the outlets, the rates of delta reclamation, and the changes in the coastline from 1966 to 1996 has been quantitatively studied through remote sensing and GIS techniques. The total reclaimed area in the entire delta during the period has been calculated to be 344km², at the average rate of 11.47km²/year, which is much greater than in the historical period. Of this total, 146km² has been reclaimed in the Lingdingyang District, where four eastern outlets (Humen, Jiaomen, Hongqili and Hengmen) are found. In the Modaomen and Jitimen Districts in the western part of the delta, 115km² has been reclaimed, and around the Yamen and Hutiaomen in the Huangmaohai district, 73km² has been reclaimed.

By contrast, the eastern coast of the Lingdingyang estuary has grown much more slowly, with some sections even experiencing a slight retreat due to erosion. In the western part of the delta during the same period, the coastline has moved seaward by 4.7km, at the rate of 156m/year, due to rapid reclamation, which has seriously affected the hydrological conditions and sediment dynamics in each outlet and its adjoining channel. This has caused the channels to lengthen greatly and resulted in channel splitting, distribution of runoff and sediment load, and frequent river flooding.

Rapid reclamation from 1966 to 1996 led the Modaomen outlet to rapidly advance seaward by 4.7km. After the completion of a planned reclamation project, shown in the area with the dashed line, the present Modaomen outlet will advance further seaward by more than 11km, while in the Huangmaohai Estuary, the Yamen and Hutiaomen outlets are merging into a new outlet due to rapid reclamation. Table 2 shows Land Reclamation in the Lingdingyang Area of the Pearl River Estuary from 1966 to 1996.

Table 2 Land Reclamation in the Lingdingyang Area of the Pearl River Estuary from 1966 to 1996 (unit km²).

Time	Jiposha and Shaken Area	Wanqingsha Reclamation Area	Hengmen Reclamation Area	Jinxingmen Reclamation Area
1966-1986	ignore	23.6	ignore	10
1986-1996	21.7	26.3	21	ignore
Total	21.7	49.9	21	10

Source: Yuefeng et al. (1998).

3.1.3 Mineral Resources

According to statistics, there have been 662 mineral deposits discovered in the South China Sea wetlands; of this total, there have been 21 large mineral deposits, 60 medium-sized mineral deposits, and 123 small mineral deposits discovered. Besides these mineral deposits, 60 underground hot mineral springs have been discovered. In Guangdong, mineral deposits include zirconium quartz, ilmenite, tin mine, niobium and tantalum mine; while in Hainan, reserves of titanium and zirconium are the highest in China. Groundwater springs are also abundant in the wetland. For example, in the Zhuhai coastal hot spring, the temperature of water is approximately 80°C.

3.1.4 Estuary Resources

There are more than 200 large harbours in the South China Sea. The Dapeng Bay, Daya Bay, Hong Kong, Hailing Bay, and Yulin are large enough to build huge deep water harbours, while the Zhanjiang Harbour, Guangzhou Harbour, Fangcheng Harbour, Mawan Harbour, Shenzhen Harbour, Yangpu Harbour, Sanya Harbour, Qinzhou Bay, and Tieshan Harbour are also suitable for huge deep water harbours if dredging is conducted.

In the South China Sea, the following ports have a throughput which exceeds 10,000 thousands tonnes: the Guangzhou Port (throughput of 84,320 thousands tonnes in 1997; throughput exceeds 0.1 billion tonnes presently); Shenzhen Port (throughput of 19,350 thousand tonnes in 1993); Zhanjiang Port (throughput of 18,000 thousand tonnes in 1996); Shuidong Port in Maoming (throughput of 14,250 thousand tonnes in 1995); and the Hong Kong Port (throughput of 0.12 billion tonnes in 1992). In the South China Sea, the following port has a throughput which exceeds 5,000 thousands tonnes: the Shantou Port (throughput of 8,000 thousands tonnes in 1997, and throughput of 65,000 thousands tonnes in 1997).

3.1.5 Utilisation for Tourism

Wetlands provide many values essential for tourism, including their innate biodiversity, landscape diversity, and culture diversity. From the point of view of sustainable eco-tourism, tourism within wetlands may be developed up to the carrying capacity of the wetland; that is, of the development of tourism should only be developed to the point where it will not have a negative effect on the wetland ecosystem function.

There are many famous tourist spots, including the Huizhou Western Lake (which is a famous coastal lake wetland tourist spot); Dameisha and Xiaomeisha in Shenzhen; Zhuhai Coastal Park, Shangchuan Island and Zhao in Yangjiang; Fangji Island in Dianbai; Jiaowei Coral Reef Wetland in Xuwen; Wenchang Coco Forest in Hainan; Dadonghai, Yalongwan and Tianyahaijiao in Sanya in Hainan; Silver Beach in Beihai in Guangxi; and the Hepu-Shankou Mangrove Wetland. Utilising wetland land resources, 33 coastal tourism areas have been created, including 11 coastal tourist holiday areas at the provincial level, and 22 scenic tourist spots that involve coastal scenery.

In recent years, wetland tourism has sprung up in Guangdong, including the ecological Paradise in Jun'an in Shunde; Fazenda on the Sea; Lotus Pond and Sunflower Garden in the town of Wanqingsha in Panyu; and the Rural Holiday spot in the town of Shajing in Shenzhen.

The annual mean number of tourists in these areas totalled 30,343.5 thousand from 1999 to 2001, and the gross economic earnings from tourism were 39.74 billion.

In recent years, officials at all levels of government have considered opening up and suspending the development of wetland environments. Integrated investigation and research of coastal beach and sea recourses in the SAS (which includes three Provinces in South China) was carried out throughout the 1980's. Management and planting of mangroves were stressed during the 1990's. For example, seven protected areas of coastal mangroves (32,585.5hm²) were established in the Guangdong Province from 1997 to 1999. From 1985 to 1995, 1,867.4hm² of mangrove was established in Zhanjian, Guangdong, and the mangrove wetland eco-tourism was exploited.

3.2 Causal Chain Analysis for Threats to Wetlands

3.2.1 Global Climate Change

According to one study, the Pearl River Delta Sea-Level Rise and its Defending Measures, Huang Zhenguo, if the sea-level rises by one metre, the low-lying plains area of the Pearl River Delta (including the city of Guangzhou) would be submerged; if the sea-level rises by 0.6m, 74 percent of the Pearl River Delta low-lying plains would be submerged. The rates of relative sea-level rise will greatly influence coastal wetlands. According to research results from the Chinese Academy of Science (1993), the rates of relative sea-level rise will reach 0.4m to 0.6m by the year 2050. The result, according to the National Mapping Bureau and National Marine Information Centre (1996), is that the rates of relative sea-level rise will reach 0.42m. Based on the above research results, sea-level rise will lead to the following consequences: raising the water depth and sea-level height of the eight River outlets, slowing the rate of delta edge sediment deposition, eroding and causing the destruction of banks and coastlines, and submerging the low-lying, reclaimed land areas.

3.2.2 Typhoons and Storm Tides

The Pacific Ocean and South Sea are the main source of these typhoons. From 1949-1982, an average of 12.7 typhoons per year affected Guangdong and Hainan. From 1949-1984, the number of annual mean typhoons that affected Guangxi was 2.3. Storm gusts, rains, tides, and gigantic waves followed typhoons and caused severe destruction. Typhoon No. 8607 landed on the Jieshi Bay in the city of Lufeng in Guangdong, and led to the complete destruction of many coastal counties and cities. The direct loss exceeded 1,100 million; 1,387 people were injured or died; more than 533,333ha of agricultural fields were destroyed; 500 thousand tonnes of early rice paddies were lost; and crops, dykes (embankments), fish ponds, and shrimp ponds were also damaged. In 1996, Typhoon No.15 hit the Leizhou Peninsula, which suffered a 1.6 billion loss. However, a 30km long sea wall protected 1,400hm² of farmland (with an economic value of approximately 16,000 thousand RMB Yuan) and 10,000 people.

On July 6, 2001, the eastern coastal zones in Guangdong were devastated by a storm tide called "Youte," the aftermath of which included a 2.45 billion economic loss, destruction of 57km of dikes, 17 bursts, 1,169 damaged dams, and aquaculture loss of 56 thousands tonnes.

In 2002, three tropical storms hit Guangdong; seven cities were affected, 220m of banks were destroyed, 115 ships were damaged, four people died, and 23 fishermen disappeared.

In 2002, Tropical Cyclones No. 0214 and No. 0220 hit. In the station of Haikou Xiuying, the water rose by 58cm as a result of Cyclone No.0214, and the largest tidal level was 145cm (Yulin 76 base level). In the station of Haikou Xiuying, the water rose by 53cm as a result of Cyclone No. 0220.

3.2.3 Red Tides

The coastal areas which suffer from red tide encroachment along the Guangdong Coast includes the Peal Estuary, Dapeng Bay, Daya Bay, and coast of Zhanjiang. Over the period from 1980-1990, there were 26 red tides that occurred in Guangdong, 14 red tides in the Peal Estuary, approximately seven in the Dapeng Bay, and five in the Daya Bay. Since 1983, red tides have occurred every year. In April of 1983, red tides occurred simultaneously in the Dapeng Bay and Daya Bay.

In 2002, nine red tides occurred in the area of the Guangdong Sea. The affected areas covered approximately 500km². The main species of the red tide included *Thalassiosira* sp., *Skeletonema costatum*, *Gyrodinium instriatum*, *Noctiluca scintillans*, *Mosodinium rubrum*, and *Phaeocystis* sp.

On May 1, 2002, a red floater seawater strap appeared east of Weizhou Island, in Beihai, Guangxi. Although monitoring was conducted, the algae leading to the red tide could not be identified. On June 19, 2002, a red tide occurred east of Weizhou Island, with an area of approximately 20km². The biomass of this red tide was 2×10⁶ entries/L. On February 19, 2002, a red tide also occurred in the coastal area near Danzhou.

3.2.4 Enclosing Beaches for Land Reclamation

From 1978 to 1997, the area of beach enclosure in the Pearl River Estuary was 210km². One example can be seen with the town of Wanqngsha, in the southern part of the city of Guangzhou, which is a new town that was created by enclosing beach land.

Guangdong Province has one of the most abundant distributions of mangrove wetlands of any coastal city. There were 40,000ha of mangrove wetlands in the 1950s; however, there were only 147,000ha left by the 1990s. There have been 7,911.2ha of mangrove wetlands destroyed or occupied since 1980, including 7,767.5ha which were dug as ponds to breed aquatic species; 139.4ha which were used for construction; and 5.3ha which were turned into salt fields. From 1966 to 1996, the total reclaimed area in the entire delta was 344km², at an average rate of 11km²/year, which is much greater than in the historical period. Most of these reclaimed areas are located along the western coast of the Lingdingyang and Modaomem districts, and coast of Huangmaohai.

From 1950 to 1997, the total area of land reclamation was 44,640hm². Of the enclosed lands, 753hm² were used for urban development and industry, 669hm² for ports and harbours, 2,336hm² for plantations, and 33,809hm² for aquaculture. A similar situation occurred in both Guangxi and Hainan.

3.2.5 Urbanisation and Industrial Development

The main causes of wetland pollution include the following:

1. *Drainage of municipal wastewater and industrial wastewater*

According to the statistical yearbook of the Guangdong Province in 2003, the total wastewater drainage of the Pearl Delta area was 3.4 billion tonnes in 2002, accounting for 69.75 percent of the Province total. Of the total amount, industrial wastewater drainage amounted to one billion tonnes, and household sewage amounted to 2.41 billion tonnes. The sewage is usually disposed directly into wetlands, due to the shortage of wastewater treatment facilities. The total sewage exceeded one billion tonnes in Guangzhou and Dongguan.

2. *Non-Point Source Pollution*

Many water bodies and waterways in the delta of the South China Sea are nutrient enriched and eutrophic. Nutrients come from point sources (e.g., inadequately treated sewage) and non-point sources (e.g., agricultural and urban runoff).

3. *Oil Pollution*

The seawater is polluted by oil from the petroleum survey, residences, and leaks or accidents. When mangrove wetlands are heavily polluted, they are destroyed. For example, the mangrove wetlands in the city of Zhanjing (town of Haitou in the Xiashan District) have been mostly destroyed by pollution. From 1992 to 1993, a great deal of pollutants was discharged to the Pearl Estuary, which caused more than 100 species of fish and 20 species of shrimp to die off.

3.2.6 Other Causes of Destruction

Other causes of wetland destruction include the illogical use of the wetland water resources, the annual accumulation and rate of sedimentation, and the expansion of coastal erosion.

4. THE ASSESSMENT OF THE ENVIRONMENTAL ECONOMIC VALUE OF THE WETLANDS ALONG THE SOUTH CHINA SEA

4.1 The Environmental Economic Value of Wetlands

In order to exploit and protect the wetlands resource within reason, we should assess the wetlands environmental economic value. In generally, wetlands can provide the following services for the environmental economic system:

- (1) Wetlands are the source of some raw and processed materials of the economic system, such as primary products, aquatic species, and mineral products;
- (2) Some compositions of the wetland ecosystem provide necessary services for the life system, including nitrogen balance maintenance, moisture regulation, promotion of soil replacement, regulation of floods and droughts, and enhancement of system stability;
- (3) Wetland systems can provide appealing services, especially wetland tourism; and
- (4) The wetland ecosystem can break down some pollutants.

In 1997, an article on wetland valuation was published in the journal Nature. In this paper, the author estimated the total value of the world's wetlands. In this estimation, the total value of the world's wetlands was approximately US\$15,000 billion. Among the above, the value of the tidal wetlands and mangroves was approximately US\$1,640 billions, or US\$9,990 per hectare/year.

4.2 The Economic Value of Exploitation and Utilisation of the Wetlands along the South China Sea

According to the theory of environmental economics, the wetland resource should have an economic value. Based on fundamental economic data, the direct market value method was adopted to estimate the direct use value of the coastal wetlands along the South China Sea (Table 3).

Table 3 The Gross Product of the Main Industries Associated with Coastal Wetlands along the South China Sea from 1996 to 1999 (unit: billion RMB Yuan).

Area	Year	Total	Aquatic Products	Oil and Gas	Costal Sand Mines	Salt Industry	Coastal Shipbuilding	Transportation	International Coastal Tourism
Guangdong	1996	79.013	24.092	17.231		0.95	3.087	13.377	21.098
	1997	84.976	23.988	19.309		0.051	3.078	16.674	21.858
	1998	79.1	26.4	13.4	0.03	0.1	3.2	13.1	22.8
	1999	89.6	31.6	16.7	0.1	0.1	3.6	12.1	25.4
Guangxi	1996	7.614	5.586			0.033		1.968	0.027
	1997	7.765	7.324			0.024		0.36	0.03
	1998	9.3	8.8		0.002	0.04		0.4	0.1
	1999	10	9.5		0.002	0.05		0.4	0.1
Hainan	1996	4.302	2.774			0.053		0.812	0.658
	1997	4.72	3.105			0.025	0.012		0.723
	1998	5.3	3.8		0.02	0.1		0.8	0.6
	1999	5.5	4.8		0.02	0.03			0.6
Total		387.19	152.79	66.64	0.174	0.601	12.977	59.991	94.021
Annual Mean		96.798	38.198	16.66	0.044	0.151	3.244	14.997	23.505

4.2.1 Total Benefit Value of the Coastal Wetland Ecosystem in the South China Sea

In 2000, two Chinese researchers, Zhang Zhong-xin and Zhang Xinshi, estimated the value of the wetland ecosystem in the South China Sea. By their estimation, the benefit value of the wetland ecosystem in China is approximately 2,676.351 billion RMB Yuan per year. In 2003, the area of wetlands in China was estimated to be 3,848hm². According to remote sensing estimations of the wetlands in the South China Sea, the area of the coastal wetland in the South China Sea was 15,333.35km². According to the above parameters, the benefit value of the coastal wetlands in the South China Sea was calculated to be approximately 106.46 billions RMB Yuan per year.

4.2.2 Assessment and Analysis of the Value of Wetland Tourism along the South China Sea

The Value of Wetlands for Tourism and Education and Scientific Research

1. The Tourist Value of Wetlands

Wetlands are often areas for tourism because of their high biodiversity. Wetland biodiversity is attractive due to the high number of species found there, their unique habitats, communities, ecosystems, landscape, natural processes, and special wetland types. For example, the Futian mangrove wetland protected area in Shenzhen occupies 367.5ha, and provides the habitat for many winter migratory birds. Every year, many people come here to visit the reserve, for both study and tourism, which brings many economic benefits to the surrounding region. In the area of the South China Sea, there are many such areas like Futian, and many famous wetlands are already famous tourist destinations now.

2. Value for Education and Scientific Research

Wetlands provide a good laboratory for many scientific activities (for example monitoring, experiments, and comparison). Wetlands are increasingly the site for research studies on global change trends, because wetlands carry both the past markers and today's eco-processes. Through these studies, scientists can begin to understand more about the evolution process between humans and nature.

In addition, scientists need to also maintain wetlands as areas for education and research. Wetland ecosystems, with their diverse communities and species which are endangered, have an important value for scientific research, because they provide the objects, material, and experiment for these studies. In some wetlands, biological and geological information has been maintained.

Analysis of the Value of Wetland Tourism along the South China Sea

There are many famous tourist sites in South China Sea wetlands. For example, in Guangdong, these famous tourist sites include the Dameisha and Xiaomeisha coastal wetland areas in Shenzhen, the Futian Mangrove Wetland Protected Area in Shenzhen, the Coastal Park in Zhuhai, and Shangchuan Island and Zha-po in Yangjiang; in Hainan, the famous tourist sites include Dadonghai and the East Coco Forest in Wenchang; and in Guangxi, a famous tourist site is the Silver Beach in Beihai.

These wetland tourist sites provide great benefits to South China Sea region. According to the statistics, the average mean of tourists between 1999 and 2001 reached 30.3435 million, and the income produced was 39.738 billion RMB Yuan. In the Pearl River Estuary, the income from wetland tourism reached 32.73 billion RMB Yuan (Table 4).

Table 4 Total Economic Income of Tourism of South China Sea Wetlands.

Province	District	Number of traveller (million person-time)	Outlay income (billion Yuan)	Total
Guangdong	Shantou	2.1290	3.538	Average number of travellers from 1999 to 2001 reaches 30.3435 million person-time, the income reaches 39.738 billion Yuan
Guangdong Pearl river delta	Guangzhou	6.5211	8.515	
	Shenzhen	6.1250	7.420	
	Zhuhai	4.2930	7.860	
	Zhongshan	3.1260	4.522	
	Jiangmen	5.4462	4.413	
Guangxi chuang municipality	Hepu	0.3216	0.413	
	North beilunkou	0.1620	0.208	
Hainan	Wenchang	1.2594	1.616	
	Danzhon-lingao	0.9612	1.233	

4.2.3 Environmental Economic Analysis of the Value of Land Resources along the South China Sea

Wetlands are a type of land resource, because they have a potential land value. Without wetlands, there will be no people. Wetlands will have a high value when people conduct business and market exchange based on their resources. The value of wetlands differ in various locations. The value is high in rich economic regions, while low in poor economic regions. The value of different wetlands will change with its type, purpose, and location. The six wetland demonstration areas in the South China Sea were analyzed for their land value in Table 5 below.

Table 5 Analysis of Land Resource Value along the South China Sea.

	Shantou	The Pearl River Estuary	Hepu	Beilun Estuary	Wenchang	Danzhou-lingao	Total
Area (ha)	20,090.92	12,783.43	3,950.68	1,082.84	217.69	805.69	38,931.25
Value/unit Million RMB Yuan/ha	2.001	8.004	1.0005	1.0005	1.502	1.502	
Total Value Billion Yuan	40.202	102.318	3.952	1.083	0.327	1.21	149.092

4.2.4 Analysis of the Transportation Value of Wetlands along the South China Sea

The coastal seaports along the South China Sea are often located in areas of coastal wetlands. In Guangdong, there are 65 seaports, 1,430 docks, 155 ten thousand docks, throughput reached 0.2346 billion tonnes, and income reached 12.148 billion Yuan (Table 6).

Table 6 Economic Income from Transportation at Wetland Seaports and Gulfs along the South China Sea (1999-2001).

	Guangdong		Guangxi		Hainan		Total
	Shantou	The pearl river estuary	Hepu	Beilun estuary	Wenchang	Danzhou-lingao	
Billion Yuan	2.123	7.026	0.782	0.513	0.634	0.351	11.206
Rate (percent)	18.9	62	6.9	4.5	5.6	3.1	100

4.2.5 Value of Ecological Services of Wetlands along the South China Sea

The value of the ecological services of three of the six wetland demonstration areas of the GEF project in the South China Sea were determined: the Shantou wetland, the Pearl River Estuary, and Hepu wetland areas.

1. The Value of the Ecological Services of the Shantou Wetland Demonstration Area

The total area of the Shantou Wetland Demonstration area is approximately 20,090.92hm². The resource value, environmental value, and human cultural values were estimated as follows in Table 7.

Table 7 Assessment of the Principle Ecological Services Values of the Shantou Wetland Demonstration Area.

Values	Categories	Basis for Calculation	Value per Unit Area (RMB Yuan/hm ² /year)	Value (ten thousand RMB Yuan/year)
Resource Value	Land	Land usufruct : 200.1 ten thousand RMB Yuan/hm ²	2,001,000	4,020,193.09
	Mangrove forest	The biomass is 46.20t/ha, the price for timber purchasing is 0.4Yuan/kg; one time every 30a for cutting down; the area of mangrove forest is 1,192hm ²	616	73.43
Environmental Value	Habitat protection	Based on the world average mean for wetland ecosystem habitat protection	2,520	5,062.91
	Purifying water quality	Based on the world average mean for wetland water purification	3,500	7,031.82
	Water regulation	Based on the world average mean for wetland water regulation	3,200	6,429.09
Human Cultural Value	Tourism	The price of entrance ticket is 50Yuan/person, annual mean tourists is about 30 ten thousands	6,250	1,500.00
		The price of the other tourism items is two times the price of the entrance ticket	12,500	3,000.00
	Research and Education	Based on the world average mean for wetland research and education	7,300	14,666.37

2. The Value of the Ecological Services of the Pearl River Estuary Wetland Demonstration Area

The total area of the Pearl River Estuary Wetland Demonstration Area is approximately 12,783.43 hm². The resource value, environmental value, and human cultural values were estimated as follows in Table 8.

Table 8 Assessment of the Principle Ecological Services Values of the Pearl River Estuary Wetland Demonstration Area.

Values	Categories	Basis for Calculation	Value per Unit Area (RMB Yuan/hm ² /year)	Value (ten thousand RMB Yuan/year)
Resource Value	Land	Land usufruct: 800.41 ten thousand RMB Yuan/hm ²	8,004,000	10,231,985.20
	Mangrove forest	The biomass is 112.60t/ha, the price for timber purchasing is 0.4Yuan/kg; one time every 30a for cutting down; the area of mangrove forest is 1,859hm ²	1,501	279.03
Environmental Value	Habitat protection	Based on the world average mean for wetland ecosystem habitat protection	2,520	3,221.42
	Purifying water quality	Based on the world average mean for wetland water purification	3,500	4,474.20
	Water regulation	Based on the world average mean for wetland water regulation	3,200	4,090.69
Human Cultural Value	Tourism	The price of entrance ticket is 50Yuan/person, annual mean tourists is about 100 ten thousands	6,250	5,000.00
		The price of the other tourism items is two times of the price of the entrance ticket	12,500	10,000.00
	Research and education	Based on the world average mean for wetland research and education	7,300	9,331.90

3. The Value of the Ecological Services of the Hepu Wetland Demonstration Area

The area of Hepu wetland demonstration area is approximately 3,950.68hm². The resource value, environmental value, and human cultural values were estimated as follows in Table 9.

Table 9 Assessment of the Principle Ecological Services Values of the Hepu Wetland Demonstration Area.

Values	Categories	Basis for Calculation	Value per Unit Area (RMB Yuan/hm ² /year)	Value (ten thousand RMB Yuan/year)
Resource Value	Land	Land usufruct: 100.05 ten thousand RMB Yuan/hm ²	1,005,000	395,265.53
	Mangrove forest	The biomass is 52.72t/ha, the price for timber purchasing is 0.4 Yuan/kg; one time every 30a for cutting down; the area of mangrove forest is 1,585hm ²	702.93	111.41
Environmental Value	Habitat protection	Based on the world average mean for wetland ecosystem habitat protection	2,520	995.57
	Purifying water quality	Based on the world average mean for wetland water purification	3,500	1,382.74
	Water regulation	Based on the world average mean for wetland water regulation	3,200	1,264.22
Human Cultural Value	Tourism	The price of entrance ticket is 30 Yuan/person, annual mean tourists is about 50 ten thousands	6,250	1,500.00
		The price of the other tourism items is two times of the price of the entrance ticket	12,500	3,000.00
	Research and education	Based on the world average mean for wetland research and education	7,300	2,883.99

5. THE LEGISLATION AND MANAGEMENT SYSTEM FOR WETLANDS PRESERVATION IN THE SOUTH CHINA SEA REGION

5.1 Relevant Administrative Bodies and Conservation Action Programmes

5.1.1 Establishment of Administrative Bodies

National Administrative Bodies

The administrative bodies that are responsible for the protection of wetlands include the State Environmental Protection Administration, the Ministry of Forestry, the Ministry of Agriculture, the State Scientific and Technological Commission, the State Oceanic Administration, and the Ministry of Construction.

1. *The Status of Environmental Protection Administration*

The State Environmental Protection Administration is a functional department under the State Council, which is directly responsible for environmental protection in China (Legal Office of the State Council, 2000). It is not only responsible for the general management and supervision of nature reserves and species, but also the integrated co-ordination of efforts in different areas to protect the biodiversity of China.

The Department of Nature and Ecological Conservation under the State Environmental Protection Administration is the primary agency responsible for wetland protection and the affairs related to it. Its main responsibilities are as follows: to formulate and supervise the enforcement of the nature conservation laws and regulations; to formulate the plan for biodiversity conservation; to develop the national plan for nature reserves; to propose recommendations for establishing new nature reserves of various kinds at the national-level; to supervise the management of national-level nature reserves; to supervise environmental protection efforts in the activities of natural resource exploitation; to guide and monitor land reclamation in mining areas, the recovery of ecological damages, wetland conservation, and desertification prevention and control; to supervise the management of marine environmental pollution prevention and control related to coastal projects and land-based activities; to manage the environmental safety of biotechnology; and to manage rural ecological conservation projects and guide the construction of national ecological demonstration areas and eco-agriculture projects.

2. *The State Forestry Administration*

The State Forestry Administration is a functional department directly under the State Council responsible for the management and protection of forests and terrestrial wildlife resources (Legal Office of the State Council, 2000).

3. *The State Oceanic Administration*

The State Oceanic Administration is the administration under the Ministry of Land and Resources responsible for supervising the use of the seas, protecting the oceanic environment, safeguarding oceanic rights and interests, and organising research on oceanic science and technology.

The main responsibilities of the Department of Oceanic Environmental Protection under the State Oceanic Administration are as follows: organising the investigation, surveillance and assessment of the oceanic environment; monitoring the pollution caused by oil exploration and exploitation at sea caused by dumping waste into the ocean and oceanic construction projects; drafting the programmes, standards and criteria for oceanic environmental protection and restoration; drafting the standards for pollutant emission and discharge into the ocean; establishing the overall control systems; supervising pollutant discharges from the land into the ocean pursuant to national standards; supervising the oceanic nature reserves and specially protected areas; organising the observation and monitoring of the oceanic environment; and managing the disaster forecast and alarm system.

4. *The Ministry of Agriculture*

The Ministry of Agriculture is a functional department directly under the State Council responsible for the management of agriculture, fisheries and livestock production. It is responsible for protecting the natural environment and animal and plant resources in agricultural wetlands.

The responsibilities of the Fisheries Bureau under the Ministry of Agriculture include: studying and proposing recommendations for fishing development strategies and programmes, technology improvement measures, and relevant laws, regulations, and policies; formulating and implementing the policies, measures, and programmes for the protection and wise use of fishery resources, and protection of the natural environment of fishery areas and aquatic wildlife.

The responsibilities of the Animal Husbandry and Veterinary Bureau are: protecting and using grassland resources wisely, protecting the natural environment, and organising the protection and wise use of domestic animal and bird species, livestock resources, and fodder resources.

The responsibilities of the Department of Crop Industry Management are: studying and proposing recommendations for policies to promote the development of the crop production industry, including broad development strategies, programmes and the annual plan; guiding the adjustment of the structure and overall arrangement of the crop production industry; drafting relevant laws, regulations, and rules on the crop production industry; formulating related standards and technical criteria; studying and proposing policies and measures on the protection, compensation, and improvement of cultivated land; implementing programmes and supervising and enforcing policies and programmes.

Local Administrative Bodies

Among the local administrative bodies at various levels of government, the departments of environmental protection, forestry, agriculture, oceans and aquatic species are concerned with the protection of the natural environment and biodiversity in wetlands. But the administrative institutions at the provincial level are different in various Provinces. In Guangdong Province, the departments of oceans and aquatic species have been combined into one department, the Department of Oceans and Aquatic Species, while in the Guangxi Zhuangzu Autonomous Region and the Hainan Province, these two departments remain distinct entities. In Hainan, the departments of environmental protection, and land and resource management, have been united as the Department of Environment and Land Resources, while in Guangxi and Guangdong, the Environmental Protection Bureaus are independent administrations. Their functions are similar to those of the national administrative bodies (Environmental Protection Bureau of Guangdong Province, 2000).

The Departments of environmental protection, forestry and oceans are responsible for wetland nature reserves. The institutional arrangements for management of nature reserves are introduced below.

5.1.2 Conservation Action Programmes

There are several conservation action programmes for the protection of wetlands, which are mainly national programmes, including the following:

1. *China's Agenda 21 Process*

In order to implement the national sustainable development strategy, the State Council of the Chinese Government passed and published "China's Agenda 21-Report on China's Population, Environment and Development in the 21st Century" in May 1994 (Legal Office of the State Council, 2000). It describes the sustainable development strategy, policy, and action framework for China's population, economics, society, resources, and environment. The protection and wise use of wetlands were mentioned in many sections of the report.

2. *Action Plan for the Conservation of Biodiversity*

The Action Plan for the Conservation of Biodiversity was finalised in 1994. It is the principal document guiding the conservation of biodiversity in China. The Action Plan sets forth the threats to various biological resources and their ecological systems, including wetland resources, and the causes of those threats. It proposes the general objectives, specific objectives, and action plan for the conservation of biodiversity. It also proposes the measures by which the action plan should be carried out.

3. *China's Agenda 21-Action Plan for Forestry*

The Action Plan for Forestry was formulated in 1995 as one of the special action plans to implement "China's Agenda 21." It set forth the general strategic objectives and policies on Chinese forestry development. The report also proposed the objectives and action framework for the conservation and wise use of wetland resources.

4. *China National Wetland Conservation Action Plan*

China's National Wetland Conservation Action Plan was formulated in 2000 and serves as the principle guiding document on the protection, management, and sustainable use of wetlands in China. The report sets out the guidelines, objectives, and preferential actions for wetlands protection.

5.2 Introduction to the Creation of Nature Reserves

5.2.1 Wetlands and Wetland Nature Reserves in Guangdong Province

By the end of 1999, there were 27 wetland nature reserves that had been established in Guangdong Province. There are four national nature reserves, including the: (1) Guangdong Neilingding – Futian Nature Reserve, (2) Guangdong Zhanjiang Mangrove Nature Reserve, (3) Huidong Port Turtle Nature Reserve, and (4) Zhaoqing Xinghu National Scenic Spot. There are seven provincial nature reserves, including the: (1) Haifeng Gongpingdahu Nature Reserve, (2) Nanao Migratory Birds Nature Reserve, (3) Daiyawan Aquatic Species Nature Reserve, (4) Guangdong Leizhou White-Butterfly's Shellfish Nature Reserve, (5) Longchuan Fengshuba Nature Reserve, (6) Heyuan Xingang Nature Reserve, and (7) the Qujiang Luokeng Nature Reserve. There are 16 nature reserves at the city or county level.

These wetland nature reserves in Guangdong Province can be classified by the habitat protected. There are 15 offshore and coastal wetland nature reserves, two potamic wetland nature reserves, seven lacustrine wetland nature reserves, one swampy wetland nature reserve, two pond wetlands, and one geothermal wetland. The wetland nature reserves can also be classified in terms of the flora and fauna protected. There are seven reserves that protect the species in mangroves, 12 wetland nature reserves providing habitat for migratory birds, eight wetland nature reserves for the protection and breeding of aquatic species, and seven wetland reserves for the protection of other species.

Of the wetland nature reserves in Guangdong Province, as in Guangdong, the offshore and coastal wetland nature reserves and the nature reserves for protection and breeding of aquatic species are the largest. The proportion of their surface area to that of all the wetland nature reserves, 49.86 percent to 66.45 percent, is also the highest, which indicates that Guangdong Province has a high degree of oceanic resources.

Among the 27 wetland reserves mentioned above, 17 are managed by the Forestry Administration (including two that are managed by the Provincial Forestry Bureau), eight are managed by both the Provincial Forestry Bureau and the local Forestry Bureau at the city or county level (seven of which are managed by the local Forestry Bureau at the city or county level); eight are managed by the Marine Aquatic Species Administration (including three that are managed by the Provincial Marine Aquatic Species Department, and five that are managed by the local Marine Aquatic Species Bureau at the city or county level); one is managed by the Tourist Administration; and one is managed by the Environmental Protection Administration.

The wetland nature reserves in Guangdong Province comprise a total area of 244,856.2hm², which represents only 13.08 percent of the total wetland area in Guangdong. Therefore, these nature reserves are not sufficient to protect the natural environment and species in wetlands. According to government programmes, Guangdong Province plans to establish 31 wetland nature reserves over the period from 2001 to 2005, totalling 442,190hm², which would represent 23.62 percent of the total wetlands area of Guangdong. These wetland nature reserves will be established mainly for the protection of dolphins, different types of marine ecosystems, near shore islands, and shallow seas.

5.2.2 Wetlands and Wetland Nature Reserves in the Guangxi Zhuangzu Autonomous Region

The Guangxi Zhuangzu Autonomous Region is situated next to the Beibu Bay in southern China. The coastline begins from the Hepu Yingluo Harbour in the east, and ends in the Beilun River in the Town of Dongxing in the west. The total coastline is 2,199km long, and is winding with many bays. Along the coastline, there are many types of wetlands, including shallow seas, coral reefs, tidal seashores, mangrove swamps, lagoons, and estuaries. The climate of the region is tropical monsoon. The average yearly temperature ranges from 22 to 23°C, the average temperature in January is 15.2°C, and the average temperature in July is 28.4°C. The frost-free period is 354 days, and annual rainfall is approximately 2,000mm. It rains mostly from May to August. The main vegetation are mangrove forests, made up of *Aegiceras corniculatum*, *Avicennia Marina*, *Bruguiera gymnorrhiza*, and *Rhizophora styrosa*. The biggest mangrove forest in China's coastal area is located in this region.

There are 79 species of water birds in the coastal area in the northern Beibu Bay. This area lies on the migratory route from Northeast Asia to Southeast Asia, the Malay Archipelago, and Australia. When the migratory season occurs (in spring or autumn), there are many species of water birds migrating through the area. The extent of water birds found in the area is much greater than in the inland areas of the Guangxi Zhuangzu Autonomous Region. For example, there are 17 species found here that cannot be found inland in Guangxi.

There have been three wetland nature reserves established by the country along the coast of the Guangxi Zhuangzu Autonomous Region, which include the Shangkou Mangrove Ecological Nature Reserve, the Beilun Hekou Marine Ecological Nature Reserve, and the Dugong Marine Ecological Nature Reserve. These three nature reserves are among the first-class of national marine ecological nature reserves and are managed by the Marine Bureau of the Guangxi Zhuangzu Autonomous Region. Besides these reserves, the Guangxi Zhuangzu Autonomous Region has not yet established further nature reserves that protect wetlands in particular.

The Guangxi Zhuangzu Autonomous Region is also home to 12 man-made nature reserves, 35 watershed forest nature reserves, and eight rare animal and plant nature reserves. The wetland ecosystems in these nature reserves are well protected. But the protection of wetlands outside the nature reserves is not as good as within the nature reserves, because they lack regular and scientifically-based protection measures. Protection of wetlands outside the reserves completely depends on the degree of education and the level of management of the users of the land.

The 55 nature reserves mentioned comprise a total area of 17,099km², which represents only 7.1 percent of the total area of the district. Compared to the large area of wetlands in the Guangxi Zhuangzu Autonomous Region, the extent of nature reserves is still very small and they cannot provide enough protection for the wetlands.

5.2.3 Wetlands and Wetland Nature Reserves in Hainan Province

There are 20 different types of wetlands in Hainan Province, which comprise a total area of 311,830.2ha (excluding man-made paddy field wetlands). Shallow sea wetlands are the largest, followed by pond wetlands, and perpetual rivers. Mangrove wetlands and coral reef wetlands are the most important types of wetlands in Hainan, due to their three important characteristics:

- (1) The wetlands along the coasts are vast. There are 12 predominant types of wetlands, including shallow sea wetlands, delta wetlands, coral reefs, and mangrove swamps. The wetland area along the coasts represents 61 percent of the total wetland area in Hainan Province, while the area of shallow sea wetlands represents 26 percent of the total wetland area;
- (2) The largest mangrove wetland in China is located in Hainan Province. The area of mangrove wetlands is the largest, with the most mangrove plants in them. The total mangrove area of China is approximately 5,886.1hm², and the mangrove area in Hainan Province represents 82 percent of the total area. There are 16 families, 19 genera, and 29 species of mangrove plants in China, and 26 of these species can be found in Hainan Province; and
- (3) Hainan Province is the place where coral reef grows best in China. The area of coral reef wetlands represents 6.3 percent of the total wetland area of Hainan Province. There are many coral reefs along the coastline, especially from Wenchang to Qionghai, from Danzhou to Lingao, and in Sanya.

There are 34 varied wetland nature reserves in Hainan Province, totalling an area of 2,543,572.15ha. Hainan Province has the second most wetland nature reserves in China. These nature reserves are located in 11 cities or counties, and in Xisha and Nansha. The city of Danzhou has the most nature reserves, with a total of 11. The city of Sanya has eight nature reserves, Lingao County has five, and the city of Wenchang has two reserves. Among the 34 nature reserves in Hainan Province, there are two national nature reserves, which are the Dongzhaigang Mangrove National Nature Reserve and the Sanya Coral Reef Nature Reserve; nine provincial nature reserves; and 23 nature reserves at the city or county level.

Of the 19 mangrove wetland nature reserves in China, nine of them are located in Hainan Province, which represents 47.4 percent of the total number of mangrove wetlands. Among the seven coral reef wetland nature reserves in China, six of them are in Hainan Province, which represents 85.7 percent of the total number of coral reef wetlands. Eight of these 34 nature reserves are managed by the Forestry Administration, 12 are managed by the Environmental Protection Administration, four are managed by the Water Conservancy Administration, three are managed by the Aquatic Species Administration, two are managed by the Marine Administration, two are managed by the Agricultural Administration, and three are managed by other administrations.

5.3 Management of Wetlands and Wetland Nature Reserves

5.3.1 Management of Wetlands in Guangdong Province

1. *Fundamental Research on Wetland Resources*

In order to gain a thorough understanding of the wetland resources in the whole district, the Government of Guangdong Province has spent a lot of manpower and resources on two research studies on wetland resources and the natural environment. The first project was an investigation on the resources and ecology of coastal wetlands, which was carried out from 1995 to 1997. The second was an investigation and computer-aided mapping of wetland resources in Guangdong Province, which was carried out from 1999 to 2000. As a result of these research studies, data on the classification, quantity, quality, distribution, conditions of use and threats to wetland resources in Guangdong Province have primarily been collected. Two reports, entitled "The Report on the

Investigation into Wetland Resources in Guangdong Province” and “Report Form of the Statistics of Wetland Resources in Guangdong Province,” chiefly edited by Professor Chen Guizhu, were completed as a result of these studies. The studies also provided a good foundation to establish a database and information system on wetland resources in Guangdong Province in the future. Furthermore, the researchers gained experience in utilising technological tools to programme, manage, and use wetland resources wisely.

2. Wetlands Administration

The administrative agencies and staff responsible for managing the national and provincial nature reserves have been running smoothly, and are carrying out the job of protecting and managing wetland resources. Some nature reserves have done an exceptional job with protection and management, such as the: (1) Guangdong Neilinding Futian Nature Reserve, (2) Guangdong Zhanjiang Mangrove Nature Reserve, (3) Huidong Port Turtle Nature Reserve, and (4) Guangdong Leizhou White Butterfly's Shellfish Nature Reserve.

The administration of nature reserves at the city or county level is mostly within the departments of related organisations. For example, the administration of mangrove nature reserves is mostly under the jurisdiction of the Forestry Bureau at the county level, while the administration of aquatic species nature reserves is under the jurisdiction of the Marine Aquatic Species Bureau. Some agencies are not currently operating, and the management and protection of wetlands is not strong enough. Some nature reserves are operating effectively, such as the Xinhui Birds' Heaven Nature Reserve, Huidong White Basin Pearl Nature Reserve, Huidong Mangrove Nature Reserve, Zhuhai Mangrove Nature Reserve, and Nanhai Huangji Nature Reserve, while others are not functioning.

5.3.2 Management of Wetlands in the Guangxi Zhuangzu Autonomous Region

1. Fundamental Research on Wetland Resources

In 1994, on the basis of the “Notice on the Initiation of Research on Wetland Resources” issued by the General Office of the Ministry of Forestry in 1994, the Forestry Department of the Guangxi Zhuangzu Autonomous Region formulated a “Research Plan on the Wetland Resources in Guangxi.” (Ministry of Forestry, 2000). In order to ensure that the research could be carried out smoothly, the Government of the Autonomous Region decided to establish a co-ordinating group in 1996 according to the requirements of the “Research Plan on Terrestrial Wild Animals and Plants.” The co-ordinating group for research on wetland resources and the co-ordinating group for research on terrestrial wild animals and plants were then united. The director of this group was the Vice-Chairman of the Government of the Guangxi Zhuangzu Autonomous Region. The deputy directors and members of the co-ordinating group included the general directors of relevant departments. The co-ordinating group was responsible for ensuring that the research could be conducted smoothly. A general office was created under the research study's co-ordinating group. Both the study on wetland resources and the study on the animal resources were conducted at the same time. The study on wetland resources in the Guangxi Zhuangzu Autonomous Region was organised by the Forestry Department of the Autonomous Region (now the Forestry Bureau of the Guangxi Zhuangzu Autonomous Region) (Forestry Bureau of Guangxi Zhuangzu Autonomous Region, 2000). Several organisations contributed to the completion of the report, including Guangxi University, Guangxi Normal University, Guangxi Natural Museum, Guangxi Academy of Sciences, Administrative Agencies for Wild Animals, Plants, and Nature Reserves under the Forestry Bureau of the Autonomous Region, and the local Forestry Bureaus at the city or county level. In order to carry out the research successfully, the Forestry Department of the Guangxi Zhuangzu Autonomous Region drew upon numerous documents, and asked for the support and co-operation of relevant departments and of the Forestry Bureaus at the city or county level (Forestry Bureau of Guangxi Zhuangzu Autonomous Region, 2000). These organisations provided a great deal of organisational and technological support for the study on wetland resources. The fieldwork was completed at the end of 1999, but supplementary fieldwork was completed from January to May 2000. Based on this work, a report was published entitled the “Report on Research into the Wetland Resources of the Guangxi Zhuangzu Autonomous Region,” which was verified and accepted by the National Forestry Administration.

2. *Wetlands Administration*

To date, the only nature reserves specially designated for the conservation of wetlands in the Guangxi Zhuangzu Autonomous Region are the: (1) Hepu Shatian-Yingluo Harbour Dugong Marine Ecological Nature Reserve, (2) Shangkou Mangrove Ecological Nature Reserve, and (3) Beilun Hekou Marine Ecological Nature Reserve.

The Hepu Shatian-Yingluo Harbour Dugong Marine Ecological Nature Reserve lies along the coast in Southern China (to the east of the Guangxi Coast, next to Beibu Bay in the south). The total area of the nature reserve is 350km² and the core area is 120 km². Worldwide research on dugong species has shown that the distribution of dugongs mainly occurs between 15 and 22 degrees north latitude. The Dugong Marine Ecological Nature Reserve is located within this latitude, which is the perfect natural sea area for the dugongs. The State Council ratified this nature reserve as a national nature reserve in 1992. However, because of a budget shortfall, the management organisation was not established, and the boundaries of the reserve area were not defined. In 1996, the North Sea Marine Environmental Monitoring Centre, entrusted by the Guangxi Environmental Protection Bureau, established a protection programme and defined the boundaries and area of the nature reserve (Environmental Protection Bureau of Guangdong Province, 2000). The Management Station of the Guangxi Hepu Shatian-Yingluo Harbour Dugong Marine Ecological Nature Reserve, which was established in 1998, is responsible for the protection and management of the nature reserve, and controlling the damage to the seaweed and the living environment of the dugongs. The management organisation also monitors to ensure that people are prevented from fishing by explosion and electric fishnet. It also regularly monitors all indicator species of the natural environment that are useful for the protection of the coastal areas, in order to provide a favourable natural marine habitat for the dugongs to reproduce. This nature reserve is managed by the Environmental Protection Bureau of the Guangxi Zhuangzu Autonomous Region, under which there is a management station (Environmental Protection Bureau of Guangdong Province, 2000). The management station is also a part of the North Sea Marine Environmental Monitoring Centre. There are 23 people working in the management organisation, three of whom work in the office, five in the laboratory, two in the exploitation branch, four in the management branch, five in the Shatian Station, and four in the police station.

The Beilun Hekou Marine Ecological Nature Reserve was established by the government of the Guangxi Zhuangzu Autonomous Region in March 1990, and is one of the autonomous region-level nature reserves. The main protected species are the natural ecological system of mangroves and its related resources. This nature reserve later became designated as a national nature reserve. The boundary of this nature reserve begins from Beilun Hekou in the west, and ends in the Zhenzhugang Bay in the Bailong Peninsula in the east. It lies on the border with Viet Nam. The Beilun Hekou Marine Ecological Nature Reserve is not only one of the most important oceanic nature reserves along the south-western border of the coast of China, but also a unique mangrove nature reserve located in a minority region along China's border. The total area of the nature reserve is 11,927hm². The reserve's coastline is 105km. The reserve contains many species of mangroves, and the largest continuous South Asia tropical mangroves in China. There is a high degree of oceanic resources and diversity of creatures, which the local people often rely on for their livelihoods. The mangroves in Beilun Hekou play a very important role in maintaining the rights and interests of the estuarine territory of China. There is currently a working force of ten people in the nature reserve. In order to strengthen the management, 15 native people have been hired to protect the forests, and six guards have also been temporarily hired. The reserve staffs often exchange their experiences and improve their professional skills. It is necessary for them to master the knowledge of both the oceans and the mangrove forests to protect and make wise use of the mangroves. They not only work hard, but also continue studying to improve their jobs. The government of the Guangxi Zhuangzu Autonomous Region published a report on "Measures of the Guangxi Zhuangzu Autonomous Region on the Management of the Beilun Hekou Marine Nature Reserve" in 1994, which provided the foundation for the implementation of protection measures in accordance with the law. The management organisation has also published and implemented many bylaws, such as the "Rules of Patrol and Monitoring" and the "Responsibilities of Guards to Protect the Forest," which reinforce the protection and management of the nature reserve.

Though the establishment of these three nature reserves has greatly improved the management of the mangroves in the Guangxi Zhuangzu Autonomous Region, not all of them can be well protected. Many problems frequently arise, including, deforestation, illegal manufacturing and management within the boundaries of the nature reserves, land reclamation of oceanic shoals, and harvesting the

fruits from the mangroves. Some problems are very serious. In the town of Zhakou in the Zhakou Nature Reserve, 5,000 mus of the shoal have been reclaimed, and 2,000 mus of the mangroves have been destroyed since 1999. Although the media reported on the problem, and government at all levels ordered an investigation and punishment for those responsible, the final result is not yet clear yet. Furthermore, the mangrove nature reserves are managed by the Marine Bureau after it was established in the Guangxi Zhuangzu Autonomous Region, but the Marine Bureau is often short of personnel to address cases such as this, because it has no professional monitors like the forestry police.

Protection of the wetlands in the Guangxi Zhuangzu Autonomous Region can be attributed to the establishment of the nature reserves. There are currently 12 synthetic nature reserves, 35 waterhead forest nature reserves, and eight rare animal and plant nature reserves in the Guangxi Zhuangzu Autonomous Region. In these nature reserves, the ecosystems in the wetlands are well protected.

5.3.3 Management of Wetlands in Hainan Province

1. *Wetland Administration*

Hainan Province has abundant and varied wetland resources. Hainan's Mangrove wetlands and coral reef wetlands are of great importance to the entire nation. Nature reserves at different levels have been established to protect those wetlands of special value and great importance. Altogether, there are 34 various wetland nature reserves in Hainan Province. This number is the second largest of all China's Provinces. The government at all levels has attached great importance to the management and protection of these wetlands.

On January 3, 1980, the Dongzhaigang Mangrove Wetland was established as a provincial nature reserve by ratification of the government of the Guangdong Province. In July, 1980, the State Council recognised it as a national nature reserve. In 1992, it was placed in the list of wetlands of international importance under the Convention on the National Important Wetlands Especially as the Habitats of the Water Birds. Since the nature reserve was established, protection of mangrove forests has been strongly supported by the local government and people, and management measures to protect the resources have been highly effective. The local government, the Qionghang County government, published subsequent announcements in 1980, 1983, 1984, and 1986, requiring people to do a better job with the management and protection of the animals and plants in the Dongzhaigang Mangrove Nature Reserve. In September 1988, the People's Congress in Hainan Province passed the first local legislation on mangroves in China, entitled "Provisions of Hainan Province on the Protection of Mangroves."

Over several years, through the support of all levels of government, the management organisation of the Dongzhaigang Nature Reserve have carried out the following responsibilities: (1) The government organised several joint defence and protection committees with participation of leaders of the towns and villages, and thus strengthened the management of resources in the nature reserve; (2) The Sanjiang Management Station and the Tashi Management Stations were created with full-time enforcement officers, which contributed a lot to the protection of the nature reserve; and (3) Police stations were established to investigate and penalise those persons destroying the forests.

5.3.4 The Wetland Management System and Legislation of the Hong Kong Special Administrative Region (HKSAR)

1. *The Wetland Management System*

The functions of this agency in terms of nature protection are as follows:

- a. To manage national parks, special areas, marine parks and marine reserves in order to realise the aim of nature conservation, recreation, tourism, and education, etc;
- b. To offer advice on nature conservation and development, formulate plans and strategies and environmental impact assessments, and recognise the regions with special scientific values;
- c. To raise public awareness of nature protection, and execute rules and regulations on nature protection;

- d. To co-ordinate nature protection programmes and development strategies for harbours and airports, in order to mitigate their effect on the ecology; and
- e. To regulate the international trade in endangered species through permits and licenses, and also constrain the illegal trade in endangered species that happens through Hong Kong.

2. Wetland Conservation Regions and Administrative Measures

In Hong Kong, most of the wetlands are located in the northwest of the New Territories section of Hong Kong. They include mangroves, mudflats, reedbeds, fishponds and gei wai (inter-tidal shrimp ponds), etc. In September 1995, the central government, in accordance with the Ramsar Convention, recognised the 1,500hm wetland in Mai po and the Inner Deep Bay as a Ramsar Wetland.

Wetland protection in Hong Kong is the responsibility of the AFCD, which also co-operates with some environmental protection agencies, as well as the public, to implement environmental protection programmes.

3. Important activities and programmes

In 1996, the then Agriculture and Fisheries Department (now renamed the Agriculture, Fisheries and Conservation Department) commissioned a consultancy study on the "Development of a Comprehensive Conservation Strategy and Management Plan in Relation to the Listing of the Mai Po and Inner Deep Bay Site as a Wetland of International Importance under the Ramsar Convention:"

- a. Protective aims: to achieve the aim of conservation and wise use of wetlands and their resources by means of maintaining and increasing their biodiversity (especially bird species);
- b. Administrative aims: to perform the international obligations under the Ramsar Convention; to maintain and raise the standard value of the wetland under the Ramsar Convention; to maintain and increase the value of biodiversity comprehensively; to educate citizens and raise their knowledge of the value of wetlands in order to explore the full potential of the wetland; and to promote Hong Kong's opportunities while undertaking the regional and international obligations of the Ramsar Convention and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
- c. Management Agencies: the AFCD is the designated administrative management agency of the Ramsar wetland and the Director of the AFCD works as the management authority of the Ramsar Convention. Moreover, a wetland advisory committee composed of both members from within and outside of the government has been founded to provide advice to the Director of the AFCD; and
- d. Division of Management Regions.

4. Legislation Related to Wetlands

- So far, there is no legislation that particularly addresses wetlands in Hong Kong. However, numerous statutes have some elements related to wetland protection.
- The above legislation emphasizes the management and protection of the animals, plants, and special areas of great ecological value in Hong Kong.
- The Rules and regulations related to wetland protection include.
- Up to now, the existing legislation related to animals, plants and environmental protection has been adequated.

5.3.5 The Wetland Management System and Legislation of Macau

In order to effectively protect the mangrove resources in Macau, the local government plans to develop two wetland protection zones. One of them is the natural conservation region, covering an area of approximately 40 hectares, located on the west bank of the city of LuDang in the sea stuffing area. This wetland zone extends from the site of the original Future Yacht Club to the LuHuan sewage factory. The government plans to separate the protection zone from the surrounding highways in order to create good conditions for meeting the needs of ecological protection, environmental education, and tourism. The other piece of the wetland protection zone is a swamp of 15 hectares.

The agency responsible for environmental matters in the Macau government is the Environmental Committee. It operates the functions of formulating policies on environmental protection, putting forward legislative advice on environmental and ecological protection, supervising the execution of environmental laws, and implementing environmental education programmes, etc..

5.4 Wetland Laws and Regulations

5.4.1 Legislation on Land and Maritime Resources

Current Legislation

Costal wetlands are usually located at the intersection of the land and the sea. They are often made up of certain areas of land and maritime space, so land and marine resources are two important resources in the wetlands. The legislation on these two resources includes:

National Statutes

1. Land Administration Law of the People's Republic of China

In order to strengthen the wise use and management of land, the "Land Administration Law of the People's Republic of China" was promulgated in 1986, and modified in 1998. Several systems were further improved, e.g., land tenure, land programming, expropriation, and compensation for land. Moreover, "sustainable development" was regarded as the guiding tenet behind this law. The co-ordination between the exploitation and protection of the land was emphasized. Several new systems were introduced into this law, such as the system of control of land use, the system of protection of cultivated land, and the system of overall control of land use. The modified law reflected the new developments and requirements of the legislation on resources. In 1998, the State Council published the "Regulations for the Implementation of Land Administration Law of the People's Republic of China," which provided further interpretation of the law and help to enforce it effectively.

2. Marine Environment Protection Law of the People's Republic of China

In order to strengthen the management of the marine environment, the "Marine Environment Protection Law of the People's Republic of China" was promulgated in 1982, and modified in 1999. Some provisions were substantiated, including the management of pollution within specified times, the evaluation of influences on the environment, "three simultaneities" and civil compensation for marine environmental pollution. Several new legal provisions were introduced in the law to ensure marine ecological protection and programmes for marine environmental protection, including: the overall control of the amount of pollutants in key maritime areas, standards for the marine environment, charges for pollution and dumping, prohibition of backward techniques and equipment that do great harm to the marine environment, supervision of the marine environment and management of supervision information, provisions for responding to marine pollution emergency accidents, provisions for on-the-spot inspections, requirements for marine oil pollution insurance, and establishment of a fund for compensation for oil pollution damages.

3. Fisheries Law of the People's Republic of China

The Fisheries Law of the People's Republic of China was enacted in 1986 and modified in 2000. The promulgation and implementation of the modified fisheries law gave prominence to the protection of fishery resources and the natural environment. In the past, there was no supervision or management of bait and feed use during the course of breeding, which led to the degradation of the quality of aquatic species. Therefore, a new provision was added to the modified fisheries law, which stipulated, "People who are engaged in aquatic breeding should not use bait or feed containing poisonous or harmful substances." In some places, water bodies are heavily polluted because some aquaculturists use fertilisers, bait and medications, and discharge sewage arbitrarily. A new provision was added which stipulated that persons engaged in aquatic breeding should "scientifically determine the breeding density, and use fertilisers, bait, and medication reasonably. Furthermore, they should not pollute the water bodies used for aquatic breeding." A unified programme for protection of water bodies by the state was stressed. The system of aquatic breeding licenses was modified and improved, and the protection of the water bodies used for aquatic breeding was also stressed. The management of young aquatic species was standardised. The prevention and cure of diseases in breeding was added. At the same time, attention was paid to the control of fishery intensity and adjustment of the structure of fisheries. Related legal systems are being constituted and improved.

4. Law of the People's Republic of China on the Administration of Coastal Areas

The "Law of the People's Republic of China on the Administration of Coastal Areas" was promulgated on October 27, 2001, which replaced the "National Interim Provisions on the Administration of Coastal Areas." The main provisions of the law include: the partition of marine functional areas, the application and approval of the use of coastal areas, the right to use coastal areas, the using fee and the inspection of the use of coastal areas. The promulgation of the law on administration of coastal areas guarantees that Chinese marine economics will develop quickly and sustainably. It is a watershed law in the history of Chinese marine exploitation. People used to freely exploit marine resources without limit and in a disorderly fashion. Now marine resources will be utilised in a scientific, reasonable, harmonious, and orderly fashion.

In addition to these laws, the State Council and its departments, such as State Bureau of Land Management, State Oceanic Administration, State Environmental Protection Administration and Ministry of Agriculture, have promulgated many regulations. These include the Provisions on the Land Reclamation; Regulations on the Protection of Fundamental Farmland; Interim Measures for Handling Activities that Go Against the Land Administration Law; Registration Measures for the Right to Use Coastal Areas (2002); Interim Measures for the Application and Approval of the Use of Coastal Areas (2002); Mediation and Settlement Measures for Disputes Regarding the Rights to Use Coastal Areas (2002); Implementing Measures for Maritime Administrative Punishments (2003); Regulations of the People's Republic of China on the Management, Control, and Prevention of Pollution of the Marine Environment from Land-Based Pollutants (1990); Regulations of the People's Republic of China on the Management, Control, and Prevention of Pollution of the Marine Environment from Coastal Construction Projects (1990); Regulations of the People's Republic of China on the Control of Pollution Prevention from Ocean Vessels (1983); Regulations of the People's Republic of China on the Control of Dumping Wastes into the Ocean (1985); Administrative Measures on Fishery Licenses (1989); and Provisions on Fishery Administrative Punishments (1997).

Local Legislation

The government of Guangdong Province has constituted several local regulations, including: Implementing Measures of Guangdong Province for Land Administration (1986); Management Measures of Guangdong Province for the Compensation for the Expropriation of Collectively-Owned Land in the County (1994); Regulations of Guangdong Province for the Settlement of Land-Tenure Disputes (1995); Provisions of Guangdong Province for the Administration of Coastal Areas (1996); Decision on the Modification of Provisions of Guangdong Province for the Administration of Coastal Areas; Interim Standard of Guangdong Province for the Collection of the User Fee for Coastal Areas; Partition of the Environmental Functional Areas of the Seashore Coastal Areas in Guangdong Province (1999); Implementing Measures of Guangdong Province for Fishery Management (1990); Decision of the Standing Committee of Guangdong People's Congress on the Construction of Man-Made Reefs to Protect Marine Resources and the Environment (2001); and Management Measures of Guangdong Province for the Protection of Aquatic Breeding in Shallow Coastal Waters (1994).

Many counties and cities have also constituted some related regulations, for example the: Management Provisions of the Shenzhen Neilingding-Futian National Nature Reserve; Management Measures of the Huidong Port Turtle Nature Reserve; and Management Provisions of the Dayawan Aquatic Species Nature Reserve. These regulations also contained some articles related to fisheries and the use and management of coastal areas.

The government of the Guangxi Zhuangzu Autonomous Region has promulgated several local regulations, including: Implementing Measures for Land Administration; Implementing Measures for Fishery Administration; Administrative Measures for the Use of Coastal Areas (1997); Administrative Measures on Young Aquatic Species; and Administrative Provisions for the Protection of Aquatic Wildlife.

Some counties and cities have also promulgated some local provisions, such as the Standard of the City of Qinzhou for the Collection of User Fees for Coastal Areas; Provisions of the City of Beihai on the Administration of the Use of Coastal Areas; Working Scheme of the Fangcheng District on User Registration for Coastal Areas; and Administrative Measures for the Use of Coastal Areas for Aquatic Breeding in Hepu County.

The Office of Oceanography of Hainan Province has promulgated several local regulations, including the: Interim Administrative Provisions of Hainan Province on the Demonstration of Feasibility of the Use of Coastal Areas (1998); Interim Working Guide of Hainan Province on the Demonstration of Feasibility of the Use of Coastal Areas (1998); Interim Provisions of Hainan Province on the Management of Project Files on the Use of Coastal Areas (1998); and Working System on the Approval of the Use of Coastal Areas (1998). In September 1998, the People's Congress of Hainan Province promulgated the Provisions of Hainan Province on the Protection of Mangrove Forests.

Some counties and cities have also promulgated several local provisions, such as the Provisions of the City of Haikou on the Management of Coastal Area Use (1998); Interim Measures of the City of Sanya on the Management of Coastal Area Use (1992); and Implementing Measures of the City of Dongfang on the Management of Coastal Area Use (1997).

Deficiencies with Legislation

The above-mentioned laws and regulations provide protection for the wise use and management of coastal wetlands, land-use, and aquatic breeding in Guangdong Province, the Guangxi Zhuangzu Autonomous Region, and Hainan Province. The promulgation of the Law on the Administration of Coastal Areas was of great importance. This law established the basic legal systems for the management of use of coastal areas. As a result, management practices are now standardized and greatly improved. The modified Fisheries Law stipulates the legal protection for the sustainable development of fisheries. Over the past few years, the creation and modification of the laws on the management of coastal area use and aquatic breeding by the national and local government has contributed a lot to the protection of maritime wetlands. However, most of the wetland resources in these three Provinces are in economically flourishing coastal areas. For example, coastal wetlands in Guangdong Province are found along open coastal areas, where industry, agriculture, aquaculture, real estate, and tourism industry are well developed. The coastal wetlands in the Guangxi Zhuangzu Autonomous Region are also under great pressure because of the development of industry, aquaculture, real estate, and tourism. Hainan Province is located at the edge of the tropics. The growing period for crops is long and the productivity of wetlands is high. Therefore, overexploitation and blind use of wetlands are serious problems.

As a result of these threats, the main problems with the creation and implementation of the laws and regulations on the management of coastal area use are as follows:

- Lack of Integrated Legislation on Resource Limits or Integrated Management of Wetland Resources
- Lack of Updated, Effective Local Legislation
- Emphasis is on Resource Exploitation, not Conservation and Rehabilitation
- Lack of Clarity Regarding Rights to Resources

Suggestions for Improving Legislation

In order to resolve the problems with the formation and implementation of laws and regulations on the management of coastal area use, the following suggestions are made:

– Integration of Statutes

There is a trend in many countries to formulate an integrated legal system for the protection of natural resources, since separate statutes cannot adequately protect natural resources. It will be difficult to establish such an integrated legal system in China in the short-term. However, some interim measures should be taken under the framework of the current legal system to mitigate the impact of the existing problems. For example, the co-ordination of the statutes should be stressed. The responsibility for formulating laws should be given to neutral organisations, such as the People's Congress or the legal departments of the government, which may compile a code of the relevant statutes as necessary.

– Adjusting the Purposes and Principles of the Legislation

From the second half of the 20th century, environmental crises have become increasingly serious. In order to alleviate the crises, many countries have recognised the goals of "sustainable development" in their development strategies. Thus, the co-ordination between the wise use of resources and the

protection of natural environment is beginning to be emphasized in the legislation on resources. In some countries, priority has been given to the protection of the natural environment instead of the exploitation of resources. China is still a developing country. It is impossible for China to give priority to the protection of the natural environment. But the harmony between the wise use and the protection of the resources should be stressed if we want to achieve the goal of sustainable use of natural resources. Nevertheless, the legislation on resources in China seldom reflects this requirement, especially local regulations. This point should be given priority when the relevant local statutes are created and modified.

– *Updating and Modifying Local Legislation in Accordance with National Legislation*

Local governments should enact new regulations that accommodate the local situation and comply with such national laws as the Land Administration Law, Marine Environment Protection Law, Law on the Administration of Coastal Areas, and Fisheries Law. Several existing regulations need to be updated and modified, such as the Provisions of Guangdong Province for the Administration of Coastal Areas, Implementing Measures of Guangdong Province for Fisheries Management, Implementing Measures of the Guangxi Zhuangzu Autonomous Region for Fishery Administration, and Measures of Hainan Province for the Implementation of the Fisheries Law of People's Republic of China. A local legal system for the administration of use of land and coastal areas should be established.

– *Clearly Defining the Rights to Resources*

The implementation of the system of non-gratuitous use of coastal areas should be evaluated and improved. The State's ownership of coastal areas must be safeguarded. At the same time, the users' interests and the fishermen's right to protect their livelihoods should also be protected. The fishermen's right to use coastal areas should be recognised if it can be proved that they have historically used these areas for aquatic breeding. Fishermen should be given the priority rights to use the specially-demarcated coastal areas nearby their residential area, and the user fees for these fishermen should be abated or even exempted.

5.4.2 Legislation on Protection of Wetland Animal and Plant Species

Current Legislation

1. *Current Legislation for the Protection of Animals*

A. National statutes for the protection of animals

There are currently mainly two types of statutes protecting animals in China: the special legislation on the protection of animals and the legislation related to it. The special legislation includes the Law of the People's Republic of China on the Protection of Wildlife (1988), Regulations for the Implementation of the Law of the People's Republic of China on the Protection of Terrestrial Wildlife (1992), and Regulations for the Implementation of the Law of the People's Republic of China on the Protection of Aquatic Wildlife (1993). Furthermore, the Ministry of Forestry has enacted several notices and measures, such as the Administrative Measures for the Licensing of the Domestication and Breeding of Wild Animals under the State's Special Protection (1991), and Notice of the Ministry of Forestry on Proper Disposal of Terrestrial Wild Animals and Products Obtained from Abnormal Sources (1992) (Ministry of Forestry, 2000). The legislation related to the protection of animals includes the Nature Reserves Regulations of the People's Republic of China (1994), and Measures for the Management of Forestry and Wild Animal Nature Reserves (1985).

B. Local legislation for the protection of animals

The government of Guangdong Province has promulgated the Provisions of Guangdong Province on the Protection and Management of Wild Animals (2001), which was a special statute for the protection of animals. Related local legislation and regulations include the Detailed Rules for Implementation of the Regulations of Guangdong Province on the Management of Forestry and Wild Animal Nature Reserves (1986), and Measures of Guangdong Province for the Administration of Licenses on the Domestication and Breeding of the Wild Animals. Several county governments where nature reserves are located have also published some relevant provisions. For example, the government of Huidong

County published the Provisions on the Management of the Daiyawan Aquatic Species Nature Reserve (1984), and Provisions on the Sea Turtle Nature Reserve in Port (1985).

The government of the Guangxi Zhuangzu Autonomous Region has promulgated the Provisions on the Protection and Management of Terrestrial Wild Animals (1984), which provided detail information on how to apply the Regulations for the Implementation of the People's Republic of China on the Protection of Terrestrial Wildlife to the local situation. Related local legislation and regulations include the Provisions of the Guangxi Zhuangzu Autonomous Region on the Management of Forestry and Wild Animal Nature Reserves (1990), Interim Measures of the Guangxi Zhuangzu Autonomous Region for the Administration of Licenses for the Domestication and Breeding of Terrestrial Wild Animals (1995), Implementing Measures of the Guangxi Zhuangzu Autonomous Region for the Administration of Licenses for the Trade and Use of the Terrestrial Wild Animals (1995), and Interim Measures of the Guangxi Zhuangzu Autonomous Region for the Administration of Licenses to Transport Terrestrial Wild Animals (1995). Furthermore, several administrative measures on nature reserves have been adopted. The relevant local legislation covers the entire process for protection of animals, and protection measures are complete.

The People's Congress of Hainan Province amended the Measures of Hainan Province for Implementing the Law of the People's Republic of China on the Protection of Wildlife in 1986, which provided the fundamental system for the protection of wild animals. In September 1998, Provisions of Hainan Province on the Protection of Coral Reefs were published, which gave some protection to the corals and their habitat.

The existing statutes contribute to an intact legal framework for the protection of animals. Local legislation is more detailed than the national statutes, and provides the means to address special local issues. Several useful systems have been established, including:

- (a) License systems. Licenses are required if people want to make use of animals. There are different types of licenses, such as concessionary hunting licenses, hunting licenses, domestication and breeding licenses, and licenses for transporting wild animals. During the course of the implementation of the license system, much useful information has been collected, which helps the administration make an effective supervision and management of the wild animal resources.
- (b) The system for public outreach and education on the protection of wild animals. Public outreach is guided by the Regulations for the Implementation of the Protection of Terrestrial Wildlife, which stipulates that government at all levels, can choose the proper time to celebrate the "Wild Animal Month" or "Bird's Week," etc. The government may launch public outreach campaigns and education about the need for protection of wild animals. The public will be more willing to protect wild animals if they are better educated. Detailed provisions have been established in the local legislation, including Article 12 of the Measures of Hainan Province for Implementing the Law of the People's Republic of China on the Protection of Wildlife.
- (c) The system of research into animal resources and the system of animal resources data. The statutes provide that the administration should organise research on animal resources periodically and keep data on them. This is a very useful activity because the administration can get more information and understand the historical and current situation of wild animals. If the situation changes, they can find the cause easier, and predict future situations. All these systems contribute a great deal to the protection of wild animal resources.

2. Current Legislation on Plant Protection

A. National statutes on the protection of plants

The special statutes on the protection of plants in China include the Grassland Law of the People's Republic of China (1985), Forestry Law of the People's Republic of China (1984), Regulations for the Implementation of the Forestry Law of the People's Republic of China (2000), and Regulations of the People's Republic of China on the Protection of Wild Plants (1996). The statutes related to the protection of plants include the Nature Reserves Regulations of the People's Republic of China (1994), and Measures for the Management of Forestry and Wild Animal Nature Reserves (1985).

B. Local legislation on the protection of plants

The extent of local legislation on the protection of plants is small compared to that on the protection of animals. There are few special statutes related to plants, but they include the Detailed Rules for Implementation of the Provisions of Guangdong Province on the Management of Forestry and Wild Animal Nature Reserves (1986), Provisions of the Guangxi Zhuangzu Autonomous Region on the Management of Forestry and Wild Animal Nature Reserves (1990), Measures of the Guangxi Zhuangzu Autonomous Region for the Management of the Shankou Mangrove Ecological Nature Reserve, Provisions of Hainan Province on the Conservation and Management of Forest, and Provisions of Hainan Province on the Protection of Mangrove Forests promulgated, which was the first local legislation on mangroves in China.

Though there are few statutes for the protection of plants, especially plants living in wetlands, some fundamental protection systems have been established, including: (a) The license system. The government grants different types of licenses to the users of the plants in order to supervise their activities and protect the plants effectively, such as the deforestation license and herborisation license; (b) The system of research into plant resources and the system of plant resource data; and (c) The system of the forestry fund and fund for the compensation of forestry ecological benefits. These funds can provide the money for the conservation of the forest.

Problems with the Legislation

After several years of work, there is now an intact legal system for the protection of the animals and plants in China. Each level of government has constituted some relevant statutes. These local laws also provide some level of protection for wildlife. However, there are still some problems in the legislation, as outlined below:

- Fundamental Laws on Wildlife Protection are Outdated
- Articles in the Laws on Animal and Plant Protection are too abstract to be Effectively Implemented
 - The System for rewards is not practicable
 - The compensation clauses are vague
 - The statutes do not stipulate how the different departments should co-ordinate and co-operate to protect wildlife.
 - The liability that the government employees should bear when they break the law is not clear.
- Lack of Liability or Compensation Principles in the Legislation
- Lack of Attention to Local Conditions/Wildlife in Local Laws

Suggestions for Improvement of the Legislation

- National Wildlife Laws should be modified using Financial Mechanisms
- Local Legislation is Needed, Taking into Account Local Features

5.4.3 Legislation on Wetland Nature Reserves

1. Current Legislation
 - (1) National Statutes on Nature Reserves
 - (a) Nature Reserve Regulations of the People's Republic of China
 - (b) Administrative Measures on Marine Nature Reserves
 - (c) Land Administrative Measures in Nature Reserves
 - (2) Local Legislation on Nature Reserves
2. Problems with the Legislation
 - (1) The Importance of Nature Reserve Regulations is ignored
 - (2) Lack of Implementation by Local Governments
 - (3) Flaws in Design of the Management Systems
 - (4) Lack of Clarity Regarding Land Tenure in Nature Reserves
 - (5) Lack of Dispute Settlement Mechanisms

3. Suggestions for Improvement of Legislation
 - (1) Increase Consistency of Statutes
 - (2) Strengthening Nature Reserve Regulations

5.5 Problems and Resolutions with Wetland Management

5.5.1 General Problems

- (1) Lack of Human and Financial Capacity
- (2) Lack of Integrated Laws and Regulations on Wetland Management
- (3) Lack of Clear Wetland Boundary Designations
- (4) Overlapping Wetland Administration
- (5) Lack of Operation of some Nature Reserves
- (6) Pressure for Wetland Exploitation from Development
- (7) Destruction of Wetlands outside Nature Reserves

5.5.2 Resolution of Problems

- (1) Specialised administrative organisations responsible for wetland protection and management should be created and improved at all levels, with hiring of professional staff.
- (2) The integrated management of wetland resources should be reinforced, with all types of laws and regulations for the management of wetland resources enacted.
- (3) A general plan for the protection and wise use of wetlands should be put in place, which will direct all departments in the local government to consider the overall situation, long-term interests, and benefits of wetlands before their exploitation.
- (4) Additional wetland nature reserves should be established, with particular emphasis on important wetland sites.
- (5) The control over the environment in the three Provinces should be strengthened.
- (6) Public Outreach and Education on the function, values, and protection of the wetlands should be intensified.
- (7) Funds, especially for science and technology, should be increased to allow more research on wetlands to be conducted.

The following tasks should be carried out as soon as possible:

- (1) An information database and system on wetlands should be constructed as soon as possible.
- (2) The changes in wetland resources, their use, and ecological conditions should be monitored continuously and in a timely manner.
- (3) Some wetland demonstration areas should be established.

6. CONCLUSION

The investigation area of the project covers all Chinese regions along the South China Sea, including Guangdong, Guangxi and Hainan Provinces, and the Hong Kong and Macao Special Administrative Regions and their coastal areas. The geographical location is 107°59'E ~ 111°00' E', 18°05'N ~ 18°05'N.

There are a total of 179 families, 593 genera and 829 species of wetland plants in the South China Sea. Rare protected species in the research area include the following species: Category I Protected Plants: *Glyptostrobus pensilis* (Staunt.) Koch, *Cycas revoluta* Thunb, etc., 2; Category II Protected Plants: *Aquilaria sinensis* (Lour.) Gilg, *Oryza meyeriana* (Zoll.etMorex steud.) Baill subsp *granulata* (Nees et Arn.ex Watt), *Nelumbo nucifera* Gaertn, *Brainea insignis* (Hook.) J.Sm etc., 9.

In the South China Sea, there are 490 species of zooplankton, 649 species of large benthic animals, 332 species of fish, 29 species of amphibians, 43 species of reptiles, 238 species of birds, and 35 species of mammals. There are 18 species of peculiar animals, 76 endemic species, and among these, there are 3 endemic amphibian species, 10 endemic reptile species, 55 endemic bird species,

and eight endemic mammal species. There are 95 rare species, including eight large benthic animals, eight amphibians, 12 reptiles, 44 birds, and 23 mammals. There are 30 endangered and threatened species, including seven species of reptiles, 17 species of birds, and six species of mammals. There are 168 migratory species in the South China Sea, including five reptiles, 146 birds, and 17 mammals.

There are both natural and man-made present and future threats to the South China Sea wetlands. Natural threats include the effects of global climate change, disasters of typhoons and giant tides, and frequent occurrences of red tide, all of which endanger marine organisms and reduce biological diversity. The primary man-made causes of wetland loss include the blind reclamation of wetlands and destruction of mangrove and coastal wetlands and their natural environment due to increased urbanisation and development of industry, pollution threats to the wetlands, and over-exploitation of the biological resources of wetlands.

Current problems with the legislation on wetlands include the following: there is no comprehensive legislation on wetlands to provide an integrated approach to wetlands administration, the speed of development of local legislation is too slow and can't keep up with the practical requirements, and there has been more attention paid to wetland exploitation than protection of the resources. The status of resources is not clear. In order to address the existing problems with wetland administration and protection in the legislation, several proposals were put forward: strengthening and harmonising wetlands legislation, and clarifying the legislative goals and purposes. Amendments to national legislation must be carried out as quickly as possible. In terms of clarifying property rights, due consideration must be given to each side as much as possible.

In order to improve the existing problems with wetland administration, the following measures have been proposed:

- Establish a special agency responsible for comprehensive wetland protection at all levels, equipped with professional and highly-skilled personnel;
- Strengthen the integrated administration of wetland resources, improve the laws and regulations for all types of wetland resources, prepare a wetland protection scheme and comprehensive plan for the use of wetlands, which will lead local agencies to develop a comprehensive viewpoint on wetland use which takes into consideration the long-term benefit of wetlands;
- Further strengthen the establishment of wetland nature reserves, in order to ensure that important wetlands receive proper protection;
- Strengthen the environmental management of wetlands in the three Provinces;
- Strengthen environmental outreach and public awareness and education programmes on the functions, benefits, and protection of wetlands; and
- Increase financial outlays, to increase the science and technology input, and strengthen research on wetlands.

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