Xiamen:
An ICM Journey

SECOND EDITION

GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)

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S E C O N D E D I T I O N

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Xiamen: An ICM Journey
Second Edition

November 2006

Published by the GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA).

Printed in Quezon City, Philippines

PEMSEA. 2006. Xiamen: An ICM Journey. Second Edition. PEMSEA Technical Report No. 18, 86 p. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), Quezon City, Philippines.

ISBN 978-971-812-017-0

A GEF Project Implemented by UNDP and Executed by IMO

MISSION STATEMENT

The Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) aims to promote a shared vision for the Seas of East Asia:

> "The resource systems of the Seas of East Asia are a natural heritage, safeguarding sustainable and healthy food supplies, livelihood, properties and investments, and social, cultural and ecological values for the people of the region, while contributing to economic prosperity and global markets through safe and efficient maritime trade, thereby promoting a peaceful and harmonious co-existence for present and future generations."

PEMSEA focuses on building intergovernmental, interagency and intersectoral partnerships to strengthen environmental management capabilities at the local, national and regional levels, and develop the collective capacity to implement appropriate strategies and environmental action programs on self-reliant basis. Specifically, PEMSEA will carry out the following:

- build national and regional capacity to implement integrated coastal management programs;
- promote multi-country initiatives in addressing priority transboundary environment issues in sub-regional sea areas and pollution hotspots;
- reinforce and establish a range of functional networks to support environmental management;
- identify environmental investment and financing opportunities and promote mechanisms, such as public-private partnerships, environmental projects for financing and other forms of developmental assistance;
- advance scientific and technical inputs to support decisionmaking;
- develop integrated information management systems linking selected sites into a regional network for data sharing and technical support;
- establish the enabling environment to reinforce delivery capabilities and advance the concerns of nongovernmental and community-based organizations, environmental journalists, religious groups and other stakeholders;
- strengthen national capacities for developing integrated coastal and marine policies as part of state policies for sustainable socioeconomic development; and
- promote regional commitment for implementing international conventions, and strengthening regional and subregional cooperation and collaboration using a sustainable regional mechanism.

The 12 participating countries are: Brunei Darussalam, Cambodia, Democratic People's Republic of Korea, Indonesia, Japan, Malaysia, People's Republic of China, Philippines, Republic of Korea, Singapore, Thailand and Vietnam. The collective efforts of these countries in implementing the strategies and activities will result in effective policy and management interventions, and in cumulative global environmental benefits, thereby contributing towards the achievement of the ultimate goal of protecting and sustaining the life-support systems in the coastal and international waters over the long term.

Dr. Chua Thia-Eng
Regional Programme Director
PEMSEA

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List of Abbreviations and Acronyms

BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
EKC	-	Environmental Kuznets Curve
EMS	-	Environmental Management System
EPBs	-	Environmental Protection Bureaus
ERA	-	Environmental Risk Asssessment
FDIs	-	Foreign Direct Investments
GDP	-	Gross Domestic Product
GEF	-	Global Environment Facility
GIS	-	Geographic Information System
GPS	-	Global Positioning System
ICM	-	Integrated Coastal Management
IEIA	-	Integrated Environmental Impact Assessment
ITC-CSD	-	International Training Center for Coastal Sustainable Development
IMO	-	International Maritime Organization
IOC-UNESCO	-	Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization
ITTXDP	-	Integrated Task Team for Xiamen Demonstration Project
LGU	-	Local Government Unit
MEG	-	Xiamen Marine Experts Group
MMCC	-	Marine Management Coordination Committee
MMCO	-	Marine Management Coordination Office
MMD	-	Marine Management Division
MMO	-	Marine Management Office
mmt	-	million metric tons
MPP-EAS	-	GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas
PEMSEA	-	GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia
PLA	-	People's Liberation Army
PMO	-	Project Management Office
PNLG	-	PEMSEA Network of Local Governments for Sustainable Coastal Development

RA	-	Risk Assessment
RMB	-	Ren Min Bi (Chinese currency)
RS	-	Remote Sensing
RNLG	-	Regional Network of Local Governments
SEMP	-	Strategic Environmental Management Plan
SEPA	-	State Environment Protection Agency
SEZ	-	Special Economic Zone
SFA	-	State Fishery Administration
SHSA	-	State Harbor Superintendence Administration
SOA	-	State Oceanic Administration
SOEs	-	state-owned enterprises
UNDP	-	United Nations Development Programme
XDP	-	Xiamen ICM Demonstration Project
XOFB	-	Xiamen Oceans and Fisheries Bureau

Acknowledgements

The GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) produced this material as part of its efforts to share knowledge and practical experiences in integrated coastal management. The initial draft of this document was prepared by a Project Task Team composed of Dr. Xue Xiongzhi, Prof. Huasheng Hong and Ms. Xu Xiaochum of the Xiamen International Training Center for Coastal Sustainable Development and Mr. Wang Chunsheng of the Xiamen Ocean and Fisheries Bureau, in fulfillment of a contract with PEMSEA.

The final output benefited from the technical rewrite of Ms. Catherine Frances J. Corpuz, PEMSEA Technical Officer for Public-Private Partnerships, with input from Dr. Chua Thia-Eng, PEMSEA Regional Programme Director; Mr. S. Adrian Ross, PEMSEA Senior Programme Officer; and Ms. Maria Corazon Ebarvia-Bautista, Technical Officer (Economics).

For this second edition, editorial support by Mr. Cristine Ingrid Narcise, Ms. Maria Corazon Ebarvia-Bautista, Ms. Bresilda Gervacio, Ms. Belyn Rafael, Ms. Daisy Padayao, Ms. Caroline Velasquez, Mr. Nogel S. Viyar, Ms. Anna Rita Cano and Mr. Jonel Dulay of the PEMSEA Regional Programme Office are likewise appreciated.

Introduction

The past few decades have seen China become a dominant economic force with the standard of living for its people, especially for those in the East and Southeastern coastal provinces, rising to unprecedented levels. In retrospect, however, industrialization is often linked to deteriorating environmental quality, and if the proponents of the Environmental Kuznets Curve (EKC) are correct, rarely turn around until a country has increased its standard of living.[1] These environmental problems occurred in developed countries and were subsequently dealt with in stages. Unlike the experience of the western economies, China's fast-paced development means many of those steps are happening simultaneously.

Needless to say, income growth without institutional reform will not suffice. Environmental improvement is not automatic with rising income and is dependent on the ensuing policies and institutions. Whereas GDP growth creates the conditions for environmental improvement by raising the demand for better environmental quality and provides the necessary resources for supplying it, whether the desired environmental quality improves depends on government policies, institutions, and market conditions.

Contemporary China continues to strive for industrial growth but cannot afford to delay action needed to repair the damaged environment it has inherited. Fortunately, the government has made pollution control an official goal and has recognized that lessons from other nations can be useful in curtailing further ecological degradation in the country.

Xiamen City was the recipient of the 2003 Nations in Bloom Award and the UN Habitat Scroll of Honor Award 2004.These international competitions focus on best practices that improve the quality of life by providing adequate shelter and creating livable communities.

[1] *Named after Simon Kuznets, a Nobel Prize awardee for Economics, the EKC shows a systematic relationship between income changes and environmental quality. It assumes that a certain level of economic prosperity must be attained before stringent environmental protection and regulations can be implemented and that environmental degradation is an unavoidable cost of economic growth.*

Table 1. Selected Xiamen Socioeconomic Indicators.

Length of Coastline (km)	234
Sea Area (km^2)	390
Land Area (km^2)	1,565
Population (million)	2.17 (2004)
GDP (billion RMB)	25.02 (1995)
	88.3 (2004)
Per Capita Net Income of Urban Residents (RMB)	12,915 (2003)
Total Industrial Value (billion RMB)	172.9 (2004)
Import and Export Trade Volume (billion $)	24.1 billion S$ (2004)
Value of Ocean Industry (billion RMB)	17.8 (2003) (23.44% of GDP)
Green Space (m^2/capita)	9.7 (2001)
Industrial Solid Waste Generated (tons)	44,330 (2001)
City Wastewater Generated (million tons)	
·Industrial	29.15 (2001)
·Municipal	126.47 (2001)
Biodiversity Value	Chinese White Dolphin
	Mangroves
	Lancelet
	Egret
	Limulus (Horseshoe Crab)

Sources: www.fdi-xiamen-cn.com ; Xiamen Environmental Protection Bureau Bulletin, 2001.

Enter the Gateway to China

Xiamen is relatively young when compared to China's overall history, which dates back to 2,000 BC. Historical records indicate that it was founded during the Song Dynasty (960–1279 AD), and it subsisted as an isolated farming community of approximately 4,000 residents. Although Xiamen was prosperous during this period, it was only second to Quanzhou. Xiamen's first significant exposure occurred in the late 1300s when the ruling Ming Dynasty became apprehensive about the increasing power and wealth of Quanzhou and shut it down as a port. Later, the Ming took advantage of Xiamen's coastal location and natural harbor by transforming it into a center of defense against coastal pirates and the advances of Japanese expansionists (Figure 1).

Xiamen, which means *gateway* or *entrance*, has always been an international center for trade. It was once part of the *Silk Road of the Sea*, with Quanzhou as its starting point. Endowed with a strategic location (at the mouth of the Jiulongjiang — *Nine Dragon* — River, looking across the Taiwan Strait), Xiamen has been an important player in the Southeast Asia trading routes since the Song Dynasty. Formerly known as Amoy, this city on the southeastern coast of Fujian Province became a major labor market for the European plantations in Southeast Asia. Aside from the labor trade, the overseas shipping and commerce industry have likewise flourished (Table 1).

After the defeat at the hands of the British during the Opium Wars and the signing of the Treaty of Nanking in 1842, Xiamen became one of the treaty ports that was opened to foreign trade and which, subsequently, increased human settlement. Xiamen quickly grew into a busy commercial port, while nearby Gulang Island

became an international settlement where the European and American embassies were located. To date, many of the old, Western-style colonial buildings still exist.

At the time of its founding, Xiamen Island was under the jurisdiction of Tong'an County, which is some 30 km away on the mainland. Now, Tong'an is administered by Xiamen, together with five other districts: Siming, Huli, Haicang, Jimei, and Xiang'an (Figure 2).

Siming District covers most of the old part of the city. In May 2003, Gulangyu or Gulang Island and Kaiyuan were merged under Siming District. At present, the district is both a commercial center and a tourism area. During its pursuit of more foreign investment, it focused on tourism and the real estate industry, taking advantage of its beach area and bordering mountains.

Huli District and most of Siming District (except Gulangyu) are on Xiamen Island. The other four districts are on the mainland. Haicang District (formerly Xinglin District) is the first Taiwanese Investment Zone, having been established in 1989. Electronics, machinery, chemicals, and textiles are the pillars of this district's economy. Jimei District is linked by the Xiamen Bridge to the Island of Xiamen and serves as an important gateway to the Xiamen Special Economic Zone (SEZ). Like Haicang, Jimei is a Taiwanese Investment Zone. Tong'an is rich in natural resources, with its abundant reserves of granite, kaolin earth, mineral water, and hot springs, aside from being a prime agricultural area. In November 1996, Tong'an changed its administrative state from a county to a district of Xiamen. Nearly seven years later, in May 2003, Xiang'an District was created out of five towns of Tong'an District.

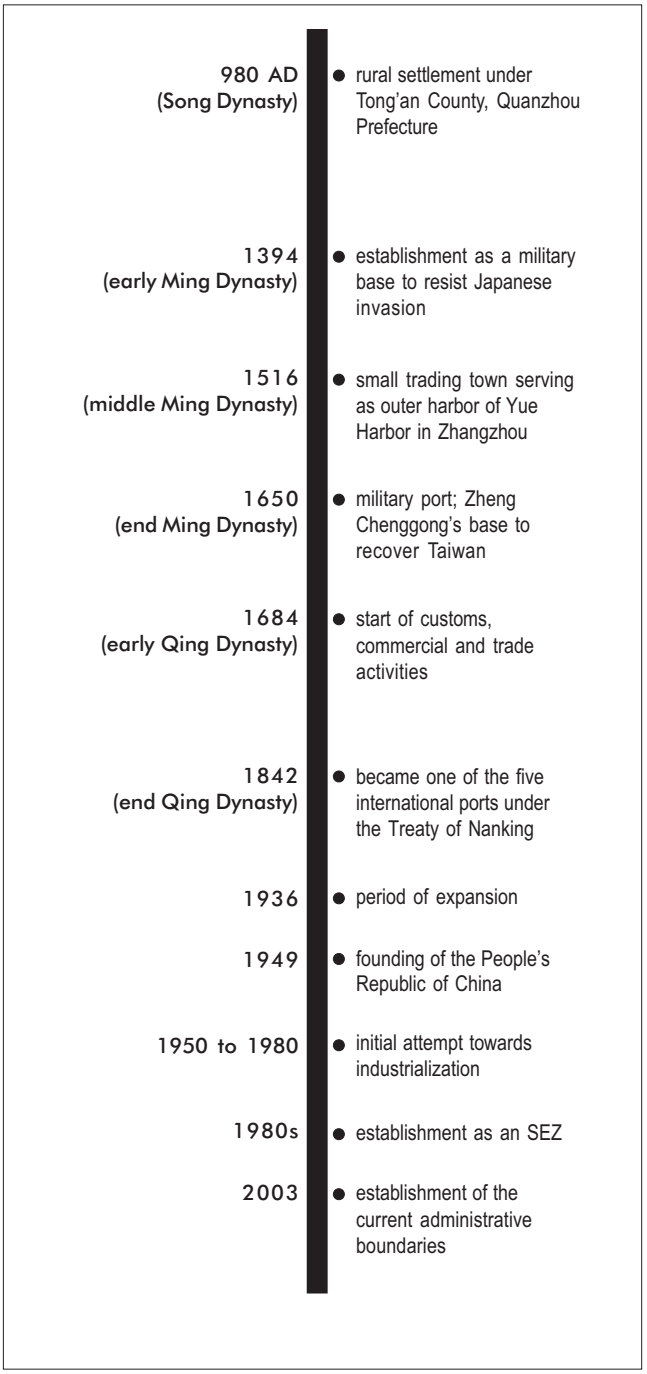


Figure 1. Xiamen's Historical Development.

As "The Gateway to China," Xiamen became not only a gateway for foreigners to get in; it was also the way out for the Chinese who wanted to try their luck around the world. The entire Fujian Province, particularly Xiamen, is the *guxiang* (hometown) of enormous numbers of overseas Chinese. Overseas Chinese merchants returning to Xiamen in the early 20th century supplanted the

Figure 2. Map of Xiamen City.

Source: Xiamen City Government website (http://www.xm.gov.cn/english).

former international concession's holdings and contributed to the modernization efforts, especially during the 1920s. Hence, the city's relative prosperity was due both to trade and to wealth sent back by Xiamen's substantial emigrant community.

Unfortunately, Xiamen had been embroiled in a sequence of strife that resulted in intermittent growth and a boom-bust cycle for its economy. During the 17th century, Xiamen Island was once the home of the legendary anti-Manchu resistance fighter, Zheng Chenggong (a.k.a. Koxinga), who used the island as his military base. Three centuries later, in 1949, Xiamen became the frontline in the continuing struggle against the Kuomintang who were controlling nearby Jinmen. Fortified to defend against possible invasions, Xiamen became a military fortress instead of a commercial trading port. From 1949 onwards, Xiamen Island was no more than a military base and had little or no civilian industry. It is said that for the next 30 years, Xiamen grew very little, appearing not much different from the city of 1949. Subsequent cross-strait tensions with Taiwan led to limited local industrial development prior to 1980.

Physical Features and Characteristics

The city of Xiamen, on the southeastern coast of China, is a bustling enclave of over two million people and lies in the Minnan Golden Triangle of Fujian Province covering Xiamen, Zhangzhou and Quanzhou. More precisely, it lies at 118°04' 04'' East longitude and 24°26'46'' North latitude. On its own, Xiamen Island is only 130 km^2 but the entire Xiamen City has a land and sea area of 1,565 km^2 and 390 km^2, respectively. The topography of Xiamen is characterized by a gradual descent from the south to the north, with the northwestern area composed of mounds of volcanic rocks and the southern area mountainous and hilly. The Yunding

Rock, which stands 339.6 m above sea level, is the highest peak in the south. The coastal waters of Xiamen City cover a portion of the Jiulongjiang River, the West Harbor, Maluan Bay, Xinglin Bay, Tong'an Bay, the Outer Harbor, Eastern Channel, and the Northern Channel to Jinmen Island (ITTXDP, 1996).

Xiamen's relative prosperity is often attributed to its deepwater sheltered harbor that supplanted nearby Quanzhou, the port that had been the center of the maritime trade with the Indies. Xiamen Harbor is ice-free year round and is more than 12 m deep in most parts. The scattered islands all along the waters form a natural barrier that protects the harbor from turbulent waves, while the mountains surrounding the harbor act as a windbreaker.

The coastal waters of Xiamen, likewise, serve as an important habitat for various marine species. It is home to 181 species of phytoplankton, 192 species of zooplankton, 248 species of nekton, 731 species of benthos and 817 intertidal zone species (ITTXDP, 1996). In addition, pockets of mangrove areas can be found in Haicang and some small islands.

Xiamen has a subtropical monsoon climate with abundant rainfall mainly occurring in the months of May to August. It has neither a severe winter nor intense summer, and the temperature averages 21°C throughout the year. The weather is humid and wet. The average precipitation is 1,143 mm, while the average relative humidity is 74 percent.

Despite its rich geological and botanical resources, there is a dearth of flatlands in Fujian Province. Farmers survived only by terracing steep mountains. Later on, reclamation projects along the coast were undertaken, but these were not sufficient to support food requirements. As a result, thousands went abroad to seek their fortunes notwithstanding the prohibitions to leave under the threat of capital punishment. Their diligence and perseverance explains why the wealth of Asia today is in the hands of overseas Chinese, most of whom trace their roots to Fujian (Brown, 2004).

The Dragon Takes Flight

In the 1980s, Deng Xiaoping introduced in economic liberalization as a part of his administration's reform policies. This changed the dynamics of China. The flow of foreign direct investments (FDIs) was legalized with the establishment of the Special Economic Zones (SEZs). Ironically, proximity to Taiwan, which originally led to Xiamen's stagnation, became the prime reason for its selection as an SEZ, together with Shenzhen, Zhuhai and Shantou, in October 1980. These four SEZs were selected as a means to test market mechanisms in a relatively risk-free manner, working on the assumption that if the experiment fails, the economic consequences to the rest of the country would be limited (Lambert, Gilmartin and Yang, 2002). Xiamen, in particular, was selected to test the economic reform approach. In addition, since slower development had occurred in Xiamen over the previous three decades, the city had fewer environmental and natural resource problems to overcome compared with bigger cities such as Beijing or Shanghai.

Preferential treatment in the SEZs was facilitated through land acquisition, self-management, longer leases, tax holidays, tariff free inputs, and lower income tax. It was expected that the SEZs would have a spillover effect on the surrounding local economy, as well as in the region and the nation.

As an SEZ, Xiamen had the capacity to serve as a "window and bridge" for technology, knowledge, and management. Nonetheless, this prospect was still met with caution, as the original

Jimei Taiwanese Investment Zone

SEZ in Xiamen was limited to Huli District with a land area of only 2.5 km^2. In 1984, following the relative success of the experiment, local authorities agreed to expand the coverage of Xiamen's SEZ to 131 km^2 and include the whole island of Xiamen and Gulangyu. The initial FDIs, which were primarily coming from Taiwanese investors in light manufacturing and later, electronics, mainly concentrated in designated Taiwanese Investment Zones within Xinglin, Haicang and Jimei Districts, established in May 1989. In November 1992, the Xiangyu Island Tax Bond Area was formed.

Despite being declared as an SEZ, things did not immediately become easy for Xiamen. Foreign investments did not exactly pour in as expected. From 1980 to 1983 only $7.75 million of the $37.06 million pledged investments materialized (Howell, 2000). The initial lack of foreign investment was compensated for by the increase in government spending, mostly on development of infrastructure, which amounted to Ren Min Bi (RMB) 1.78 billion between 1980 and 1985 (Lambert, Gilmartin and Yang, 2002). Hence, while foreign investment was still absent, pump-priming activities, including construction of infrastructure to facilitate economic growth and foreign investment was being prepared. It was also at this time that local laws and regulations in support of foreign investments were developed. Eventually, the amount of FDIs rose as the Taiwanese restrictions eased. As the municipal government demonstrated its commitment to economic reforms, the risks to long-term investment declined and paved the way for the establishment of longer term projects with more capital intensive facilities.

Living in a Material World

Xiamen did not evolve into an economic powerhouse or an environment-conscious city overnight. In fact, a long-time resident of Xiamen recalls that, in the 1980s, "Xiamen was a dirty backwater town with inadequate and unreliable water, frequent power outages, heavy pollution, and abysmal infrastructure"(Brown, 2004). The gradual return of prosperity ushered in changes, both positive and negative, some of which are briefly discussed below.

Population

Following the implementation of economic reforms, Xiamen experienced rapid economic growth, but in doing so, many facets of the environment were neglected. The government was driven not only by the lofty goals of rapid economic progress but also out of the necessity to support its enormous population. From the late 17th century to the 1940s, its population changed only slightly. However, by 1995 its population reached a record high of 1.25 million, five times higher than its population 16 years earlier (ITTXDP, 1996). An average annual growth rate of 1.9 percent was observed for the period of 1984 to 1995. The city's population spurt coincided with the increase in economic activities as an SEZ. The employment prospects continued to attract migrant workers and at present, the permanent population is 2.17 million (Xiamen Statistics Bureau).

Economy

As if to make up for lost time, the city's gross domestic product (GDP) had grown at an enviable average rate of nearly 20 percent per annum for the past 20 years. It has become a preferred destination of foreign companies, most of which belong to the top 500 corporations in the world. From the RMB 1.2 billion GDP registered in 1984, it has ballooned to RMB 25 billion and RMB 76 billion in 1995 and 2004, respectively.

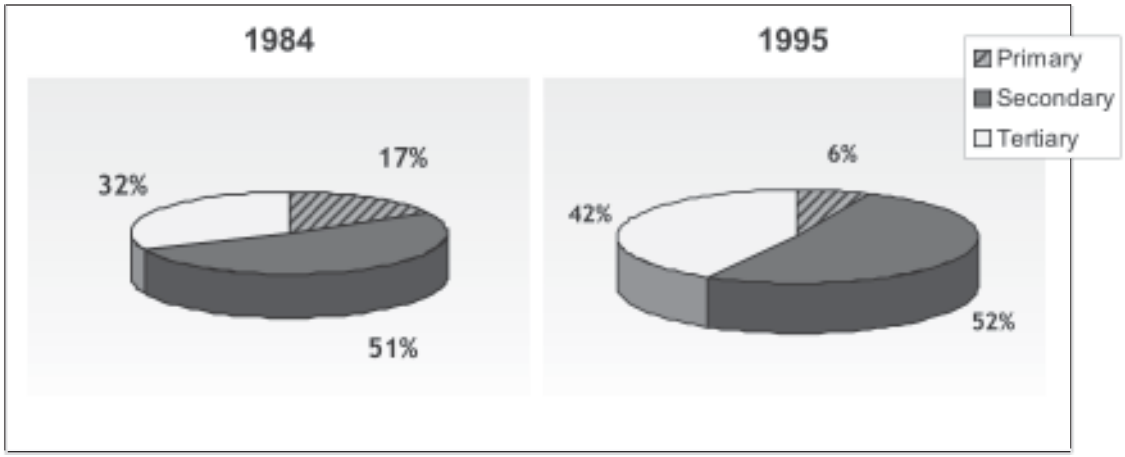
Not only had the value of local output skyrocketed, but there had also been changes in the economic structure. Following the legalization of Taiwanese investments, Xiamen's leadership decided that attracting secondary industry should be a priority, and there was a large industrial growth in heavy industry between 1980 and 1990. Data indicate a marked shift away from primary industries and toward secondary and tertiary activities.[2]

The contribution from the primary sector to the municipal economy decreased from 17 percent in 1984 to 6 percent in 1995; the contribution from the tertiary sector increased from 32 percent to 42 percent; and the contribution from the secondary sector remained stable over the same period (Figure 3).

In addition to the sectoral shift, the production of privately funded enterprises surpassed the gross production of state-owned enterprises (SOEs) beginning in 1989 (XFIEC, 1998). At the same time, the various industry types were distributed across the city. Xiamen Island, the traditional urban center, accords emphasis on high technology research and development centers, industrial parks, finance, and trade. The Haicang area is designed as the city's new urban center with thrusts in heavy machinery, petrochemicals, vehicles, metals, chemical fibers and plastics, in addition to raw materials. Xinlin District supplements Xiamen Island in technological industries and Haicang area in large industries. Tourism, retail trade, light industries and arts and crafts, are the features of Jimei. Tong'an County is the city's satellite town, with emphasis on export-oriented industries, including high technology enterprises, light industries, manufacturing, machinery and recreational facilities, in addition to pottery and construction materials. Gulangyu Island is solely devoted to tourism and related services.

Contracted FDI, mostly from overseas Chinese in Taiwan and Hong Kong, have substantially

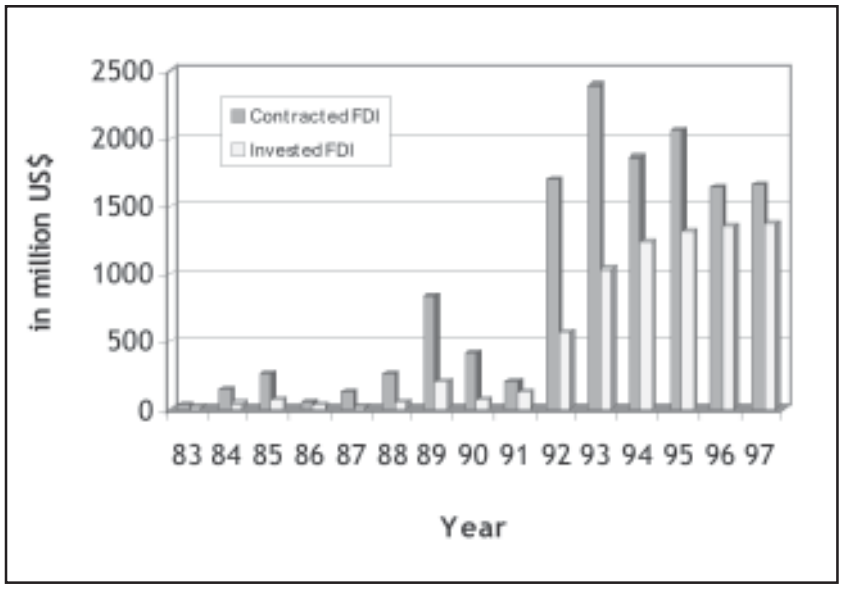
Figure 3. GDP Sectoral Contribution.



Source: Xiamen Municipal Government.

[2] *In general, industrial activities are classified into Primary (generally extractive; includes agriculture, forestry, fisheries and animal husbandry), Secondary (includes machinery, electronic, electric, and petrochemical production, as well as construction) and Tertiary (services; including transportation and communication, public utilities, finance, trade, insurance, real estate, arts and crafts).*

Figure 4. Foreign Direct Investments to Xiamen, 1983–1997.



Source of basic data: Lambert, Gilmartin and Yang, 2002.

increased. This peaked after the SEZ was expanded to its current size and continued to climb, especially after the establishment of the Taiwanese Investment Zone in Jimei (Figure 4).

Coastal and Marine Activities

The establishment of Xiamen SEZ and the opening of the port to the outside world enabled more city development, compared to pre-Cultural Revolution days. As a coastal city, Xiamen has always relied heavily on coastal and marine activities such as 1) port and shipping, 2) fisheries, and 3) marine mineral production. With the opening up of the economy, opportunities for tourism promotion, coastal reclamation, and the construction industry were amplified (Box 1).

Port and Shipping

In the case of port and shipping operations, the amount of cargo Xiamen handled grew nine times over the 1990 figures in 1996 — from 1.68 million metric tons to 15.53 million metric tons (Figure 5). Whereas port activities have always been historically vibrant, they expanded even faster due to improvements in operations and an increase in foreign capital inflows. By 2003, the amount of cargo handled reached 34.03 metric tons. Following Xiamen Harbor's rapid expansion, this deepwater harbor now belongs to China's top ten ports (No. 7 in China and No. 40 worldwide) and is a natural port of call for ships linking over 60 ports in 40 countries.

Box 1. Uses of Coastal Waters.

Natural uses:	– Food
	– Shelter and breeding ground for many fish, shellfish, mammals and shorebirds
Recreational uses:	– Boating
	– Fishing
	– Shellfishing
	– Swimming
	– Snorkeling
	– Bird-watching
Commercial uses:	– Ports and marinas supporting shipping and industrial uses
	– Breeding grounds for some commercial fish and shellfish

Fisheries

For the fisheries sector, the average annual production was 67,204 tons (40,912 tons from capture fisheries and 26,292 tons from aquaculture) from 1990 to 1994, with only slight variation in values from year to year (Figure 6). The yield from fish capture declined over that period, while aquaculture production achieved some growth. However, the production per unit of the culturing area decreased from 332 tons/km^2 in 1990 to 296 tons/km^2 in 1995.

Marine Mineral Production

Xiamen is not known for offshore oil and gas production. Nonetheless, exploration has proven the existence of two petroleum hydrocarbon deposits offshore. The first is located some 60 km southeast of Xiamen, with an estimated reserve of 0.44 billion tons, and the other having approximately 0.27 billion tons is found 120 km northeast of the city (Chen and Zhang, 1995). Marine mineral production in the city includes sand and gravel, granite and sea salts. Sea-salt production covers an area of 1,510 ha, with an output of 59,000 tons of crude salts in 1996.

Tourism

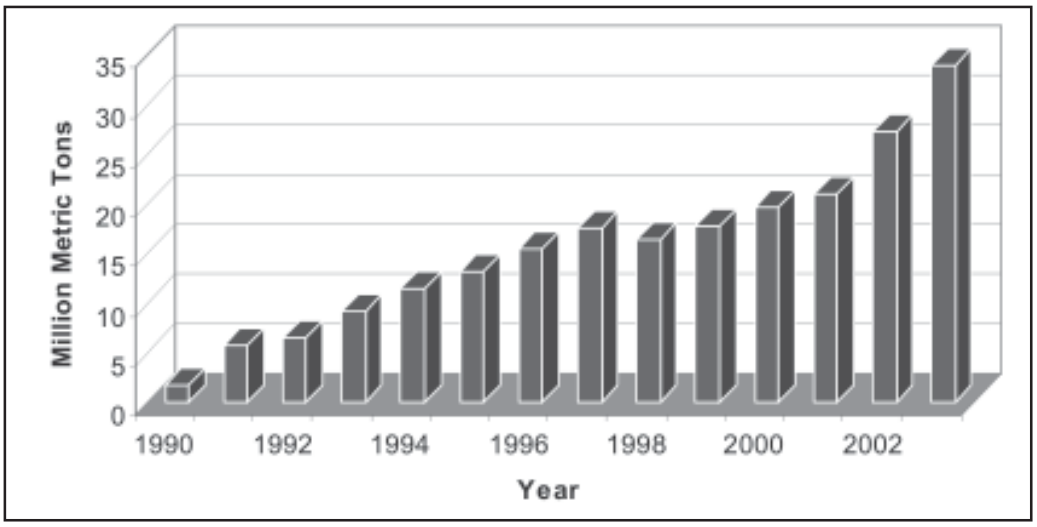
The natural scenery and cultural sites in the city provide some unique tourist attractions. Complementing the beaches, mountain parks, and other resources are cultural attractions including archeological ruins, historical sites, Buddhist temples and traditional arts and crafts (Chen and Zhang, 1995). For example, the colonial architecture of Gulangyu, which at the time of their construction initially symbolized foreign domination, is now fully embraced as one of the foundations of Xiamen's unique character and burgeoning tourism industry. Xiamen has become a major tourist attraction for overseas Chinese, particularly those coming from Taiwan, Hong Kong, and Macao. The number of tourists from the three areas is about 0.15 million per year (SOA, 1997). In 1994, the total number of local and foreign tourists was about 0.7 million, including 0.23 million international tourists. By 1996, the city received 0.33 million international tourists, which generated a revenue of $221.6 million.

Coastal Reclamation and Construction

Aside from the lack of land to accommodate all the new developments, the presence of appropriate infrastructure serves as the backbone of development and enhances attraction for would-be-investors. But even before the post-1980s ending of Xiamen's age-old isolation, there have been attempts to build infrastucture. Since 1955, some 38 reclamation projects added 122 km^2 of land, about 7.5 percent of the total land area in the city. The reclaimed lands were used for port expansion, sea salt-making, aquaculture, recreation and agriculture. In 1956, Xiamen Island was turned into an artificial peninsula with the construction of the Gaoji-Jimei Causeway, which connects the island to the mainland. Similarly, in 1960 the Maluan Bay became an enclosed water body as the construction of the Maluan Causeway separated the bay from the rest of the West Sea. There are nine rivers flowing into the bay, comprising a catchment area of 123 km^2. During the 1970s, the West Causeway was built between the foot of Huwei Hill and Fuyu Islet, in order to reclaim lands for farming. Thus, the now famous Yuandang Lagoon came into being.

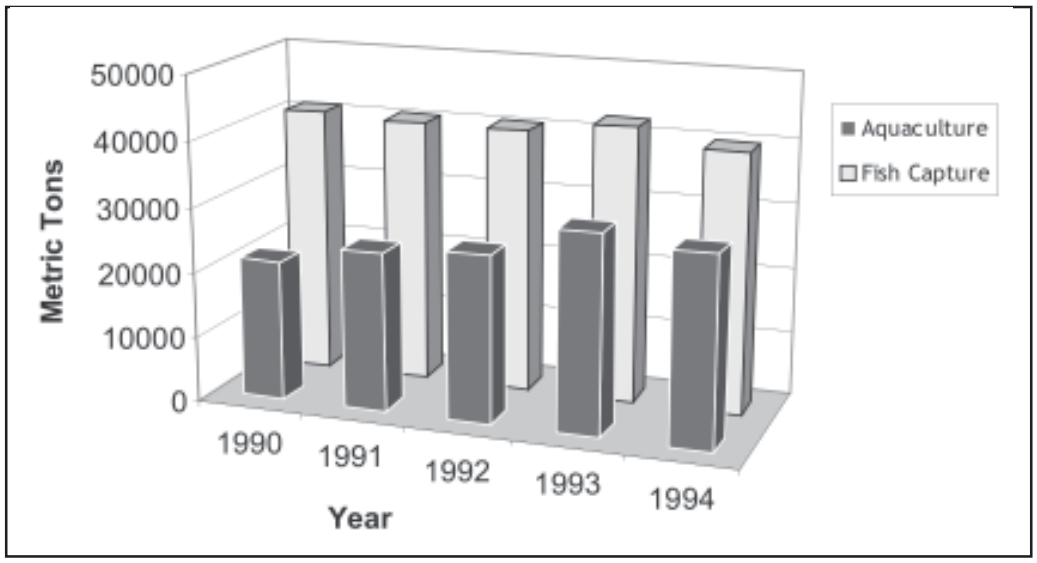
From the early 1980s to the present, there has been an infrastructure frenzy. The city began sprouting new high-rise buildings,

Figure 5. Cargo Handling Capacity, 1990–2002.



Source of basic data: SOA and Xiamen Port Bureau.

Figure 6. Fisheries Production, 1990–1994.



Source of basic data: XDPO, 1998.

concrete roads, an airport, a railway system, communication networks, and other facilities in a headlong urban sprawl.

But What Good is a Used-up World

Being an SEZ increased income-generating opportunities by improving access to market-oriented activities and increasing employment through economic expansion. Compared to the 1980 figure of RMB 406, the per capita disposable income for urban dwellers rose dramatically, reaching RMB 10,813 in a span of 20 years. For the same period, the per capita net income of rural residents rose to RMB 4,030, which is 18.2 times the 1980 figure.

Xiamen's urban landscape was transformed by construction projects throughout the city. Unfortunately, the new-found affluence also brought forth a host of environmental problems. It was also during this time that the prospect of

lucrative returns from the sea led to the mushrooming of aquaculture farms in the western and eastern coasts of Xiamen. This contributed to contaminating the coastal waters and damaging the ecosystems due to the increase in untreated aquaculture waste and the perennial occurrences of red tide. The sheer number of aquaculture farms resulted in the narrowing of the coastal waters intended for navigational purposes. Compounding the situation was deforestation and land conversion, which silted the once naturally deep waterways. In addition, poorly designed infrastructure, such as the bridge connecting Xiamen Island to the mainland and dikes intended to control tidal fluctuation, resulted in the restriction of water flow and exchange. Pollution was also a factor in the destruction of the marine habitat, which had a negative effect on Xiamen's biodiversity and placed the Chinese white dolphin, Chinese egret, and lancelet on the verge of extinction. Hence, economic activities placed considerable burden on the coastal resources, resulting in the reduction and deterioration of natural habitats, siltation and erosion, shoreline retreat and the blocking of navigational channels.

By the late 1980s, the waters around Xiamen became extremely polluted. Moreover, the deterioration in environmental quality resulted in a significant reduction in fish catch and caused fish kills. From 1984 to 1996, at least 26 major fish kills have been documented (Table 2). The market value of the damaged unharvested fish alone was placed at approximately RMB 25 million ($3 million), excluding the additional social and economic impact to fisherfolks, employment and related industries. About one third of the incidents were attributed to poor water quality and the accumulated effect of pollution, while the balance was due to episodes of toxic and hazardous discharges, including oil spills.

During the late 1980s, the city was annually generating approximately 200,000 tons of solid waste and 55.5 million tons of sewage. Brown (2004) vividly recalls that the streets and sidewalks of Xiamen were covered with litter. A film of black coal soot not only coated the town, but the lungs of the residents as well. There was only one sanitary landfill servicing the entire city, and collected waste was usually dumped in four existing dumpsites. As of 1989, there was only a single sewage treatment facility, the No. 1 Wastewater Treatment Plant, with treatment capacities of 134,000 and 37,000 tons/day for primary and secondary treatment, respectively. Clearly this was not sufficient to cover the volume of wastewater being generated. As a result, wastewater was usually discharged through open channels into bodies of water without any treatment. One of the victims of this indiscriminate dumping was the Yuandang Lagoon, which ended up squalid, noxious and biologically dead. The residents living around the lagoon became dissatisfied with the poor environmental quality and started leaving the area. Real estate agents who were then engaged in developing the place as a residential and business center could not attract buyers.

With increases in income, people had more leisure time and demanded a cleaner environment in which to spend their time. Fortunately, the Xiamen leaders realized that a dirty environment was not good for the city and was in fact, bad for business. This realization, coupled with the increasing sense of civic duty towards the environment and a new sense of ownership on the part of the residents, helped solidify the decision to address the different environmental problems and take appropriate action towards cleaning up Xiamen.

The efforts to rally all sectors in Xiamen to participate in the cleanup of the Yuandang Lagoon did not go unnoticed. The rehabilitation of the lagoon received praises not only from the national government but also became a factor in Xiamen's

Table 2. Damage to Fisheries Due to Pollution, 1984–1996.

Timeframe	Location	Area affected and Cost	Cause
1984	West Sea (Gaodian Village)	Cultured razor clams and 50% oysters in 38 ha /RMB 0.3 million	Poor water quality
1985	West Sea (Baozhu Islet)	60–100% of oysters in some culturing areas	Poor water quality
1986 (June)	Jiulongjiang River Estuary	2 ha of short-necked clams/ RMB 0.09 million	Spills of ship anti-corrosion paints
1986–1987	West Sea (Gaopu Village)	a large area of short-necked clams	Diseases due to poor environmental quality
1987	West Sea (Dongyu Village)	360 tons of cultured oysters in 200 ha/ RMB 1.44 million	Diseases due to por environmental quality
1987–1988	West Sea (Gaopu Village)	Short-necked clams larvae in artificial hatcheries	High copper content content in the water
1988	West Sea (Huoshaoyu Islet)	Seabream in cage culture/RMB 0.01 million	Poor water quality
1988 (Sept.-Oct.)	West Sea (Hulidian tidal flats)	30 tons of cultured short-necked clams in 7 ha/RMB 0.09 million	Mud flow from land reclamation
1988 (Oct.)	West Sea (Gaopu Beach)	Short-necked clams/RMB 0.01 million	Oil leakage from a power plant
1989	West Sea (Dongyu Islet)	60–80% of oysters, razor clams and short-necked clams/several million RMB	Poor environmental quality
1989 (June)	West Sea (Gulangyu Islet)	Over 10 ha of prawn larvae and groupers in cage culture/RMB 0.25 million	Glassware factory gasoline leakage
1990 (March)	Tongan Bay (Huli Village)	Short-necked clams/RMB 2.7 million	Chemical factory sewage
1990 (May)	West Sea (Xiangyu tidal flats)	133 tons of clams in 1.3 ha/RMB 0.18 million	MSG factory sewage
1992 (July)	West Sea (Huoshaoyu Islet)	1,000 kg of seabream and perch/ RMB 0.17 million	Shrimp pond discharge
1993 (June)	West Sea (Gaopu Beach)	Crabs, shrimps and clams/RMB 0.09 million	Factory oil leakage
1993 (June–Sept.)	Tongan Bay(offshore of Jimei)	1,365 tons of cultured short-necked clams/RMB 2.73 million	Suspended sediment from land reclamation
1994 (April)	West Sea (Dongyu Islet)	19 ha of cultured shellfish/ RMB 0.63 million	Suspended sediment and sulfides from a construction site
1994		Cage-cultured fish	Ship oil spill
1995 (April)	Tong'an Bay (Huli County)	66 ha of shellfish/RMB 1 million	Crude oil leakage from the airport
1995 (April)	Tong'an Bay (off the airport)	Oysters in suspended culture/ RMB 0.5 million	Ship oil spill
1995 (May)	Tong'an Bay (Shixun Ponds)	3 tons of crabs in 40 ha /0.2 million	Leakage of heavy oil from a beer brewery
1995 (July)	West Sea (Dongyu)	26 ha of cultured prawn and fish/ RMB 0.5 million	Increased suspended sediments
1995 (Aug.)	West Sea (Haicang)	Cultured prawns/RMB 0.16 million	Ship oil spill
1996 (June)	West Sea (Maluan Bay)	96 ha of cultured fish, shellfish and crabs/RMB 0.2 million	Power plant oil leakage
1996 (July)	West Sea (Gaopu)	70 cages of cultured fish/RMB 0.38 million	Power plant coal ashes
1996	West Sea (Eaoguan tidal flats)	97% of short-necked clams in 107 ha/RMB10 million	Poor environmental quality

Source: XDPO, 1998.

selection as a demonstration site for an international program for the prevention and management of marine pollution.

It's Sink or Swim

As a late bloomer, Xiamen was spared many of the environmental dilemmas faced by cities saddled with older and heavily polluting enterprises. Nonetheless, Xiamen had to face the challenges posed by double-digit annual GDP and export growths. Furthermore, the municipal government wanted to attract investors, but industrial development spewed toxic waste into the local waters and added to the already alarming levels of pollution (Box 2).

Overall, China's quest for economic growth has rendered dire consequences on its air, land and water quality. To address the degradation, the Chinese government adopted two strategies: increased local autonomy and the encouragement of international assistance (Chen and Uitto, 2003). Devolving more power to local governments would provide incentives to promote economic development and fiscal self-sufficiency. This was seen as a means to address the central government's inability to meet the diverse local demands for public services, including environmental protection. It would enable the local authorities to implement new environmental laws and interact directly with the international community.

Becoming an SEZ enabled Xiamen to enjoy substantial legislative autonomy and this became instrumental in the ensuing environmental campaigns. It became one of the few municipalities with not only independent status in state economic planning, but also local legislative power in economic administration. In March 1988, Xiamen was granted provincial-level autonomy in economic affairs to aid its development as an SEZ and held a sub-provincial government status. At the same time, the relaxing of centralized control exposed, and subsequently influenced, the city leaders and planners to regional and global drivers, particularly on the concept of sustainable development. Xiamen leadership stepped in to promote clean, sustainable development within the city. In the early 1990s, the administration of Mayor Hong Yongshi saw the beginnings of cleanup efforts in the development of infrastructure and services to get things moving.

From 1990 to 1999, there was a negative growth rate for the heavy industry. During the same period, the light industry experienced a positive growth rate. These growth rates are attributed to policy changes in Xiamen that discouraged heavy industry in favor of light industry. These regulatory shifts were part of a broader mandate to make the city greener and more livable to attract foreign investment.

A local legislative assembly was established in Xiamen in 1994, and the first rules issued by the newly independent assembly were for environmental protection. The Xiamen People's Congress set local rules, regulations and industrial standards for the city and had a higher legal authority than the municipal government. Local

Box 2. Causes of Marine Environmental Degradation in Xiamen (circa 1990).

- Rapid industrialization and urbanization.
- Sectoral approach towards marine environmental management.
- A system where economic agencies dominate over environmental protection agencies.
- Central government's lack of capacity to coordinate integrated marine environment agenda.
- Absence of incentives at the local level to implement environmental and natural resource protection policies.

Source of basic information: Chen and Uitto, 2003.

regulations from either body could not contradict national laws, but they could require stricter environmental standards and impose penalties for noncompliance. Much of Xiamen's regulatory establishment was developed through local initiatives, instead of through national or provincial mandates.

Turnpikes

In 1994, the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS) was launched. Xiamen, together with Batangas Bay in the Philippines, was chosen as a pilot site for the development and demonstration of the integrated coastal management (ICM) framework and process. The program was designed to demonstrate how ICM could be used to prevent and manage land-based pollution sources in areas undergoing industrialization.

Changes bring forth challenges and opportunities, which are but two sides of the same coin. The local government of Xiamen, with the support of the international community, takes on a journey for environmental and marine protection governance.

The concept of ICM evolved out of the extensive coastal management practices in the US, which started in the 1970s. Bower, Ehler, and Basta (1994) described ICM as a continuous, iterative, adaptive and consensus-building process comprised of a set of goals and strategies for the sustainable use of coastal areas. It is aimed at eliminating conflicts in the utilization of resources and controlling the impact of human activities on the coastal environment. The word "integrated" appears to be the operative term in ICM (see Box 3 for its various dimensions).

As an integrated approach, ICM enables the transformation of short-term and usually untenable single-sector perspectives into more sustainable policies. It is intended to improve the quality of life of the communities dependent on coastal resources by providing a framework, strategy, and process for attaining needed development while maintaining the productivity and diversity of the coastal ecosystem. It was amply recognized that pollutive land-based activities, left uncontrolled, would eventually cause damage to the sea, so integrated programs would have a better chance of succeeding. Also, since activities, especially on the community level, are linked, the introduction of an integrated program is more cost- effective and allows for greater efficiency. ICM has become an internationally accepted approach to managing complex coastal and development issues, as manifested in 345 ICM efforts initiated by 95 nations as of 2000, doubling the efforts since 1993 (PEMSEA, 2003). Although the concept of coastal resource management was introduced to the East Asian region over 25 years ago, Xiamen became one of the first local government units to actually put ICM into practice.

A Xiamen publication on strategic environmental management plan.

Box 3. Dimensions of Integration.

- *Intersectoral integration* – integration among the various coastal and marine sectors as well as between marine sectors and land-based sectors that affect the coastal and ocean environment. This type of integration is important in the planning of effective coastal management and promotes knowledge sharing and commitment among the different stakeholders.
- *Intergovernmental integration* – this helps in understanding the differences in perspectives among different levels of government and agencies in order to facilitate harmony and have a leveling of expectations among national, provincial and local governments in addressing public needs.
- *Spatial integration* – connects land-based activities with coastal impacts.
- *Integration of science and management* – sharing of information and knowledge among the different disciplines concerned with coastal resource management.
- *International integration* – focuses on minimizing and controlling international disputes over maritime issues such as fishing activities, transboundary pollution, boundaries and vessel navigations.

Source of basic information: NOAA, 2000.

Challenges

The decision to adopt ICM meant tackling the bottlenecks that hounded the early attempts towards environmental and resource management. China's traditional coastal management system could not keep up with Xiamen's growth, as the multiple resource-use conflicts and increasing pollution threats require innovative and holistic management interventions. The existing institutions and policies were not effective with Xiamen's serious marine pollution and growing resource conflicts. There were constraints that needed to be addressed including weak institutional capacity, narrow sector-oriented policies, a lack of coordination, under utilization of scientific knowledge in support of policymaking, insufficient legal frameworks and law enforcement, low understanding of marine environmental issues and scarcity of funds for integrated management.

Increased Multiple-use Conflicts

Coastal space and resources are scarce and exist in limited quantities while needs and wants have been growing exponentially. Purveyors of offshore resources run into conflicts not only among themselves, but also with those engaged in onshore activities. As such, the resultant conflict among the users adds pressure to an already fragile ecosystem. Traditional management systems have not been able to establish a cross-sectoral mechanism for conflict resolution.

Agency "Turf Wars"

Several line agencies vied in claiming to be the lead agency in marine environment management, and pursued their sectoral mandates in the name of "national interests," ignoring the consequences of their actions on other sectors. Many agencies were duplicating tasks, leading to unnecessary increase in management cost and waste of resources (Box 4).

Fragmented Legal Framework and Law Enforcement

Local regulations and rules were patterned after national legislation and are usually intended to support their implementation. Therefore, the regulations were also oriented toward single-sector issues. They offered little guidance in addressing management issues

across administrative boundaries and were ineffective in multiple use conflict resolution. There was no legal framework that considered coastal lands and waters as a management unit. Moreover, environmental law enforcement was limited due to a shortage of funds, qualified personnel and facilities.

Financial Constraints

Additional funds needed to be mobilized if environmental improvements were to be achieved. As in most cities, financing environmental projects relied heavily on government appropriations. During the early 1990s, it was estimated that environmental expenditure had already risen to 0.8 percent of the GDP. Still, this fell short of the 2.2 percent benchmark.

Lack of Environmental Facilities and Services

Pollution emanating from wastewater and raw sewage discharged into lakes, rivers and seas posed another problem because Xiamen was inadequately prepared to handle the resulting byproducts of heightened consumption and production. For example, there was no comprehensive sewage pipeline system covering the entire city. Factories, particularly the SOEs, have no choice but to use poorly designed and outdated waste treatment plants. The absence of treatment facilities contributed to Xiamen's previous reputation as a dirty and dingy port city.

Inadequate Environmental Monitoring and Assessment

Monitoring programs were developed for individual marine environment departments in accordance with their respective mandates. There was no common protocol observed and data obtained were often incompatible. Most monitoring schemes dealt with water quality indicators but failed to track down the ecosystem changes. Similarly, there were no environmental quality standards adapted to the local conditions.

Absence of Sound Information Management System

As in the case of the monitoring systems, information was collected by individual institutions. Information sharing proved very difficult, as the institutions were scattered everywhere and the collectors tended to keep the data for their own use. There was also a tendency to focus research efforts on the same topics and the same areas, such as in the West Harbor and Jiulongjiang River Estuary, when there are other equally important surveys and studies that need to be undertaken.

Inadequate Application of Technical and Scientific Knowledge

The tendency to prioritize marine resource development over marine environmental protection was partly due to the low level of public awareness. There was also a tendency to leave the results of scientific studies in the realm of the laboratories, academe and research institutions. Hence, important findings that could have been useful inputs in environmental awareness and policymaking often ended up in some obscure journals in musty libraries. For example, the Yuandang and Maluan causeways were constructed despite the considerable adverse effects on the ecosystem, including changes in hydrodynamics, siltation of nearby shore areas and navigation channels, reduction of environmental carrying capacity, and marine pollution.

Box 4. Institutions for Marine Environmental Protection.

The 1982 Chinese Constitution asserts that the state is responsible for environmental protection but it was only under the country's 1989 Environmental Law that marine protection received high-level prioritization. China has complex institutional arrangements for protecting marine environment and resources where various central agencies led by the State Commission on Environmental and Natural Resources Protection and the State Council Committee for Environmental Protection are involved in the policymaking, legislation, supervision and coordination of activities in environmental protection. By virtue of the 1999 Marine Environmental Protection Law, five other central institutions — the State Environmental Protection Administration, the State Oceanic Administration, the State Harbor Superintendence Administration, State Fishery Administration, and the People's Liberation Army — have been accorded specific roles and responsibilities to protect marine environmental quality as shown in the table below:

Major National Ocean-related Agencies in PR China.

Agency	Ocean Related Mandate
State Environmental Protection Administration (SEPA)	Overall guidance, coordination and supervision of the country's marine environment; Prevention of marine pollution from land-based sources and coastal construction projects.
State Oceanic Administration (SOA)	Monitoring and managing the marine environment; Conducting surveys and scientific research; Prevention and control of pollution from offshore construction projects and marine dumping.
State Harbor Superintendence Administration (SHSA)	Supervision and management of pollution from non-fishing and non-military vessels in its jurisdictional harbors; Investigation of pollution incidents.
State Fishery Administration (SFA)	Supervision and management of pollution from fishing vessels outside of harbors; Protection of ecosystems in fishing areas.
People's Liberation Army (PLA)	Environmental protection departments are responsible for the supervision and management of pollution and related incidents involving military vessels.

Existing national legislations concerning coastal and marine environment have reflected the differences in mandates among the line agencies, mostly oriented to single type, issue or areas of the resources. However, the absence of integrated planning for addressing interactions among the involved institutions has resulted in conflicts over the use of the resources. Each institution acts on their sectoral interests such as those involved in port construction, mariculture, land reclamation, maintenance of scenic resources and marine environmental protection. As they work at cross-purposes, there is a tendency to become competitive and coordination becomes unsystematic. Chen and Uitto (2003) observed that when a marine problem arises, this is typically handled through ad hoc discussions and policymakers sometimes craft solutions based on political rather than environmental considerations.

Low Technical Capability for Integrated Marine Management

The efficacy of agencies tasked to manage marine and coastal resources is affected by the quality of the personnel and equipment available. The application of an integrated management system necessitates multidisciplinary expertise and skills. Hence, there is a need to upgrade the resources, both physical and human, to improve accomplishment and delivery of required services.

Transboundary Problems

Pollution emanating from sources outside Xiamen's administrative boundaries, particularly the Jiulongjiang River and adjacent municipalities, likewise affected the quality of its marine waters. It was said that if pollution from these sources remained unabated, it would hamper further growth of Xiamen.

Opportunities

The challenges were balanced by opportunities for successfully developing and implementing new environmental management approaches such as ICM. For Xiamen, the prevailing conditions characterized by a progressive economy, environment-sensitive politicians, and heightened awareness by the general public were conducive to the adoption of ICM.

Legislative and Administrative autonomy

The level of autonomy accorded an SEZ allowed local governments to take on independent legal and management initiatives. While the initiatives had to be kept within the constitutional framework, they could go beyond the scope of existing national environmental laws and regulations in order to suit the local needs.

New Breed of Leaders

There existed a new generation of leaders at various levels of the city who were more highly educated and were familiar with what was happening with the rest of the world. These leaders were open to reforms. The policymakers in particular had been exposed to a range of use conflicts and impacts, and were, thus, amenable to innovative management approaches.

Existence of Untapped Scientific Knowledge and Expertise

Xiamen is replete with underutilized academic and research communities. There is a wealth of local resources in science and education, which can be tapped to build up environmental management capacity and enhance public awareness initiatives.

Supportive Constituents and Investors

As the people's livelihood improved and income steadily increased, public demand for an improved quality of life, including a clean environment, also rose. This was supplemented by the growing collaboration with international investors and overseas Chinese communities that bring in innovative concepts, methodology, and technology.

As Xiamen pursued interventions to stem pollution, promote environmental protection and conserve the ecosystem under the ICM framework, the activities undertaken were loosely divided into three levels of focus areas.

The first level involved institutional arrangements, the development of strategic plans, pollution reduction programs, awareness building, and capacity development. These were preparatory activities and inputs to the second level tasks intended for marine conservation, such as the sea-use zoning scheme and the establishment of marine protected areas. Finally, the third level related to the scaling up of ICM by taking on the challenge of addressing transboundary environmental issues.

Preparing the Path

An effective intervention program such as ICM requires the presence of an institution that is bestowed with sufficient authority to engage in planning, executing and regulating all activities associated with coastal management. Hence, with a view of addressing coastal and marine pollution, the initial focus of the ICM program was on the development and establishment of necessary mechanisms to back up and ensure sustainability and continuity of initiatives.

Prioritizing these activities, particularly the establishment of the coordinating mechanism, has enabled better understanding among the partner institutions, improved decisionmaking and greater awareness of operational priorities. It has been duly recognized that a holistic and coordinated approach is needed for the city's sustainable development.

Institutional Arrangements

The Xiamen project demonstrated the effectiveness of ICM in handling marine pollution through the adoption of a decisionmaking framework and a management process that attempted to involve all major stakeholders, namely: the government and its agencies, the private sector, local communities, scientific and educational institutions, as well as ordinary citizens. An interagency coordinating mechanism for coastal management was established to improve synergy among the different institutions. Initially, there was resistance to its formation from individual agencies because of the fear of dilution of power. This resistance was overcome over time through repeated mutual consultations. Under this mechanism, the various government agencies formulated a local marine legislative framework linked to the national legislative system, established a network of scientists and experts for policy and decisionmaking support, and initiated public participation.

Typically, local environmental protection bureaus (EPBs) have the main authority to implement environmental laws and regulations following policy directives from the State Environment Protection Agency (SEPA). However, not only are the laws deficient, given the enforcer limitations, but the implementation of laws is ineffective, especially in marine protection. Interactions with the international community and donor organizations offered opportunities for Xiamen to better tackle its marine environmental problems by educating decisionmakers, as well as the other stakeholders, and to change the incentive structures to incorporate environmental protection in the local development strategies and legislations.

The municipal government continued its ICM program when the MPP-EAS Xiamen ICM Demonstration Project formally ended in 1999. This transition from a donor-led project to an initiative that relies on local funds and resources is seen as a positive development.

ICM coordinating mechanism

At the onset, an interagency executive committee composed of representatives from 22 local government agencies, such as planning, finance, marine affairs, land use, environment, fisheries, port operations and tourism, was established. The committee was to provide policy advice, review progress of activities and provide recommendations arising from the ICM project, (Chua, Yu and Chen, 1997). Under this set-up, the Marine Management Division (MMD) had been designated as the lead implementing agency and served concurrently as the ICM Project Management Office (PMO). Later on, the Executive Committee evolved into the Marine Management Coordination Committee (MMCC).

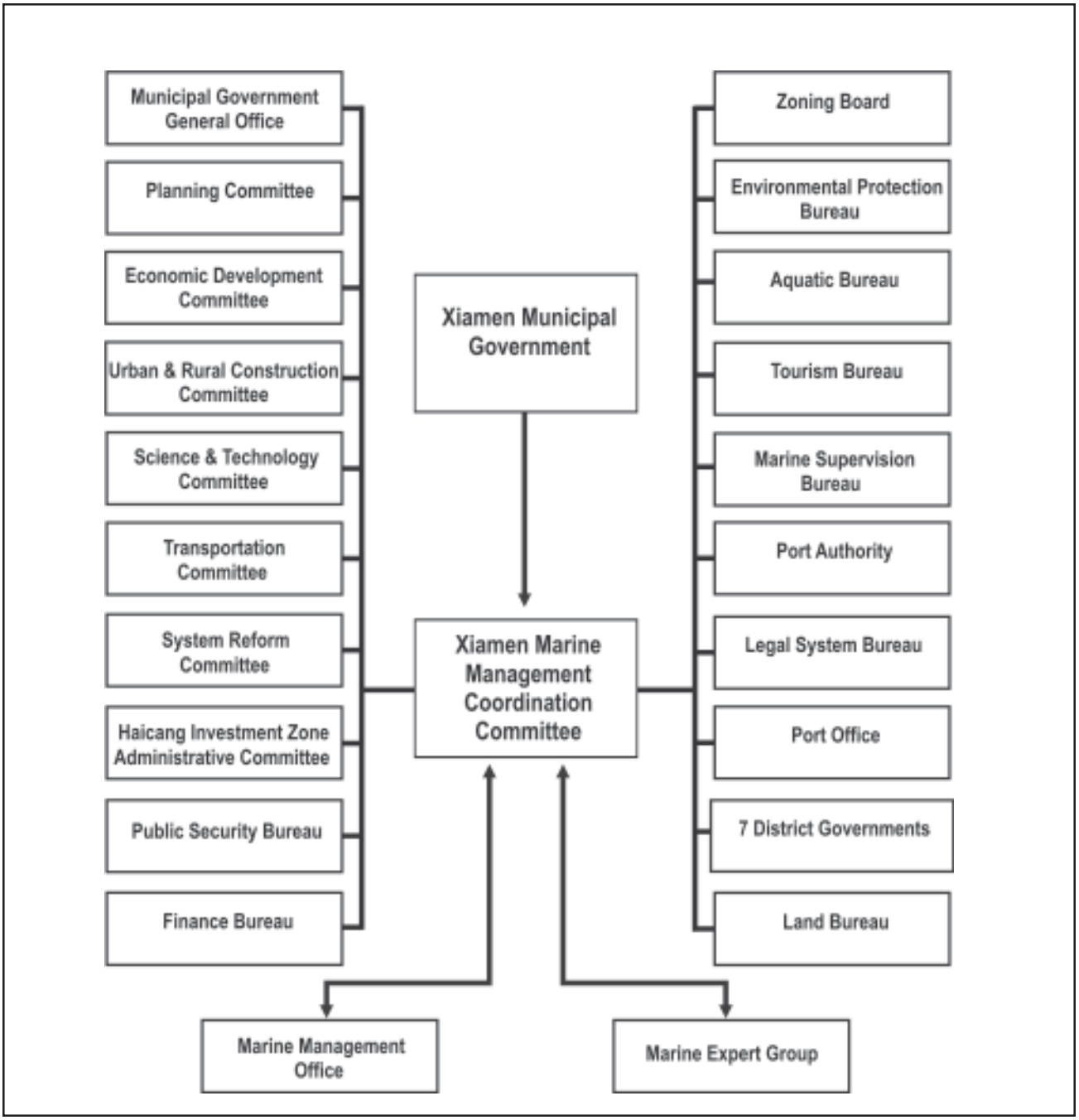
Recognizing the importance of veering away from the usual sectoral approach in managing coastal and marine resources, the local government established the MMCC, otherwise referred to as the Leading Group (Figure 7). Considering that over 12 national, provincial and municipal government agencies were involved in managing various coastal and marine-related issues, it was not surprising that it often resulted in conflicting policies. As such, the formation of the MMCC was a means to overcome the overlapping jurisdictions and functions of the agencies and promote a harmonious working relationship. The MMCC was a high-level, interagency committee set up for coordination and consultation on coastal development policies. The group was headed by Xiamen's Executive Vice-Mayor and included four other vice-mayors as deputy-heads. The MMCC provided an organizational structure that could implement the recommendations contained in the Strategic Environmental Management Plan (SEMP). Within the MMCC, a multi-agency enforcement team was formed to ensure that laws and regulations were enforced and violators were penalized.

The MMCC's tasks include: 1) preparation and coordination of the functional sea-use scheme; 2) protection and management of the marine environment; 3) enactment of local coastal and marine legislations; 4) joint enforcement of coastal and marine regulations among relevant agencies; and 5) management of activities covering the use of coastal resources.

The implementing or administrative arm of the MMCC is the Marine Management Office (MMO) under the leadership of the Secretary-General of the Xiamen Municipal Government. It was the reorganized Marine Management Division formerly under the Municipal Science and Technology Commission. Kho and Agsaoay (1999) noted that these coordinating systems are effective in resolving use conflicts. Furthermore, the coordinating mechanism developed is not another bureaucratic bottleneck. On the contrary, it is a means of streamlining operations, harmonizing interagency functions and operations and decreasing the cost of delivery of services.

The most significant step the local authorities took in order to ensure the continuity of ICM initiatives was to make the MMCC, which was only a temporary body during the ICM project days, into a formal institution called the Marine Management Coordination Office (MMCO) directly under the jurisdiction of the municipal government. Still led by the Executive Vice-Mayor, the MMCO continued to coordinate and manage ICM activities. It has been given enforcement powers to implement management interventions in accordance with municipal administrative orders and legislations. Institutionalizing ICM into local environmental and natural resource governance ensures organizational stability and sustainability.

Figure 7. Xiamen Integrated Management Coordinating Mechanism.



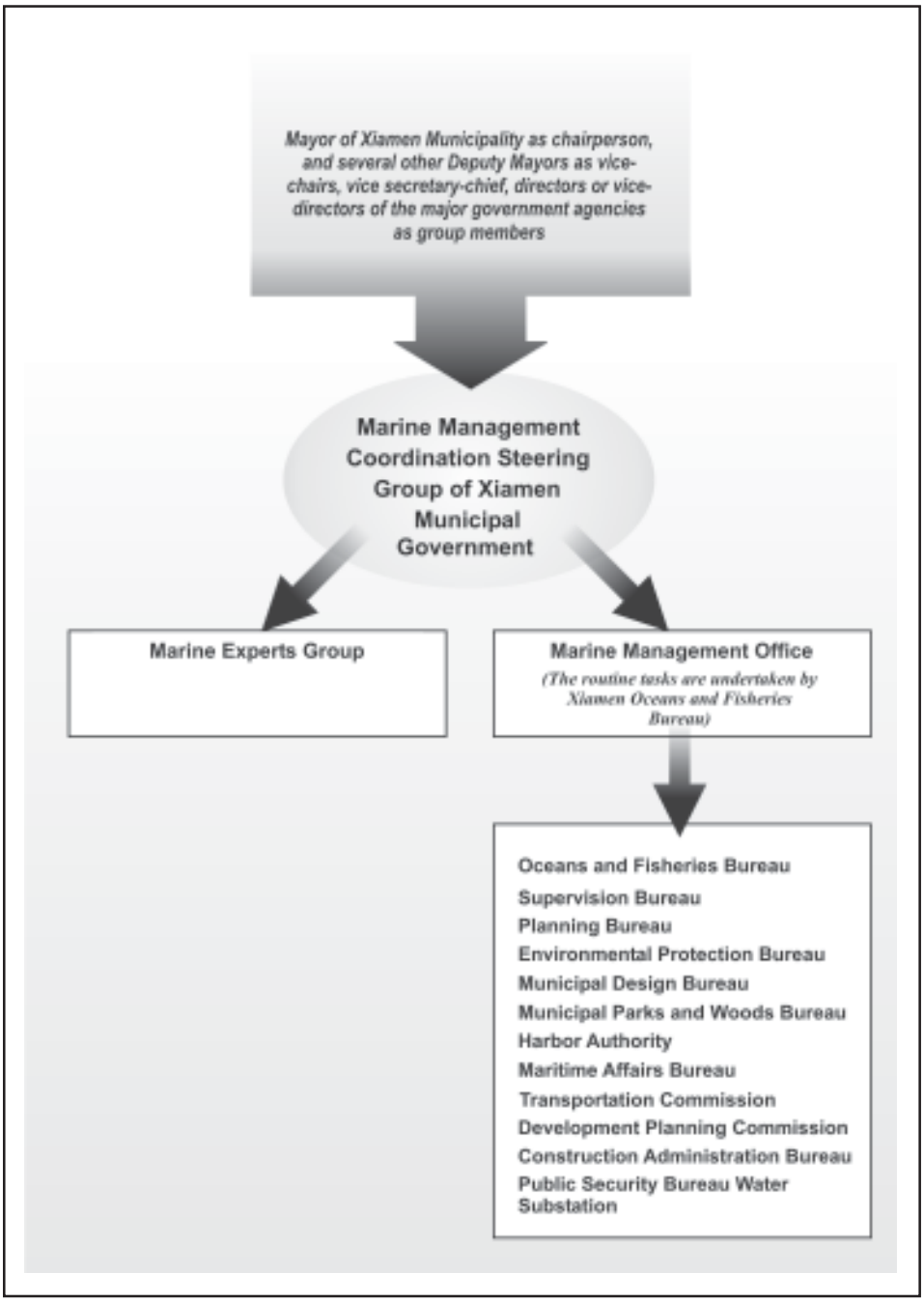


Figure 8. New Institutional Set-up for Administering ICM in Xiamen.

To improve the coordinating mechanism, the MMO and the Fisheries Bureau were merged into a new agency in 2002, the Xiamen Oceans and Fisheries Bureau (XOFB), which is now in charge of the marine and fishery affairs for the entire city (Figure 8). The Mayor now heads the Steering Group for Marine Management in Xiamen City as the executive chairperson. Group members include the vice secretary-chief, directors or vice-directors of the major government agencies like maritime affairs, transportation, environmental protection, aquaculture, land-use, planning committee, port affairs, urban construction, water security, and the heads of various districts. Under the group, an

administrative office was assigned to the XOFB. The major responsibility of this office is to coordinate the routine activities of the Steering Group and the Xiamen Marine Experts Group (MEG). Within the XOFB, full-time personnel have been assigned to the PMO of Xiamen ICM.

Scientific and technical support

The success of ICM program in Xiamen is made possible by the active involvement of scientists and other experts who rendered support from its start-up phase to the present. In 1996, the MEG was formed by the municipal government to provide a venue for integrating science into environmental management and policy/decision making. The group, composed of marine scientists, economists, and legal and other technical experts, was given the responsibility of providing essential socioeconomic, scientific, legal, and technical advice when needed. Information and findings from scientific studies provided the basis for the policies and decisions made by the MMCC. MEG members are asked to provide information and lend their expert opinions to ensure that potential development projects would have no adverse effect on the ecosystem. This enabled government officials to better understand the role of science in management decision making, and with better understanding they have been more receptive to environmental projects and the application of ICM. Thus, the MEG has become a major support for the local government and the scientists have become more conscientious in participating and contributing to the management decisionmaking process. Since its formation, the group contributed to the development of the Xiamen functional sea-use scheme, completion of a comprehensive marine economic development plan, establishment of a marine environmental monitoring network, and the operation of the Xiamen International Training Center for Coastal Sustainable Development (ITC-CSD) (McCleave, Xue and Hong, 2003).

Obtaining valuable inputs from the technical and scientific community.

The MEG meets once every quarter with the Executive Vice-Mayor to discuss current issues on marine management. In order to effectively perform this task, the members of the scientific community continue to carry out research and training activities. These, combined with the actual application of their research activities, further enhance their capacity to contribute to the environmental protection programs of the local government.

According to the head of the MEG, Professor Huasheng Hong of Xiamen University, the effective integration of science and management via a sound scientific support mechanism is a major factor in Xiamen's ability to grow with minimal adverse effect on its environment. One such enhancement is the application of the integrated environmental impact assessment (IEIA) intended to identify the cumulative impact of economic activities and provide preventive and mitigation measures. For example, the findings from IEIA applications were used to develop a marine functional sea-use scheme, which helped set priorities and reduce conflicts among the different

Table 3. Summary of Research Projects Providing Scientific and Technical Support for the Development and Implementation of Xiamen ICM (1994–1998).

Stage	Project Name	Project Achievement	Participating Institutions	Interdisciplinary Composition
Development Stage	Coastal Environment Profile and Strategic Plan for the Prevention and Management of Coastal Pollution	Provided an overview of Xiamen's coastal environment; formulated a strategic plan for coastal environment management in Xiamen	Xiamen University, 3rd Oceanographic Research Institute under State Oceanic Administration, Fujian Oceanographic Research Institute, Xiamen Environmental Protection Bureau, Xiamen Zoning Board, Xiamen Planning Committee, Environmental Monitoring Station of Xiamen Port Authority, Xiamen Fishery Administration, and Xiamen Marine Management Office	Marine Chemistry, Marine Biology, Marine Geology, Environment, Urban Planning, Ecology, Aquaculture, Economics, Legal, Management, Planning Management, Fishery Management, Environmental Protection Management and Marine Management
	Ecological & Socioeconomic Impact Assessment of Xiamen Coastal Economic Development	Report on the assessment of the ecological and socioeconomic impact arising from economic activities; Management guide in response to ecological and socioeconomic impact for the mitigation and control of marine pollution; Conducted training for ecological and socioeconomic impact assessment	Xiamen University, 3rd Oceanographic Research Institute under State Oceanic Administration, Fujian Oceanographic Research Institute, Xiamen Port Construction Command Center, and Xiamen Environmental Protection Bureau	Marine Chemistry, Geography, Marine Geology, Ecology, Environment, Economics, Environmental Management, and Ports
	Xiamen Coastal Waste Management and Pollution Prevention	Technical report on solid and waste management; strategies and guide for effective solid and waste management; substitute solid and waste collection and disposal system guidelines; database of potential solid and waste disposal sites within the program area; application of solid and waste assessment methods; environmental impact assessment report on two sea waste dumping sites at Zhenhai point and Tower Point in Xiamen Bay	Environmental Science Research Center of Xiamen University, Xiamen Marine Jurisdiction of State Oceanic Administration East Sea Branch, Preparatory Office for Waste Disposal Yard Project, and the Legal Division of Xiamen University	Marine Chemistry, Marine Biology, Environment, Chemistry, Legal, Marine Supervision and Management

Stage	Project Name	Project Achievement	Participating Institutions	Interdisciplinary Composition
Development Stage	Integrated Management Action Plan for the Control of Pollutant Discharge in Xiamen	Solid and waste management information database, and action plan for integrated solid and waste management in conformance to the Global Waste Survey	Xiamen Environmental Protection Bureau, Xiamen Oceanic Administration	Environment, Chemistry, Marine Hydrometeorology, Marine Geology, Marine Chemistry, Environmental Protection Management, and Marine Management
Implementation Stage	Establishment of Marine Legal System of Xiamen, China	Establishment of Marine Legal System of Xiamen, China; Xiamen Municipal Regulations on Sea Area Utilization Management; legal framework for coastal management in Xiamen	Xiamen Bureau of Legal Affairs, Xiamen Polity Research Section, Xiamen University, and the Xiamen Marine Management Office	Legal and Marine Management
	Xiamen Sea Area Functional Zoning	Technical report on Xiamen sea area functional zoning; improvement on related marine industry planning; Xiamen sea area functional zoning atlas; Proposed management strategy for sea-use conflicts; sea area functional zoning scheme approved by local government for enforcement	Engineering Consultancy Center of Xiamen Planning Committee, Fujian Oceanographic Research Institute, Xiamen Zoning Board, Xiamen Port Authority, Xiamen Environmental Protection Bureau, Xiamen Aquatic Bureau, 3rd Oceanographic Research Institute under State Oceanic Administration, and the Xiamen Construction Committee	Construction Engineering, Marine Chemistry, Urban Planning, Port Construction & Zoning, Environment, Aquaculture, Marine Geology, Geography, and Economics
	Xiamen Marine Economic Development Planning	Prepared guidelines and overall concept for Xiamen marine economic development; established Xiamen's top four major marine industries and proposed development plans; formulated indicators for the development of the marine economy	Xiamen University, 3rd Oceanographic Research Institute under State Oceanic Administration, Fujian Oceanographic Research Institute, Fujian Aquatic Research Institute, Xiamen Planning Committee, and the Xiamen Science and Technology Committee	Marine Biology, Marine Chemistry, Marine Geology, Environmental Science, Aquaculture, Chemical Engineering, Economics, and Management Science

Stage	Project Name	Project Achievement	Participating Institutions	Interdisciplinary Composition
Implementation Stage	Control and Management of Coastal Aquaculture Pollution	Technical report on aquaculture status, withstanding capacity, ecology, social impact and minimum safe values of aquaculture; strategies for sound development and management of aquaculture; forms and models of environmental, ecological and socioeconomic assessment of coastal breeding	Oceanography Department of Xiamen University, Fujian Aquatic Research Institute, Xiamen Aquatic Bureau	Marine Biology, Marine Management, Aquaculture, Fishery Resources, Fishery Environment, and Fishery Management
	Integrated monitoring of coastal environment and monitoring of its management results	Integrated coastal environment monitoring system established; monitoring system management rules endorsed and implemented; Integrated Marine Environment Monitoring Scheme; Marine Environment Monitoring Center established (providing technical support, training services); Xiamen Marine Environment Quality Report; management of monitoring system incorporated into government activities; monitoring capability improved	3rd Oceanographic Research Institute under State Oceanic Administration, Xiamen University, Fujian Oceanographic Research Institute, Fujian Aquatic Research Institute, (Xiamen Fishery Environmental Monitoring Station), Environmental Monitoring Station of Xiamen Environmental Protection Bureau, and the Environmental Monitoring Station of Xiamen Port Authority	Marine Chemistry, Chemistry, and Environment

stakeholders (Table 3 shows specific research projects undertaken).

Legislations

Given their sectoral nature, previous local legislation had been unable to respond to the various issues and concerns pertaining to the management of Xiamen's marine waters. To more effectively deal with marine environmental issues, the National People's Congress granted environmental legislative rights to the city, which led the local People's Congress to promulgate a set of laws and regulations related to marine resources development and environmental protection (Li, 1999). Thus, a local marine legal framework emerged within the limits of the national marine legal system, which drew support from various agencies (Figure 9). Again, in order to combat the problems associated with the sectoral approach, close coordination among those involved in proposing and developing regulations is crucial.

From 1994 to 1997, 13 legislations concerning land-based pollution and environmental protection were passed. This provided the impetus for the legislative efforts supportive of the ICM framework. For example, the *Regulation on the Uses of Xiamen Sea Areas* emphasized the cross-sectoral coordination in coastal project review and permit process, scientific decisionmaking, and use of market-based instruments. It also paved the way for the institutionalization of the interagency coordinating mechanism for ICM (Chua and Gorre, 2000). Table 4 presents a list of project activities and relevant legislations that strengthened the role of the local government in coastal management.

Besides implementing existing legislation, local authorities have regularly reviewed and improved legislation according to the prevailing conditions and made them adaptable to changes. For example, the *Xiamen Regulation on Environmental Protection of Sea Areas* had been revised based on the changes made on the national law concerning the protection of the marine environment in April 2001. Other legal measures were revised, including those concerning the nature reserves for the lancelets and aquatic breeding on tidal flats.

Integrated law enforcement

With the legislative framework formulated to provide the necessary rules, enforcement had to be fortified as well. Instead of delegating the authority to supervise the implementation of laws and apprehend violators to a single agency, a multiagency law enforcement unit was organized.

The MMO has enforcement powers to implement management interventions in accordance with municipal administrative orders and legislation. An Integrated Marine Enforcement Squad, which covers nine marine-related agencies including Xiamen Marine Management Supervision Squad, Xiamen Maritime Bureau, Xiamen Fisheries Administration Division, Xiamen Fishing Port Supervision Bureau, Xiamen Marine Public Security Branch, Xiamen Marine Transportation Administration Division, Environmental Protection Squad and City Appearance Squad of Xiamen Urban Supervision

The integrated law enforcement group helped in resolving a number of sea-use conflicts.

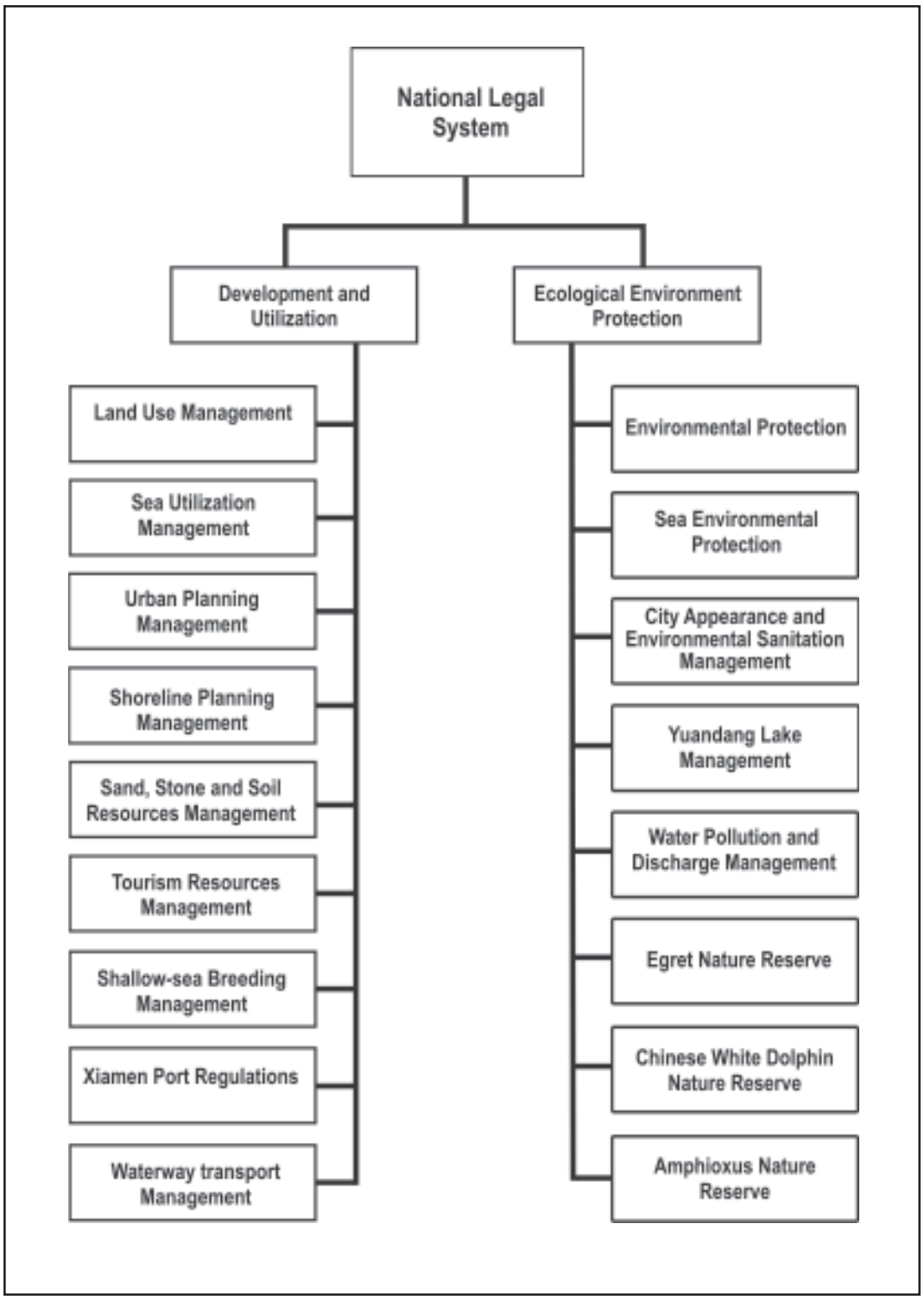


Figure 9. Xiamen Coastal Management Legal Framework.

Table 4. Strengthening Coastal Management through Local Legislation.

Year	Major ICM Project Activities	Legal Instruments
1994	• Strengthening local government commitments • Public awareness campaigns	• Regulation for Environmental Protection
1995	• Integrated management committee/ office established • Environmental profile and strategic environmental management plan prepared • Marine laws reviewed and new legal instruments proposed	• Regulations for Managing the Resources of Sands, Rocks and Soils • Regulations for the Management of Navigation; • Municipal Ordinance for Egret Nature Reserve in Dayu Island • Administrative Rules for Strengthening the Management of Catching Marine Eel Larvae • Regulations for the Management of Water Resources
1996	• Yuandang Lagoon case study • Waste problems and management assessed • Aquaculture impact study • Integrated monitoring system established	• Municipal Ordinance for Managing Yuandang Lagoon area • Municipal Ordinance for Urban Landscaping and Environmental Health • Administrative Rules for Aquaculture in Shallow Seas and Tidal Flats • Regulations for Marine Environmental Protection
1997	• Integrated environmental impact assessment • Functional zoning scheme developed • Studies on sustainable financing mechanisms	• Regulations for the Uses of Sea Areas· • Regulations for the Protection of Chinese White Dolphin • Regulations for the Management of Tourism • Government Notice on Implementation of Xiamen Marine Functional Zoning Scheme

Source: Chua, et al., 1999.

Division and the Fujian Navigational Channel Bureau Xiamen Branch was formed in 1997. Its formation improved frontline law enforcement and supervision of marine management such as those provided under the implementing guidelines for the marine functional zonation. For instance, those engaged in illegal fishing operations and aquaculture facilities found in the navigational and protected areas were arrested. These measures effectively strengthened law enforcement in sea areas around Xiamen, and promoted the protection of marine resources and the ecological environment.

There was substantial improvement in the enforcement of the permit system as the integrated enforcement team gained more experience and confidence. The united law enforcement not only brought about stronger teams and standardized procedures but also compelled law enforcement officers to uniformly apply the law. Moreover, a law enforcement supervision mechanism ensured that the team was able to perform its duties accordingly. Each year, delegates to the Municipal People's Congress and members of the Municipal People's Political Consultative Conference assess the performance of the integrated marine management and law enforcement group.

Sometimes, they conduct unannounced inspections and join in actual reconnaissance missions.

Financial Arrangements

Limited financing and a lack of technical and institutional capacity hold back local governance of marine environmental initiatives. Given the competing budgetary requirements among the necessary social services, it is not surprising that few governments have environmental programs at the top of their lists. One way of surmounting this hurdle is to have the international community develop partnerships that build the technical, financial and institutional capacity of local government units.

Xiamen's willingness to finance environmental protection projects is a good indicator of the commitment and determination of the local government to actively participate in the efforts. In Xiamen, the ICM program was jointly financed through MPP-EAS and the municipal government. Table 5 presents the estimated contributions associated with the ICM program implementation. MPP-EAS was officially completed in 1999 and negotiations for the second cycle ICM program in Xiamen began only a year later. In addition, individual agencies that were involved in some ICM-related activities also contributed, either in cash or in kind. Figure 10 indicates that the lion's share (over 89 percent) of the MPP-EAS contribution was spent for research and planning activities, which included capacity building. This implies that the MPP-EAS fund served as a seed fund to finance essential activities that, otherwise, might not have been undertaken. At the same time, the findings from the research became the basis for more concrete, on-the-ground activities. While the donor contribution would appear to be mere drops in a bucket, the activities funded have encouraged the local government to do more.

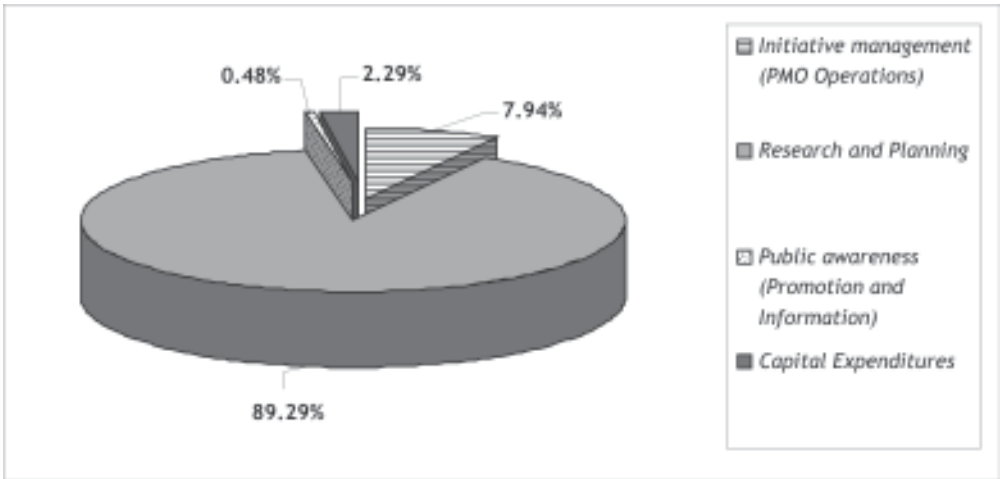
At present, the Xiamen Municipal Government allocates RMB 35 million (about $4 million) annually for the operations of the XOFB and other coastal and marine environment-related activities such as the enforcement of the marine functional zonation scheme (Zhou, 2005). The local government also spends substantial amounts in providing needed infrastructure, such as urban sewage treatment facilities and construction projects related to marine environmental protection. The present economic growth enables the government to afford these expenses but in the long run, the government will have to seek other sources of funding for the various environmental activities. The application of market-based instruments needs to be expanded and new innovative financing arrangements, such as the public-private partnerships approach, need to be made. This is

Table 5. Funds for ICM (in RMB), 1994–2001.

Year	MPP-EAS/ PEMSEA Contribution	Marine Management Office/ Local Government Contribution	TOTAL
1994		3,000,000	3,000,000
1995	2,023,372	4,200,000	6,223,372
1996	2,793,973	5,700,000	8,493,973
1997	1,762,833	13,500,000	15,262,833
1998	1,501,922	10,500,000	12,001,922
1999	116,932	12,000,000	12,116,932
2000	0	3,000,000	3,000,000
2001	448,636	3,800,000	4,248,636
Total	8,647,668	55,700,000	64,347,668

Sources of basic data: Xiamen Financial Bureau and PEMSEA.

Figure 10. Uses of the MPP-EAS Contribution, 1995–2001.



Source of basic data: PEMSEA.

one way of further encouraging the participation of the private sector in the ICM program.

ICM Blueprints

Aside from the formation of the marine management coordinating mechanism, similar strategic activities were undertaken. Xiamen, with the support of the MPP-EAS, began by increasing the capacity of the municipal government and other institutions involved in coastal planning, development and management. Among the first outputs of the Integrated Task Team of the Xiamen Demonstration Project (ITTXDP) were an environmental profile and a strategic management plan.

Environmental Profile of Xiamen

The *Coastal Environmental Profile of Xiamen* (ITTXDP, 1996a) presents relevant information on the socioeconomic, political, legal and environmental status of the city for the past 20 years. The findings served as a means to: 1) assess the state of the coastal and marine environment; 2) gauge the severity of environmental stress; 3) identify information gaps; 4) evaluate institutional and management constraints; 5) determine availability of national and local capability to undertake ICM; and 6) identify potential benefits and opportunities for undertaking management interventions.

Strategic Environmental Management Plan

More commonly known as the SEMP, the Strategic Management Plan for Marine Pollution Prevention and Management in Xiamen was based primarily on the information gathered from the environmental profile and was the end product of consultations with various agencies and experts. The plan was in accord with, and built upon, the overall objective of the municipal government to develop Xiamen into "a socialist, modern, international and scenic port city" (ITTXDP, 1996b).

The document contains an assessment of the causes and effects of identified environmental concerns and their associated risks, evaluated management measures in place (if available) and ranked possible options for intervention. There was emphasis on developing essential coastal and marine policies and management strategies that could be carried out by the local government. It likewise contained a series of short- and long-

term action programs and guidelines for managing coastal resources, including arrangements for their implementation, monitoring, and evaluation. To facilitate the implementation of the strategic management objective, the following policy measures were included in the SEMP: 1) adoption of integrated planning and management; 2) undertaking resource valuation and environmental accounting; 3) application of the principles of functional marine use and pollution damage compensation; 4) adoption of the precautionary principle; 5) encouraging public participation; and 6) application of economic instruments for environmental management.

The above ICM blueprints have been well received. Many recommendations contained therein, such as the establishment of a coordinating agency for ICM and the development of the sea area use scheme, were submitted for review and consideration by the government while still in the process of finalization. It was surprising that they were promptly accepted for adoption and implementation — an unprecedented act, as the usual practice adheres to the dictum that no project will be implemented until its entire plan has been completed. Thus, it eliminated the problem of working with outdated information, which often causes plans to lag behind development and management needs.

Pollution Reduction

Xiamen was not, however, operating on a hit-and-miss scenario. Aside from the experiences of other countries, undertaking the Yuandang Lagoon cleanup provided valuable lessons worthy of emulation in addressing pollution within the entire city. At the same time, marine pollution monitoring is built into the local ICM framework. Monitoring results makes information on changes in the marine environment available for use in formulating management plans and can also be an indicator for project impact.

Healing Xiamen's "Ulcer"

From the top of any of Xiamen's skyscrapers, one can catch a panoramic view of the city's landscape. From there, one can notice and appreciate how clean the waters are, especially around Yuandang Lagoon. Fringed by a landscaped lawn, a musical fountain, pedestrian walkways and a venue for cultural performances, it is an integral part of the bustling metropolis. Looking at the lagoon today, it is hard to imagine that it used to be one of the most polluted water bodies in the country.

Yuandang Lagoon used to be a fishing harbor connected to the West Sea and covering an area of around 10 km^2 (6.3 km long and 1.6 km wide). Aside from serving as storm shelter for fishing boats, it also had mangroves, lancelets, Chinese limuloids (crabs), white dolphins and egrets. In the 1970s, a causeway (West Causeway) with a 4-hole floodgate was built at the mouth of the lagoon. The construction cut off the water flow, converting the lagoon into an enclosed body of water. It eventually became a catchment area for industrial and municipal waste discharges. The lagoon's surface area was further reduced to 2.2

Yuandang Lagoon before cleanup

km^2 when land was reclaimed for agriculture. It emitted a stench, attracting mosquitoes and flies, and was officially declared dead a decade later. The condition not only led to the disappearance of fishes and egrets, but also drove away residents and would-be investors. It subsequently earned the moniker: "Ulcer of Xiamen Island."

The city leaders, realizing the dire consequences if the lagoon was left in its deteriorated condition, passed a resolution in September 1988 that became the basis of the Yuandang Lagoon Integrated Treatment Project. The project had three major objectives. First, it was intended to improve the water quality and ecosystem health of this man-made body of water. In this way, the West Sea area would also be protected from further pollution. Second, it sought to improve the drainage system and flood prevention for Xiamen's new urban districts. Third, it envisioned transforming the surrounding area as a leisure and recreational destination.

This initiative had two phases, each with corresponding components geared at rehabilitating the lagoon (Box 5). It included the construction of the first ever sewage treatment facility on the island. The success of the rehabilitation, particularly in its first phase, made the international community take notice of this coastal city.

In order to protect the achievements of the cleanup project, the Xiamen Municipal Government approved the establishment of the Xiamen Yuandang Lagoon Administration Office to oversee the daily operations of the lagoon area. On July 23, 1997, the Xiamen People's Congress passed the "Administrative Regulations of Xiamen Yuandang Lagoon," which provided the legal basis for Yuandang Lagoon's management. The Xiamen Construction Management and Supervision Branch set up a special team to manage the enforcement of the relevant laws. Thus, a new management structure for Yuandang Lagoon was established. In the past few years, this team has

Box 5. Yuandang Lagoon Cleanup Activities.

Phase 1 (May 1989 to June 1992; estimated cost: RMB 110 million)

- Enforcement of the 1982 regulation requiring sewage treatment prior to discharge;
- Installation of wastewater interception systems including the construction of a sewage treatment plant with a daily capacity to provide primary and secondary treatment of 134,000 m^3 and 37,000 m^3, respectively, and laying down of 24 km of drain pipes with seven pumping stations;
- Construction of 10-km retaining wall around the lagoon;
- Dredging of 3.2m^3 of sludge;
- Construction of tidal channels to facilitate water exchange between the lagoon and the sea; and
- Providing greenbelt area covering 60,000 m^2.

Phase 2 (June 1992 to December 1999; estimated cost: RMB 240 million)

- Establishment of second sewage treatment plant with daily primary treatment capacity of 100,000 m^3, two more pumping stations and 7.15 km of drain pipes;
- Adding a 14-km embankment and 27-km walking path along the lagoon;
- Putting up a pumping station, capable of draining 40 m^3 of water/hour from Yuandang Lagoon to the West Sea area, for improved capacity for flood prevention;
- Installation of pumping station with a capacity of carrying 2.5 m^3/second of seawater from the west (Yuandang Lagoon) to the east (Song Bai Lake); and
- Developing the Bailuzhou Delta, formerly a barren marshland in the center of Yuandang Lagoon.

Table 6. Water Quality of Yuandang Lagoon.

Indicator	1987	1992	2001	GB12941-91 B Type Standard
Total amount of sewage (m^3/d)	60,000	180,000	260,000	-
Amount of sewage intercepted (m^3/d)	0	130,000	200,000	-
Cu (mg/l)	225.25	17.10	0.045	≤ 0.01
Sulphide (mg/l)	8.48	0.20	0.02	-
DO (mg/l)	0	5.2	4.99	≥ 4
BOD_5 (mg/l)	14.5	5.7	4.30	≤ 4
COD_{MN} (mg/l)	86.1	7.2	4.18	≤ 6
SS (mg/l)	86.7	4.0	5.73	-

Source: Yuandang Lagoon Administrative Office.

played an important role in preventing illegal construction, sewage discharge or other harmful activities from being carried out in the lake. Aside from enforcing the law, their work involves maintaining the gains previously realized.

A staggering RMB 350 million was spent in the 10-year cleanup; nevertheless, the cost is far outweighed by the long-term benefits.

Environmental Benefits

After 10 years, the environmental quality of Yuandang Lagoon gradually improved (Table 6). Its water quality approached fishing water standards, dissolved oxygen (DO) annual average value was maintained at around 5 mg/l, and chemical oxygen demand (COD_{Mn}) and biochemical oxygen demand (BOD_5), were within the national standards. There was a remarkable decrease of heavy metals, such as Mercury, Chromium, Lead, and Cadmium. The water of Yuandang Lagoon has since been classified as suitable for boating and recreational purposes.

Egrets, seagulls and other aquatic creatures have returned to Yuandang Lagoon. The type and number of aquatic creatures in the lake have increased remarkably and the diversity of aquatic life now closely mirrors those of the West Sea.

Social Benefits

The successful implementation of the lagoon's treatment project generated positive reaction from the residents of Xiamen. Having realized that a clean environment could contribute to the city's development, the local government decided to devote more time and resources towards pollution control, not only for Yuandang but for the entire city.

In addition, the lagoon has become a favorite community venue for cultural, recreational, tourism and leisure activities. It hosted the Gold Leaf F1 motorboat tournament, participated in by 24 athletes and about a hundred officials from 12 countries in November 1997, and the International Overseas Chinese "Yan Huang Cup" dragonboat race in October 2000. The success of these events helped in the promotion of Xiamen.

Economic Benefits

As a preferred business site, more investments poured into the area. The

immediate vicinity of the lagoon hosts the headquarters of prominent business and finance corporations. As early as 1997, the area emerged as a new city center for international and domestic investments, tourism and residential development. In a survey conducted under the Xiamen ICM Demonstration Project (XDP), over 53 percent of the 173 investors located around the lagoon area listed "beautiful environment" as a major reason for their choice of investment site.

With the improvement in the living environment, there was renewed interest in the lagoon causing real estate and land prices to soar. The reclaimed land of about 700,000 m^2 is now priced at RMB 2,000 /m^2 or a total value of RMB 1.4 billion (about $175 million).

Waste recycling also became part of the project wherein methane and sludge were utilized. It is estimated that this has an annual economic value of RMB 2 million (around $250,000). Moreover, the Yuandang cleanup leveraged environmental investments in other areas. The project was instrumental in the establishment of waste treatment plants in Xinglin, Jimei, and Haicang, as well as solid waste management projects.

In December 2001, the Yuandang Lagoon Integrated Treatment Project was named as one of the ten excellent construction projects during the 20-year development of Xiamen as an SEZ.

Marine Monitoring Network

The XDP brought together the existing monitoring efforts to develop a collaborative network and program, under which monitoring efforts are optimized, resources shared, and methods, standards and results exchanged. This integrated program did not supplant the existing sectoral monitoring plans of the participating institutions, but rather sought coordination and standardization (Xu and Lijuan, 1997). It included eight subprojects, namely: 1) large-scale water quality monitoring; 2) 24-hour water quality monitoring at fixed stations; 3) port water quality monitoring; 4) water quality monitoring in mariculture sites; 5) recreational beach water

quality monitoring; 6) sediment monitoring; 7) monitoring of bioaccumulation in bivalves; and 8) monitoring during major environmental calamities.

Part of the network's task was the development of appropriate seawater quality standards for Xiamen, in accordance with national standards, taking into account the prevailing environmental and socioeconomic conditions. In particular, the local standards defined water quality management targets for the different functional sea-use zones. Aside from the selection of 18 out of the 34 parameters in the national standards, maximum values for the suspended particulate matter and temperature were added.

A team composed of representatives from participating institutions oversees the activities of the network. Tasks are distributed among the members based on their relative competencies, and members are required to regularly submit monitoring results for validation and consolidation (Table 7).

The resulting monitoring mechanism was more effective than the old system as it strengthened institutional capacity, improved quality of monitoring data and its analysis, and reduced duplication of monitoring efforts among the concerned agencies (Xu and Yuan, 1999). The voluntary participation and genial cooperation among the members helped in the success of its operations. Team members also recognized the importance of support from the relevant government departments, as well the need for other monitoring units to look into their potentials and resources.

While environmental monitoring was previously considered synonymous with data collection, that perception has changed because monitoring data has been effectively used to administer appropriate policy and management decisions. Hence, monitoring efforts have been established in line with environmental management requirements.

Xiamen's environmental monitoring team has reported that domestic sewage is the biggest source of pollution in the city. There was a high concentration of fecal coliform bacteria in the seawater, particularly in the inshore coastal areas close to urban centers. On the other hand, the other major pollution generator is the mariculture industry. Poor mariculture practices have led to eutrophication problems and red tide occurrences. These results have been presented to the MMCC for discussion, inclusion in the environmental management plan, and appropriate action.

Xiamen Wastewater Treatment

Inspired by the successful implementation of the Yuandang Lagoon Integrated Treatment Project, the municipal government continued to

Table 7. Responsibilities of the Members of the Network of Marine Pollution Monitoring.

Working Units/ Institutions	Tasks
Third Institute of Oceanography, SOA	Routine water quality monitoring Monitoring of bioaccumulation in bivalves
Environmental Monitoring Station	Surface water quality monitoring
Environmental Research Center of Xiamen University	Recreational beach water quality monitoring
Monitoring Station of Fujian Fishery Institute	Water quality monitoring in mariculture sites
Fujian Institute of Oceanography	Sediment monitoring
Monitoring Station of Xiamen Port	Port water quality monitoring

Source: Xu and Yuan, 1999.

prioritize environmental initiatives for the entire city. It paved the way for the establishment of sewage waste treatment facilities in Xinglin, Jimei, and Haicang, as well as solid waste management projects.

In the 1980s, pollution emanating from wastewater and raw sewage discharged into lakes, rivers and, eventually, the seas posed a big problem. Clearly, the only existing sewage facility at that time was incapable of servicing the entire city's requirement. By the 1990s, total wastewater discharge in Xiamen had exceeded 1.0×10^8 tons/annum, while the wastewater treatment capacity was only 3.5×10^7 tons/annum. With the passage of the city regulations prohibiting dumping of untreated or raw sewage into the bodies of water, it became necessary to start investing in additional treatment facilities. Two projects, namely, the "Xiamen Coastal Waste Management and Pollution Prevention" and "Integrated Management Action Plan for the Control of Pollutant Discharge in Xiamen," were undertaken to serve as inputs in the development of a waste management program for the city. The former collected and analyzed data on waste generation, collection and prevailing disposal practices for both solid and liquid wastes, while the latter drew up a plan aimed at controlling pollution discharge in the coastal waters by 2020.

Sewage treatment facilities in Xiamen

By the end of 2003, the urban areas of the city had seven functioning sewage treatment plants, with over 300 km of pipe networks, and a total treatment capacity of 559,000 tons/day. During the same year, 72.8 percent (102.47 million

Table 8. Large-Scale Wastewater Treatment Plants.

Name of Plant	Start of Operation	Treatment Capacity (tons/day)		Cost (million RMB)
		Primary	Secondary	
No. 1 Wastewater Treatment Plant	1989	134,000	37,000	40.91
Xinglin Wastewater Treatment Plant	1995	30,000		70.50
No. 2 Wastewater Treatment Plant	1997	100,000		89.45
	2003 (expansion)	210,000	100,000	520
Jimei Wastewater Treatment Plant	2000	45,000		78.18
Haicang Wastewater Treatment Plant	2000	100,000		249.99
Shi Wei Tou Wastewater Treatment Plant	2001	100,000		430
Tong'an Wastewater Treatment Plant	2003	50,000		91

Source of Basic Data: Xiamen Water Affairs Group, Ltd.

Table 9. Required Funding for Sewage Treatment Facilities.

		2004	2005	2006	2007	Total
Budget for Construction and Management	Construction	17,103	46,904	17,196	10,900	92,103
	Management	7,930	8,960	10,980	11,500	39,370
	Total	25,033	55,964	11,480	22,900	131,473
Income from Sewage Treatment Fees		9,100	9,500	10,000	10,500	39,100
New Investment Needed		19,833	50,464	22,776	16,400	109,473

Source: Zhou, 2005.

tons) of the 140.76 million tons of sewage discharged (35 million tons are classified as industrial waste) were treated. Table 8 presents the major wastewater treatment plants in Xiamen and the corresponding capacities of each facility.

From 1984 to 2003, the municipal government invested RMB 1.5 billion ($180 million) to construct seven urban sewage treatment plants and sewage pipelines. The projected funding requirement to further expand sewage treatment capacity is estimated to be RMB 1.31 billion for the period 2004–2007 (Table 9), with approximately RMB 1.09 billion in the form of new capital infusion, while the balance is expected to come from income from user fees.

Public Awareness

In China, opening up policy development and program implementation to the general public is relatively new. However, some government officials have begun to recognize the far-reaching effects of involving the public in the promotion of government concerns and management actions and their outcomes. For instance, strong public clamor had been influential in the cleanup of the Yuandang Lagoon. Hence, the MMCC, through the MMO, organized several activities geared towards increasing public awareness and concern for the environment as part of the ICM initiative. The campaigns centered on "taking good care of the blue marine territory and building a scenic port city with booming tourism."

One method was the creation of a weekly column in a local paper that tackled environmental and resource concerns. In 1994, a compilation of articles on the marine environment, written in the Chinese vernacular and loosely translated as "The Sea and Xiamen," was published. "We Own the Sea," a followup publication, was released the following year. For the same purpose, a marine educational program for students from all ages was later developed. Special training programs, wherein university students tutor young children about coastal issues, were organized during the summer break.

Complementing the campaigns through the print media was a series of municipal quiz shows focusing on marine and coastal issues. These were conducted in conjunction with Ocean Day and World Environment Day celebrations. Participants for the different categories were district government and agency personnel, as well as elementary and secondary school students. These competitions were broadcasted on local television and radio stations, along with a video production on the marine environment. Senior city officials and marine experts were invited to share information and experiences on the need for marine management and marine resource protection, especially for a coastal city such as theirs.

These publicity campaigns were said to have effectively improved the marine and environmental awareness of the public. As a result, citizens enthusiastically provided their comments

and suggestions for the management of Xiamen's marine environment via telephone calls, e-mails, radio broadcasts, newspaper columns and letters. There was change in attitude and perception; thus creating a favorable atmosphere for active public involvement in ICM-related activities, such as beach cleanups. This level of involvement was necessary to sustain ICM efforts. The MMCO continued to produce newspaper articles and television programs on marine environmental concerns. Each month, a newsletter entitled *Xiamen Marine Management* highlighted current ICM activities and future plans in the city. It was distributed to relevant local government departments, bureaus and agencies, as well as local universities.

Although there were fewer opportunities for citizens to form groups and nongovernmental organizations (NGOs) compared to those found in Western countries and other Asian neighbors, many point to the high environmental awareness of Xiamen residents as a major influence in creating one of China's most environment-friendly cities. The establishment of environment hotlines that respond to complaints and websites that lists major environmental projects provided information to the public and brought attention to major issues. The relationship built through these channels spurred citizens to pressure city officials to address specific environmental problems, which led to improved overall environmental conditions. Heightened environmental awareness also resulted to willingness to pay for the preservation of endangered species, conservation of fishery resources and the maintenance of beach areas and sewage treatment. This was evident in the results of a contingent valuation method (CVM) conducted in July 1998. These led to stronger political commitments and allocation of financial resources for environmental projects. (See Table 10 for the values of the WTP.) The realization that the residents were willing to pay for better facilities and services somehow played a role in convincing the local government to invest in the sewerage system, nature-based recreational areas and preservation zones.

Capacity Building

The creation of a critical mass of ICM practitioners was necessary, if the ICM framework were to flourish. Xiamen played a pivotal role in educating not only those from the region, but from other parts of the world as well. Xiamen continues to share its experiences and help train others. Enhancing institutional capacity involved providing several avenues for directly improving the technical knowledge and skills of their personnel. As they would be the ones implementing the plans and specific action programs, whenever possible, they need to be exposed to all facets of ICM program implementation. These included:

- Attending training programs and workshops;
- Participating in consultations and forums such as those organized for the sea-use zoning scheme; and
- Attending exposure trips and study tours.

Table 10. Average WTP for Environmental Goods and Services.

	Average WTP (RMB/year)
Fisheries	59.5
Endangered species	47
Beaches	77
Sewage treatment	101

Source: Abansi, 1999.

In collaboration with MPP-EAS and some international experts, universities and scientific and research institutions took the lead in organizing the above activities. Later, these strategies became the basis for developing a larger scale, ICM capacity-building program in Xiamen and other coastal municipalities.

In July 2001, a Memorandum of Agreement was signed by GEF/UNDP/IMO Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), the State Oceanic Administration (SOA), Xiamen Municipal Government and Xiamen University for the development of the International Training Center for Coastal Sustainable Development (ITC-CSD). The Center, which was designated as an official PEMSEA ICM Training Center, was developed to facilitate sharing of experiences at the national and regional levels through study tours, workshops and annual regional training courses in collaboration with PEMSEA. The Xiamen ICM Project served as a "training laboratory" for ICM training, wherein local professionals shared their experiences and expertise in ICM program implementation. PEMSEA also envisions the Center playing a lead role in the conduct of ICM training activities for the development of new ICM parallel sites.

To increase awareness and spread the message of ICM, several videos were produced, showcasing the story of Xiamen. These were broadcast in cooperation with Living Asia Channel (Philippine-based channel airing in the Asia-Pacific region), Masan Munhwa Broadcasting Corporation (RO Korea) and Xiamen Television. Xiamen also took on a new role by agreeing to host the permanent secretariat of the PEMSEA Network of Local Governments (PNLG). The PNLG was established to forge linkages and promote cooperation and information sharing among its members, composed of coastal communities that had adopted ICM.

Regardless of the medium, whether through training programs and study tours or merely through reading materials and videos, the ICM program at Xiamen is now providing important lessons learned for the management of coastal and marine activities, both within and outside the region. Building local capacity and leadership in ICM is a means of addressing conflicts. It is evident that, in order to broaden the application of ICM, new skills must be acquired and learning must continue for the persons involved in ICM.

Getting into the Program

The Xiamen ICM Demonstration Project (XDP) successfully moved onto the operational stage. The provision of an enabling environment, wherein the ICM process was implemented, led into improved coastal governance and greater investments in necessary infrastructure. Side by side with new activities intended to restore and protect Xiamen's coastal ecosystem, there were undertakings intended to undo past mistakes, in accordance with the SEMP.

Establishing the Functional Zonation Scheme

The multiple uses of the coastal and marine areas were resulting in conflicts as activities intensified with the growth of various sectors in Xiamen (Table 11). ICM helped to reduce these conflicts by zoning the sea areas, so that compatible activities could be clustered for more efficient management. At the same time, it was more cost-effective to provide environmental protection measures to zones where activities were generating similar impacts on the environment. Zoning took into account the various aspects of coastal area development, including the functions and types of development, regulation and conservation of coastal resources, short and long-term benefits of the development and future development plans.

In 1997, with the support of the Xiamen Marine Experts Group (MEG), the Xiamen Municipal

Table 11. Resource-use Conflicts.

Kind of Conflict	Specific Problem
Use conflicts	• Multiple use of coastal zone and marine space • Oyster culture and navigation • Eel fry gathering and navigation
Conservation and economic activities	• Amphioxus fishing • Coral reef fish harvesting • Protection of white dolphin and egret • Coastline preservation and sand/tin mining • Coastline preservation and reclamation
Degradation of water quality	• High nutrient loading • High level of heavy metals • High level of coliform bacteria or *E. coli* • High concentration of hydrocarbon • Oil spill occurrence • High level of pesticides
Habitat degradation	• Destruction of spawning/nursery grounds of marine organisms
Environment disaster	• Red tide outbreaks • Major fish kills
Overexploitation	• Overfishing

Source: Chua and Gorre, 2000.

Government developed and implemented a sea-use zoning scheme. The objectives were to reduce multiple-use conflicts, maximize net social benefits in the coastal area, conserve biodiversity and ensure long-term sustainability of the marine waters. The marine waters had been classified according to the priority of uses, noting the dominant use of the area, potential compatible uses and activities that need to be restricted. Prioritization was determined based on the estimated benefits and related environmental impacts of the uses, taking into account the traditional uses in certain areas (Ruan and Yu, 1999). "Dominant" function was assigned to the use(s) considered high priority, while an activity was classified "compatible" if it had no significant adverse effects on the priority use. The "Restricted" function was assigned to those uses that needed to be reduced, moved out or closed due to their detrimental effects on the priority and other functions.

The Xiamen waters were divided into nine zones, namely: shipping/port; tourism; aquaculture; coastal industrial; ocean engineering; mining; nature reserve; special function; and rehabilitation (Table 12 and Figure 11). For instance, the West Sea's primary function was shipping and port development, while tourism and nature reserve were secondary functions.

To ensure compliance with the said scheme, the municipal government of Xiamen issued an administrative order, the Regulation on the Use and Management of Sea Areas (1997), requiring all development activities in the marine waters to be consistent with the assigned uses of the zones. Twenty-three related agencies were involved in its implementation through the incorporation of the scheme in their respective sectoral programs. The zoning scheme has since been the basis for granting water-use permits.

Geographic information system (GIS) software was used to map the sea and land areas of Xiamen, providing better information and improving the functional sea-use zonation. Use of high-precision global positioning system (GPS) and applied satellite remote sensing (RS) technologies to investigate the status of the sea and monitor the marine environment are helping the city to constantly improve the precision of the scheme.

A direct result of the zonation was the removal of the flourishing aquaculture practice in the East Sea, which had been designated as a tourism and recreational zone. Subsequent relocation of floating cages and fish farms in the West Sea and Maluan Bay took place. In the case of the fisherfolk in the West Sea, a three-year phaseout period was given for their relocation.

During the series of relocations, some RMB 250 million was paid out to nearly 13,000 displaced families. Part of the compensation package for the aquaculture farmers was the provision of tax relief for property purchases and assistance in changing professions. Although the implementation of the zoning scheme could have been viewed as a loss of income to the displaced fisherfolks, the overall benefits in their transfer were greater. For example, in additon to exceeding the desired

Table 12. Functional Sea-use Scheme.

Function	West Sea	East Sea	Tong'an Bay	Dadeng Sea
Dominant	Shipping/Port	Tourism	Aquaculture	Aquatic resource enhancement
Compatible	Tourism/Nature reserves	Shipping/Engineering/ Nature reserves	Tourism/Port/Nature reserves	Shipping/Tourism
Restricted	Aquaculture	Aquaculture	Waste disposal	Waste disposal

Source: Ruan and Yu, 1999.

Figure 11. Coastal-use Zoning.

Image courtesy of the Xiamen Municipal Government.

number of fish farms, which rendered the waters polluted and more vulnerable to fish kills, there were serious conflicts between the mariculture, fish capture and sea transportation sectors. The fishing industry tended to interfere in the shipping routes, especially during the eeling season and endangered the travels and efficiency of sea transportation. Their presence not only caused delays, but also triggered accidents.

To complement the marine use regulation, two related legislations — the Regulation on the Protection and Management of the Marine Environment and the Xiamen Marine Use Fee System — were likewise issued and implemented. The user fee system was an example of a market-based instrument working in tandem with regulatory instruments. The fees imposed were based on the activity, size of operations, and affected area in the four sub-areas, as shown in Table 13. Higher charges were imposed on the activities that were considered incompatible with the designated function of a particular location. Hence, it helped to control the access to, and exploitation of, resources.

The amount of sea area user charges collected gradually increased and reached RMB 10 million ($1.2 million) in 2004 (Table 14). The revenue collected was earmarked for the protection of the marine environment.

Protecting the Endangered Species

The Xiamen waters happen to be an important habitat for rare Chinese species such as the Chinese white dolphin, lancelet and egret. Hence, the government officials and residents alike were alarmed when the Environmental Profile reported that the population of these government-protected species had declined in recent years. Mangroves were only found in a few areas in Haicang and Dongyu. Egrets, once common in the harbor, practically disappeared due to pollution. Fishing

Table 13. Marine User Fee System (RMB).

Uses/ Activities	Unit	West Sea			East Sea			Tong'an Bay			Dadeng Sea		
		I	II	III	I	II	III	I	II	III	I	II	III
Reclamation	RMB/m^2	30.00	45.00	60.00	30.00	37.50	45.00	7.50	15.00	22.50	1.50	2.25	3.00
Docking	RMB/m^2/year	0.30	0.75	1.50	0.75	1.50	2.25	0.25	0.45	0.75	0.15	0.30	0.40
Laying of underwater pipelines	RMB/m^2	5.00	4.50	3.00	7.50	5.00	3.00	4.00	3.00	2.50	3.00	2.50	1.50
Manufacture and maintenance of boats	RMB/m^2/year	0.45	0.75	1.50	1.50	3.00	4.50	0.45	0.75	1.50	0.25	0.40	0.45
Mining	RMB/m^2/year	1.50	0.75	0.45	4.50	3.00	1.50	1.50	0.75	0.45	0.45	0.40	0.25
Water sports	RMB/m^2/year	1.50	1.20	0.75	0.75	0.40	0.45	0.15	0.25	0.25	0.15	0.15	0.15
Recreation and hotel facilities	RMB/m^2/year	1.50	3.00	4.50	1.50	2.25	3.00	0.60	0.90	1.20	0.30	0.45	0.60
Mariculture													
Net-box in shallow marine	RMB/m^2/year	3											
Pell-mell in shallow marine	RMB/m^2/year	30											
Mariculture in shoal	RMB/m^2/year	8											

Note:
I - Marine area from average spring tide line to 0 m isobaths;
II - Marine area from 0 m to 5 m isobaths;
III - Marine area more than 5 m isobaths

Basic data provided by the Xiamen Municipal Government.

Table 14. Sea Area Utilization Charges Collected (in RMB 10,000).

1999	2000	2001	2002	2003	2004	TOTAL
56.75	235.28	265.20	372.08	1,102.09	1,073.77	3,105.17

Source: Zhou, 2005.

grounds of lancelet off Liuwudian in Tong'an were wiped out and the dolphins frequently observed in Xiamen's coastal waters in the 1960s were only rarely seen. The mangrove areas were also drastically reduced due to conversion to agricultural fields, aquaculture ponds and urban construction projects.

The ICM framework contributed to strengthening the habitat management in Xiamen, where protected areas for white dolphins, egrets and lancelet breeding grounds were protected by municipal ordinances and enforced effectively by the Marine Enforcement Task Force. The city leaders, in concert with various groups took steps to promote Xiamen's environment-friendly image, setting aside natural and marine protected areas for the Bailu white egret and the Chinese white dolphin, as well as developing the Tianzushan and Xiaopin forest parks. Three legislative measures

allocated nature reserves for the three species: Measures on the Management of Lancelet Nature Protected Area (1992); Measures on the Management of Nature Protected Area for White Egret in Dayu Island (1995); and Regulations on the Management of Nature Protected Areas for the Chinese White Dolphin (1997). An 18-km^2 marine area was designated as a nature reserve for the lancelet, while the entire Dayu Island was reserved for the egret, a seabird regarded by the people as the symbol of Xiamen. Similarly, mangrove restoration programs were implemented as part of the local government's program (Ruan and Yu, 1999; Chua, et al., 1999). These specific ecosystem management efforts were examples of local implementation of the Biodiversity Convention.

The Chinese white dolphin, egret and lancelet.

In addition, the sea-use scheme enabled the designation of some 5,500 ha in the West Sea as a core protected area for the Chinese white dolphins. According to Ruan and Yu (1999), navigation was still allowed outside the protected area, as it was difficult and unnecessary to completely prohibit shipping activities in the West Sea. However, the following regulations were issued to protect these mammals:

- Regulation of ship cruising speeds below 8 knots, except during emergencies;
- Prohibition of bottom trawling or use of gill nets;
- Prohibition of surfing and the use of high speed recreational boats;
- Prohibition of discharging effluents without a permit and beyond allowable limits;
- Requirement of special permits for reclamation; and
- Prohibition of underwater explosions and other activities that would disturb the dolphin's habitat or increase suspended sediment loads in the water column.

Construction of the Island Ring Road

Sandy beaches are valuable natural resources for coastal cities. When properly used and sustained, they not only contribute toward enhancing the scenery, but can also be harnessed for tourism development. In so doing, the necessary infrastructure needs to be put into place to accommodate the various uses of the resource without sacrificing its quality. Such was the case for the eastern coast of Xiamen Island — envisioned as the center for urban development of the entire Xiamen City. The long-term development plans for Xiamen put Xiamen Island in the center of a network of adjacent districts and towns. Hence, it was intended to link the sea areas of the west and the development zones in the east, thereby creating a pattern of "one circle, multiple districts." The construction of the Island Ring Road provided the needed access and road network to accommodate the rising volume of traffic in the city. It was expected to accelerate the development of the eastern section of Xiamen Island and act as an incentive to attract investments and promote local tourism by providing improved infrastructure to decongest the increased

traffic flows. At the same time, it was expected to contribute to the protection of the shoreline.

The resulting 42-km highway combined road construction with shoreline protection activities. In addition, it transformed the surrounding environment into an ecological seaside landscape, which has become a favorite place for relaxation and recreation of local people and tourists from all over the country. Complementary greenery covering 1.5 million m^2 was also planted in the area.

The project benefited from the scientific community of Xiamen. Results from scientific research provided the basis for the technical aspects, which were then incorporated in the feasibility studies. For example, the Xiamen Research Institute for Environmental Protection Science assessed the impact of the project on the coastal environment. For particular stretches of the road, the Third Research Institute, under the SOA, conducted an integrated analysis of the coastal geology, sea beach and beach dynamics, ocean flows, unfixed sands, coastal development, utilization status and development conditions. This, in turn, provided the basis for the shoreline and beach protection schemes.

One unique feature of the undertaking was the heavy involvement of the general public from the day the project was conceived until it was implemented. Not only did this enable the groups who would be affected by the project to express their concerns, but it also provided better solutions for future environmental problems. Using various information campaign methods (e.g., questionnaires, individual interviews, public consultations, interagency meetings and billboard advertisements), the views and opinions of the local government departments, students, women's organizations, experts, residents and even tourists, were solicited. The results emerging from these activities, whenever appropriate, were adopted.

Improved Ring Road in Xiamen

Based on the monitoring results from the Fujian Oceanographic Research Institute, except for certain local scouring (mainly in the middle and low tidal zones), sandy beaches in the eastern sea area of Xiamen Island have generally remained stable. Hence, the construction of the Island Ring Road only caused minimal damage to the beaches on the east coast.

ISO 14001 and Coastal Tourism in Gulangyu

Gulangyu (or Gulang Island) lies on the western seawaters of Xiamen and is separated from the main island by the 500-m wide Egret River. Gulang means ''drum waves'' because the holes in the southwestern reefs hit by the waves make drum-like sounds. This 1.78-km^2 land area has become a key tourist destination, drawing over 2 million foreign and domestic tourists annually. In addition to its natural environment of scenic mountains and beaches, the attractive 19th century buildings have been well preserved. To take full advantage of its historical and ecotourism potential, the district government decided to adopt the ISO 14001 certification procedure (Box 6), which it achieved in 1999. Gulangyu now bears the distinction of being among the first local government units (LGUs) in the country to obtain the ISO stamp of approval.

Box 6. ISO 14001 Fundamentals.

The ISO 14000 series of international environmental management standards was an offshoot of the Rio Summit on the Environment in 1992 and the Uruguay Round of the GATT negotiations. This family of standards is composed of an environmental management system (EMS) standard, the ISO 14001 and several specific guidelines and management tools. ISO 14001 provides the procedures on how to establish an integrated system to help an organization achieve environmental objectives. It adheres to the principles of continual improvement and each cycle represents a completed process involving all the elements of the EMS (See Figure below).

To draw firms and other entities towards a sustainability promoting orientation, ISO 14001 requires:

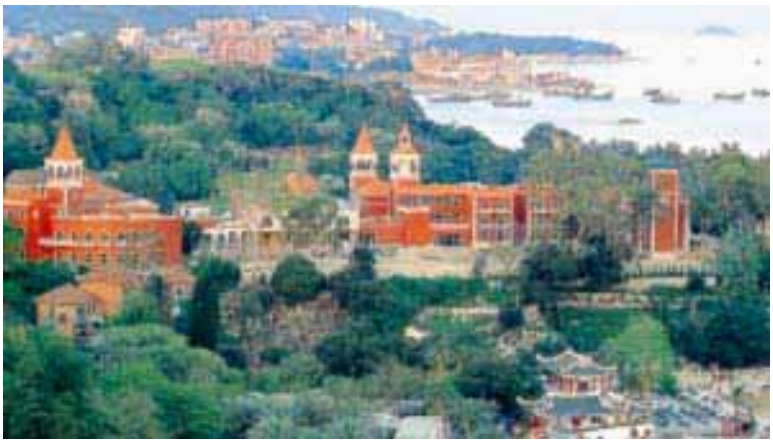
- application of the concept of life cycle assessment wherein the environmental impact of activities, products or services from raw material acquisition to final disposition is evaluated;
- compliance with relevant laws (local, national and international);
- engage in continual improvement in line with the institution's environmental policy; and,
- consideration of the views of members in standing.

By design, ISO 14001 is flexible; it is as applicable to a small business as it is to a multinational organization and even local government units. Used in conjunction with appropriate goals and management commitment, the standards help improve environmental performance and reduce negative impacts. They provide an objective basis for verifying claims about a local government's environmental performance in its day-to-day operations.

Table 15. Gulangyu Island EMS Activities and Achievements.

Issue/ Concern	Measures and Actions Planned	Initial Results
Low vegetation cover	• Increase island's vegetation cover and target 0.79 km^2 of greenery by 2005 • Rehabilitation and reconstruction projects must have at least 50% greenbelt area	• Area formerly occupied by dismantled and relocated factories and illegal structures transformed into greenbelt • Additional vegetation area amounting to 139,405 m^2 as of 2002
Improper sewage disposal and contamination of water surrounding the island	• Develop and operate a wastewater treatment and recycling facility	• Feasibility study completed • Forthcoming establishment of the facility
Deterioration of historical places	• 48 historical places identified for preservation and restoration • Rehabilitation and construction of road network • Establishment of protection fund for historical places	• Opening the Drumming Wave Pavilion in the Suzhuang Garden showcasing the piano museum which houses 70 rare ancient pianos from all over the world • 14 historical landmarks have been restored and 6 ongoing • Earmarking portion of revenue from entrance fees for protecting historical places • Addition of sculptures and background music
Poor access roads	• Develop and rehabilitate road network	• Northern section of the Island Ring Road (2.6 km) built • Reconstruction of the main road surfaces and underground networks completed
Solid waste management	• Application of the 3Rs – reduce, reuse and recycle • Development of a solid waste management program	• Garbage segregation facilitated by having properly marked trash bins • Around one-third of the domestic garbage is recycled/reused • Domestic garbage transported off the island for final disposal in sanitary landfills
Control of air pollution	• Removal of pollutive industries • Promotion of use of efficient and clean fuels/ energy sources and equipment • Implement the GWPB5-2000 soot discharge standard for restaurants	• 16 industrial enterprises originally based in the island relocated and rehabilitated • Prohibition of the use of gas-powered motorized vehicles • Only clean energy resources such as LPG and electricity are being used • 50% of the equipment discharging lampblack (soot) have been replaced
Control of noise pollution	• Control noise within the limits set for cultural and educational areas	• Prohibition on honking of horns • Set time of ferry operations
Conservation of biodiversity	• Application of scientific studies in preservation of habitat of endangered species and conservation of island's rich biodiversity • Prevent invasion of harmful plant species	• Establishment of the Xiamen National Nature Reserve of Rare Marine Species • Studies for better protection and utilization of the botanical resources conducted

Basic data provided by the ISO Office of Gulangyu District.



Gulangyu Island

The Gulangyu District government formulated their environment management system (EMS) reflective of the need for attaining environmental targets and maintaining environmental quality through a responsive management and organization scheme backed by national and local legislation. The basic premise was to systematically manage the island for its tourism potential without damaging the natural environment. Included in their top priorities of issues were improper sewage disposal, solid waste management, air pollution, and diminishing vegetation. Table 15 presents a summary of activities and progress under the EMS.

Given the island's size and the interrelationship of activities, it became necessary to go beyond the physical boundaries of the district government offices to integrate the households, academic institutions and various business entities into the efforts and to exercise indirect control on their daily activities. Through information campaigns and consultations, the other players were made aware of the significance of the EMS and were invited to participate in the various activities. Aside from making each household responsible for the cleanliness of its immediate surroundings, school children, youth volunteers and retirees were encouraged to serve as cleanliness supervisors and tour guides during their spare time. These people enjoy interacting with visitors, at the same time, they get to earn supplementary income. Hence, the adoption and implementation of ISO 14001 resulted in the incorporation and prioritization of environmental considerations in the routine of the district government, households and other institutions and organizations.

New Challenges

Not long after the XDP ended in 19there was a change in local leadership. Typically, the change in leadership and ensuing reorganization created some rough patches for programs. Fortunately, the new leaders realized the importance of continuing ICM in order to protect the marine environment, and they began to collaborate with PEMSEA.

The project complemented the other environmental initiatives being promoted within the city. These initiatives included the work to eliminate aquaculture pollution in the more stagnant mainland-facing western seawaters, public green space expansion, ambient noise reduction, public transportation, automobile emission improvements and the conversion to liquefied natural gas.

The Xiamen ICM project is now on its second cycle and continues to build upon the good practices developed earlier. The focus has shifted from marine pollution prevention and management to the protection and restoration of the marine ecological environment.

Xiamen is not about to sit upon its laurels. Despite the relative success of the ICM program, intensified marine development continues to exert pressure on its resources. The SEMP, which served as a blueprint for 10 years during the project's infancy, has been updated to address constraints and priority issues encountered in the implementation of the past initiatives and take into account recent events. As the city made efforts to scale up its ICM program, new activities were developed to consolidate its achievements and broaden applications. Box 7lists some of the priority areas as identified in the updated SEMP.

Chua and Gorre (2000) called for the consolidation of the measures adopted for ICM during its pilot phase to ensure the sustainable development of Xiamen. The established coordinating mechanism must be strengthened to ensure long-term viability. Similarly, capacity and consensus-building activities have to continue to ensure adequate and effective support for coastal and marine management. Other measures that needed to be undertaken included the consolidation of land and sea-use plans, the adoption of precautionary measures to respond to hazards relating to port activities and navigation, and the consolidation of financing mechanisms for sustainable management of Xiamen waters.

New endeavors were launched to complement previous successes. These included the strengthening of capacity-building efforts of the ITC-CSD; the rehabilitation of Maluan Bay in the West Sea area; initiating ISO 14001 for the municipal government; and the development of a Jiulongjiang Estuary management framework in collaboration with neighboring cities.

Box 7. Priority Areas under the Updated SEMP.

1. Sustain the ICM program at the demonstration site.
2. Strengthen the integrated coordination mechanism and facilitate the establishment of a regional coordination mechanism.
3. Evaluate existing ICM local legislation and refine as needed.
4. Enhance law enforcement and monitoring capacity.
5. Adjust the sea-area use scheme and promote the application of market-based instruments.
6. Implement the "Blue Sea" action plan for controlling marine pollution.
7. Develop and implement a marine ecology restoration action plan.
8. Strengthen scientific and technical support for ICM.
9. Continue implementing public information, education and communication activities.
10. Explore sustainable financing mechanisms and encourage public sector participation.
11. Promote the adoption of ICM in other coastal areas.

Source of basic information: Updated SEMP, 2005.

Developing the Jiulongjiang River Management Framework

There was a general contention that Xiamen did a good job of controlling pollution within its city limits but that upstream industries in the hinterland continues to be a problem. For example, the city continues to receive waste from Julongjiang River, the second largest river in Fujian Province. The estuary fell within the administrative jurisdiction of the cities of Longyan, Zhangzhou and Xiamen. Xiamen receives a great deal of pollution from upstream sources along the Julongjiang River and sought cooperation from upstream cities. The island sits near the mouth of the Julongjiang River, creating a need for Xiamen city officials to coordinate with upstream cities and the provincial government. They could accomplish this through a less-precisely defined "riparian cooperation council" in mitigating the downstream water pollution effects, similar to Shanghai's Yangtze River predicament, although on a substantially lesser scale.

The river receives over 200 million tons of industrial and domestic sewage each year, mostly untreated (Castensson, 2003). A large quantity of wastewater from the animal husbandry sector is, likewise, discharged. Thus, as a major freshwater resource for Xiamen and its neighbors, the pollution could compromise the city's progress and achievements, both in economic and environmental arenas. Recognizing this, a comprehensive river basin planning approach was developed.

As part of the development of a management framework for the Julongjiang River, an environmental risk assessment (RA) was carried out to identify and prioritize environmental issues in the area. The RA results served as an input to the development of a management plan on pollution prevention, treatment and ecological protection of the Julongjiang River, as well as the operating mechanism and monitoring network needed for executing the plan. This undertaking expanded the coverage of environmental management from local to regional boundaries.

Rehabilitation of Maluan Bay

Another major activity is the rehabilitation of the West Sea and Maluan Bay. Five general components have been identified for the project: 1) resettling aquaculture away from the Bay; 2) cleanup and dredging; 3) embankment;

Maluan Bay Causeway

4) construction of roads and support infrastructure surrounding the Bay; and 5) the uncorking of Maluan Bay Dam. The surrounding land around the Bay was developed into residential, commercial and recreational/tourism areas. Sewage collection and treatment facilities were, likewise, constructed to improve and maintain water quality. It was expected that 83 km² of the dredged area would be set aside for tourism and recreation, while 11 km² of land (including the reclaimed area) would be used for construction of a road network and various facilities.

Instead of dredging and dumping the silt from the bay bottom, the contaminated sludge was to be treated and deposited along the shore to recreate the mangrove ecosystem. The water surface would be increased from 3.5 km² to 10 km². As an initial step, the area was cleared of the fish cages that used to pollute the area.

The project, currently being undertaken through the Xiamen Gulf Investment Company, is estimated to cost nearly RMB 0 million (about $8 million).

Initiating ISO 14001 Certification

ISO 14001, as an international standard for environmental management, mobilizes strategic planning to produce on-the-ground action. Similarly, the application of ICM in Xiamen to protect life-support systems and mitigate risks enable the sustainable use of coastal and marine resources, ensure long-term socioeconomic benefits and sustain the values that these resources provide. Whereas ICM and ISO 14001 are distinct systems, they can complement each other. There are parallels in these frameworks that indicate the potential for LGU implementation of ICM to develop their EMS (based on ICM) and for LGUs to apply for ISO 14001 certification in the future.

Despite being a voluntary standard, it can be argued that ISO 14001 has the capacity to put pressure on companies and other institutions to observe more environmentally sound operating practices and impose higher environmental requirements in developing countries than would otherwise exist. It creates a "signal" to distinguish those who have received rigorous third party certification from those that have not. Apart from price and quality, environmental consideration is becoming an important factor in the selection and eventual purchase of a product or service. As such, global market players have been moving towards implementation of ISO 14001.

Xiamen became a pilot city for promoting the ISO 14001 urban environmental management system. Aside from the certification received by Gulangyu in 2003, close to 40 private enterprises have been certified ISO 14001 compliant. Recently, a project was initiated for the development of a citywide EMS that complies with ISO 14001 standards. The Xiamen Ocean and Fisheries Bureau, as the operating arm for ICM, is also working towards acquiring certification, using ICM as a basis for its environmental management system. Considering the major achievements of Xiamen in recent years, securing ISO 14001 certification for the municipal government would further solidify its position, not only as one of the most livable, but also among the most competitive cities in China.

Looking at the Scorecard

ICM program development and implementation requires political will and the allocation of financial and human resources. So it is but natural that some leaders or elected officials are reluctant to venture into such initiatives because outlays can be substantial and immediate, while the returns may take awhile to be visible/felt, maybe even beyond the leader's tenure. The presence of demonstration sites bolsters the confidence of decisionmakers to adopt the same projects. It further reinforces the herd mentality of following and copying what others are doing — "if you can do it, we can do it, too."

The initial phase of the XDP ran for a period of five years, from 19[illegible] to 19[illegible] The idea behind demonstration projects was to see if the tested program really worked. As such, the advantage of carrying out a demonstration project is that, if certain aspects of a program require adjustments, these adjustments can be made before the program is implemented on a widespread basis. For the same reason, if a project has not attained its objectives, or is not sustainable because the costs exceed the benefits, the project can be scrapped before it is expanded and interest groups form to protect it.

ICM Performance Indicators

The purpose of monitoring and evaluation is to assess the progress of the ICM program with regard to environmental and development objectives, specifically its efficiency, impact and sustainability. It provides a basis for decisionmaking, including adaptation to changing conditions, formulation of partnerships for enhanced implementation arrangements and changes in project design and overall project management.

A set of ICM indicators is based on the understanding that the ICM system consists of processes through which various types and levels of management interventions are administered by various agencies within a coordinating management framework. These indicators have been grouped into three sets: 1) *Process Indicators* intended to measure the process leading to the effectiveness and the sustainability of a selected set of actions; 2) *Stress Reduction Indicators* that measure the degree to which program activities have contributed to changes in the sectoral activities or reduced the human behaviors that are known to contribute to the degradation of the coastal ecosystem and resources; and 3) *Status/ Impact Indicators* that measure changes in the state of environment and socioeconomic characteristics. The changes in the environment, socioeconomic and governance attributable to programme implementation can represent the impact of programme activities.

Each of the indicators represents the accomplishment of outputs or realization of a major step in the ICM program development and implementation process. An assessment of the Xiamen ICM project is shown in Annex 1.

The result of the assessment is not surprising, considering the achievements discussed in the previous section. In fact, when the performance of Xiamen ICM was compared to other coastal management projects; its level of maturity was much higher than that of the other projects. Most of the other projects had satisfied only the first level's requirements and had not gone beyond the implementing stage. This is not to say, however, that the Xiamen model is perfect. There are still modifications that can be done to improve it further.

Benefits from ICM

A PEMSEA study[3] examined some of the benefits and costs associated with the adoption and implementation of ICM in Xiamen, using *ex-post* analysis (or, an *in medias res* analysis as the program continues) of the socioeconomic impacts obtained during the initial phase of the ICM program. Whenever possible, these were quantified and monetized.

It was demonstrated that with ICM implementation and institutional reforms related to environmental management, the following were achieved: 1) reduction of multiple-use conflicts; 2) decreased risks from pollution and red tide occurrence; 3) protection of endangered species and habitats; and 4) provision of nature-based recreational amenities for local residents and visitors. The ICM ripples also had far-reaching multiplier effects. It had directly, or indirectly, affected the sustained growth of four major coast-related economic sectors (shipping, fisheries, tourism and real property).

The major benefits related to improved coastal governance, more investment in environmental infrastructure and the reduction of externality costs. The sea-use zoning program and key legislation led to improved efficiency, increased productivity and enhanced attractiveness to investors and tourists. Attitudes and perceptions toward environmental and resource management were also improved and led to greater participation in environmental protection activities due to the public awareness campaigns.

In having a coordinating body managing all coastal and marine-related tasks, Xiamen also gained in terms of: 1) better understanding among stakeholders; 2) improved decisionmaking; 3) better agreement on coastal development priorities; 4) identification of more sustainable tourism and fisheries requirements; 5) improved spatial planning; and 6) better use of environmental monitoring and scientific inputs in decisionmaking. These improvements were instrumental in promoting the benefits of environmental quality. The local government invested in improving the sanitation services, established nature-based recreational areas and designated preservation zones for the rare and endangered species, such as the egrets, Chinese white dolphins and the prehistoric lancelet.

Estimates of some perceived ICM benefits were measured through the application of several valuation methodologies. The quantified and monetized benefits were classified into: 1) increased revenues of the economic sectors; 2) reduction in externality cost; and 3) provision of direct nature services. Table 16 summarizes the quantified values of benefits and costs.

The study did not discount the possibility that other factors contributed to Xiamen's success. Still, it was asserted that ICM intervention mechanisms

[3] *A Perspective on the Environmental and Socioeconomic Benefits and Costs of Integrated Coastal Management: The Case of Xiamen, PR China. PEMSEA, 2006.*

Table 16. Quantified Benefits and Costs of ICM.

BENEFITS								
Increased in revenue of economic sectors • Port and shipping • Marine fisheries • Tourism • Real Estate/ Property	Year	1995	1996	1997	1998	1999	2000	2001
	Adjusted Total Net Revenue (million RMB)	1,295.60	1,959.50	2,886.96	3,584.51	4,716.41	5,932.78	5,916.95
	NPV (4.5% discount rate): RMB **26,292.71 million**							
Reduction of externality costs • Reduced delays in port and shipping operations • Treatment of eroded areas (beach and cliff areas) • Dredging of silted areas	Total Externality Costs (million RMB)	27.86	27.02	27.08	17.5	17.2	17.2	17.2
	NPV (4.5% discount rate): RMB **129.46 million**							
Direct nature services • Protection of endangered species and coastal habitats • Increase in nature-based recreational sites	WTP (1998): 47 RMB/ person/year	NPV (1998-2001, 4.5% discount rate): RMB **2.865 billion**						
	WTP (1998): 77 RMB/ person/year							
Environmental services • Improvement of water quality (WTP for sewage treatment)	WTP (1998): 101 RMB/ person/year	NPV (1998-2001, 4.5% discount rate): RMB **2.865 billion**						
COSTS								
	Year	1995	1996	1997	1998	1999	2000	2001
ICM Program management costs • GEF/UNDP/IMO • Local government	(million RMB)	6.22	8.49	15.26	12.00	12.12	3.00	4.25
	NPV (4.5% discount rate): RMB **52.32 million**							
Investment in environmental infrastructure • Waste management	(million RMB)	236.66	220.89	324.73	366.55	178.49	713.36	
	NPV (4.5% discount rate): RMB **1,711.69 million**							
Investment in preservation zones	(million RMB)	1.8	0.8	2.2	1.2	1.2	1.2	1.2
	NPV (4.5% discount rate): RMB **8.16 million**							

Note: *1.00 RMB = 0.123785 USD.*

yielded positive effects on Xiamen's four major economic sectors, namely: marine fisheries; port operations and shipping; tourism; and real estate/ property. Zoning enabled better coordination and efficient use of coastal areas. At the same time, environmental monitoring, waste management and stringent enforcement of regulations helped enhance productivity.

Negative externalities resulting from heightened production and consumption were minimized (Box 8). Around RMB 73 million/year in dredging expenses has been saved since 19 It was claimed that ICM played a part in decreasing the heavy silting influencing land and sea uses; control of quarrying and reclamation; and control of mariculture activities. On the other hand, the resolutions of conflict regarding the sea-use rights between fishing and navigation reduced delays in arrival and departure of cargo vessels. The average loss absorbed by the shipping and sea transportation groups for every hour of delay is placed at RMB 1,3 3.

Data and time constraints meant that not all the benefits (and costs) were quantified. First, most benefits of environmental projects tended to be realized in longer time horizons. Other unmonetized benefits, which potentially led to substantial gains or savings in public funds, included organizational and planning improvements, as well as sustainable business opportunities.

Box 8. Externalities Addressed by ICM.

The implementation of ICM led to improvements of the state of the environmental quality, habitats and resources. The externalities in the coastal areas in Xiamen that have been managed or reduced include:

- Causeway construction and reclamation;
- Intensified coastal land uses and construction activities;
- Overexploitation of fisheries resources;
- Discharge of oil and wastes into coastal waters;
- Industrial discharge of nutrients and metals;
- Urban effluent discharge;
- Intensified mariculture and eeling; and
- Sand quarrying and unregulated construction.

The study acknowledges that improvement in environmental quality likely resulted in improvement in health conditions; however, data on incidence of waterborne disease, morbidity, and mortality cases related to red tide were not available. Thus, health impacts were not estimated. While the paper focused on only a limited subset of ICM program activities that provide socioeconomic impacts in the city (such *ex post* or *in medias res),* analysis contributes to learning about the effectiveness of ICM. Analysis provided ballpark estimates and indicators to bolster the claim that the implementation of ICM generated environmental, institutional and socioeconomic benefits not only in the long term, but also even in the midterm.

The Long Haul: Continuing to Move Forward

The city's relative political and financial autonomy were instrumental in fostering progressive attitudes among the municipal leaders. Though political support is never easy to acquire, it was essential for ensuring the success of pollution control and prevention programs. The Xiamen leaders were wise to recognize that a poor environment could be hurting to business. As part of its investment policy, proposed investment projects needed to undertake an environmental impact assessment. Projects that used outdated technologies, waste resources and create heavy pollution would not be approved. Hence, the strong political commitment and determination shaped what is Xiamen today.

In addition, the benefits arising from the city's decision to improve the environment were increased real estate values and the city's clean environment reputation, thereby attracting foreign investors. This strategy worked for them, especially since Xiamen could not rely solely on its status as an SEZ, since the incentives offered had been replicated throughout the country. The experience demonstrated the positive value of investing in a clean and sustainable environment for further economic development. Its Environmental Protection Plan forecasted that by 2005, investment in environmental protection would reach 3 percent of the GDP.

While Xiamen ICM remains a work in progress, its achievements speak for themselves. First, in terms of environmental knowledge, the increasing involvement of the residents and business in urban management decisionmaking was seen as a result of heightened awareness and better understanding. Likewise, the ITC-CSD under Xiamen University is being developed as a training base for ICM. Not only is knowledge of ICM being sustained at the national level, but even internationally. The willingness of those involved in the city's ICM program to share their experience is evident, particularly in their active participation in the Regional Network of Local Governments (RNLG), whose goal is to facilitate the sharing of information on implementing ICM programs. Second, the use of scientific and technical support through Xiamen's Marine Experts Group (MEG) contributed to sound management decisionmaking. Third, the lCM legislative efforts to incorporate market-based instruments and enforcement were successful. Not only have the enforcers grown in number, there have been improvement in capacities. Lastly, there was an increase in investments in public utilities and additional environmental infrastructure services were constructed, or existing ones were improved. For example, the urban sewage treatment plants are supplemented by treatment facilities at specific sites. The Xiamen experience indicated the significance of coordinating the capacity-development process.

Sustaining the positive gains from a project can be tricky, as shown by countless projects that had auspicious beginnings but lost steam at the end. The Xiamen project started out with multilateral

support from GEF, UNDP and IMO under the MPP-EAS, with counterpart funding from the local government. However, through the years the share of the latter steadily grew. This transition from a donor-driven initiative to a country-driven program is necessary to ensure sustainability.

Xiamen had the unique experience of being able to harmonize the top-down and bottom-up conservation and development approaches toward the sustainable management of its coastal and marine areas. In a centralized economy, the voices of industry and business, NGOs, and other civil society groups are highly dependent on their size and the discretion of the local authorities.

Citizens can play an active role in environmental preservation. There are avenues that citizens can tap to influence the enforcement of environmental regulations at the local level (Wang, 2000). A major achievement in enhancing public consultation channels in China has been the creation of environmental hotlines and websites that respond to complaints and provide air quality figures and other data. Xiamen EPB's website displays a list of major environmental projects to inform the public and bring attention to important issues. Nevertheless, despite the establishment of hotlines and media outlets, public consultation channels remain limited. Only after government decisions have been made does the public get involved, typically as a means of policy promotion. While there have been arrangements to include the public on various levels, its involvement has had limited impact on the decisionmaking process. The accountability of the system can still be improved. In the short run, the increased citizen involvement supplements the limited resources and power of environmental officialdom. In the long term, citizen involvement could develop into a check on inappropriate alliances between local interest groups and local capital.

Still, the increase in public consultations in Xiamen puts them ahead of most Chinese cities. Awareness among the general public is rising. For example, even the local fisherfolk complain that pollution of the seawater would affect their livelihoods. Media has also become a powerful means of focusing attention on a particular environmental problem or project.

Burbridge (2004) wrote a succinct reminder to ICM practitioners and would-be practitioners: "It is very important to remember that there is no Holy Grail, sacrosanct rules, essential components, or ideal way to develop ICZM. Many varied approaches have been applied in many different political, economic and social contexts and progress has been made in developing more integrated and effective means of planning for, and managing, human development in coastal systems that may well prove to be environmentally sustainable, equitable and economically efficient. A key criterion to use in assessing the progress of these different ICZM initiatives is whether the sophistication and effectiveness of the ICZM process can continue to develop and adapt plans and management strategies to accommodate global change, including the changing needs and demands of our individual societies."

There are four key lessons that emerge from the Xiamen experience. These are: 1) Environmental and resource management projects are effective if there is political will and support from the government, both national and local, that is strong enough to ensure the passage of required legislation and funding support; 2) By linking scientists and other technical experts with the political decisionmakers, there is more room for rational choices that create positive environmental effects; 3) The ability of local citizens to contribute to improving the conditions of their environment succeeds because of their

heightened awareness and exposure, training and willingness to take action when needed; and 4) A step-wise approach to problem solving is recommended, considering that problems cannot be addressed simultaneously. This approach is also appropriate when funding poses a constraint. A local government can begin by taking small steps, then take longer strides later by adding new initiatives, as it builds up its capacity and confidence. In Xiamen's case, taking the initial step of creating an environment conducive to ICM provided a solid foundation for venturing into concrete action programs for the city and even beyond its administrative boundaries.

Today Xiamen is looking forward to expanding into a greater bay metropolis and a gulf city. The island of Xiamen has become the core of the city, and the towns and industrial areas on the mainland serve as satellite economic regions that support and aid development on the mainland. The hope is that, by better connecting Xiamen Island's economy to the mainland, it will have a greater impact on the local economy. This plan also expands the city space, which will help overcome the obstacle of limited land availability on the island. Furthermore, the division also allows the Xiamen city council to move the more polluting industries off the island to the mainland, limiting the island to pollution-free enterprises and tertiary industries, such as tourism.

The ICM program is very much in line with efforts to advance the application of a recycle economy that advocates waste reduction, reuse, and recycle in municipal service, industrial and agricultural production, commercial operation and in ordinary daily life. At the same time, Xiamen's municipal authorities will join hands with counterparts in the neighboring regions for closer coordination in city planning, industrial program lay-outs, and environmental protection to avoid excessive duplication of industrial activities, repeated construction and waste of resources. By maintaining strong commitments of the decisionmakers, Xiamen should be able to make the transition from being a mere venue for creating substantial financial profit to a more sustainable wealth, where depleted resources are restored for long-term benefits.

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Annex:
Performance Assessment for Xiamen ICM Demonstration Project

Annex:
Performance Assessment for Xiamen ICM Demonstration Project

Process Indicators: measure the process leading to the effectiveness and the sustainability of a selected set of actions.

Programme Formulation and Implementation

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
Project management mechanism established	• PCC and PMO established • Human resource arrangements made • Workplan and budget allocation prepared by the local government for the implementation of the ICM program	Has the local government allocated necessary human resources and support for the implementation? Briefly describe staffing, administrative arrangements, workplan and budgetary allocation. • The Xiamen Marine Management and Coordination Committee was established in 1995 as an interagency, multisectoral structure with the Executive Vice-Mayor as head, the other Vice-Mayors as deputies and committee members are heads of other government agencies. The MMCC provided policy advice, coordinated marine uses and reviewed activities. To support the MMCC, the Marine Management Division (MMD) became the operational arm and served as the ICM PMO. • With the support of the MPP-EAS, a work plan detailing activities to be undertaken was prepared. • The ICM program was jointly financed by the MPP-EAS and the municipal government. From 1995-2001, around RMB 8.6 million and RMB 55.7 million was allocated by the Programme and the municipal government, respectively for ICM activities.

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
Multistakeholders consultation/ awareness building/ participation mechanism established and operational	• Communication plan implemented • Regular information, education and communication campaigns on ICM facilitated • Are information/coastal management issues / decisions announced and made known to those likely to be affected/stakeholders/ resource users? Briefly describe plan (target audience, modes of implementation, etc.)	Have public awareness and participation programs (consultations, etc) been undertaken? Briefly describe the communication plan formulated (if any) and implementation activities (target audience, media, regularity of activities, etc). Have civil society groups been consulted, mobilized and are actively participating in program implementation and decision making? Provide the names of organization and issue-areas where they were consulted and/or mobilized. • Public awareness tools were employed to reach the public and instill environmental concern. These include publication of a weekly column dealing with environmental issues in a local newspaper, exhibits, environmental contests, and distribution of educational materials. • The heightened environmental awareness was validated by results of a willingness-to-pay survey in 1998, which indicated that Xiamen residents were willing to pay for better facilities and services for sewage treatment, fisheries, endangered protection, and beach area maintenance. • In the development and construction of the Island Ring Road, consultation and public awareness mechanism was used. Aside from the public consultations, questionnaires, billboards, individual interviews, and interagency meetings were used to determine the views and concerns of the stakeholders affected by the construction.
Capacity-building mechanism established and operational	• Core group of local officials and stakeholders trained in the knowledge and practices of ICM program development and management • Issue-specific capacity building/specialized training conducted • Mechanism for strengthening capacity of local stakeholders in place	Have core group and local staff been trained on ICM implementation strategies? Identify the training activities and participants of these training/capacity building. • Are there formal mechanisms to strengthen the capacity of local stakeholders and institutions through training, institutional strengthening (regular meetings, dialogues, or any means to improve the performance of groups/institutions in ICM implementation)? Briefly describe the mechanisms. • Some personnel from the various agencies were provided general ICM training prior to embarking on specific ICM activities. At the same time,

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
		specific training programs, such as those for water quality monitoring and ecological assessment, were organized. • Special environmental and marine education programs for schoolchildren were developed during the summer months.
Baseline data/information gathered and priority management issues identified	• Site profiling undertaken • Problems and opportunities identified and prioritized through stakeholder consultation/s • Integrated Information Management Systems (IIMS) utilized to store and manage data • Identified issue areas included in program design	Has a document containing relevant site information (physiographic, biological, demographic, socioeconomic, institutional, pollution sources, etc.) been prepared and made available to stakeholders? Who conducted the baseline data gathering and what information were gathered? Are this contained in the IIMS and being used by decisionmakers or program implementers? Provide brief example. Has the management boundary and issue-areas to be addressed by the ICM program been defined and included in the program design? Provide geographical boundaries covered and issue areas prioritized. • The ITTXDP prepared the Coastal Environmental Profile of Xiamen in 1996 composed of members from the academe, research institutions and government agencies. • The profile covered the following topics: natural environment and its relation to development; marine resources and their development status; urban socioeconomics and status of ecological environment; status of coastal water quality; characteristics of marine ecosystem and problems; status of marine environmental legislation; and status of marine environmental management. • Xiamen does not have an IIMS similar to the one PEMSEA developed. However, they have a GIS, which is used for their sea-use scheme. • The ICM demonstration project was limited to the boundary of Xiamen City's administrative jurisdiction. The project's original objective was to address growing multiple resource-use conflicts and marine pollution in Xiamen as result of the city's industrialization and rapid growth.

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Mechanism for scientific input to management developed and operational	• Scientific information are used for management decisions	Is there a mechanism to generate and transfer scientific information and knowledge to support decision making? Briefly describe the process and areas where this is applied. • MEG was set-up in 1996 to provide scientific and technical advice to policymakers. The group was instrumental in the development of the Xiamen functional sea-use scheme, the preparation of the marine economic development plan, and the establishment of the marine environmental monitoring network.
Strategic Management Plan/ Issue or area-specific plan to address identified priority management issues including coastal use zoning plan, environmental monitoring program and financing mechanism formulated	• Strategic Management Plan/ Coastal Strategy formulated • Environmental monitoring program developed	Has a coastal strategy and other issue-specific plan been developed through appropriate stakeholders' consultation? Briefly describe priority action plans (e.g., coastal use zoning). Has the environmental monitoring program been formulated to address priority environmental risks? Briefly describe monitoring process (coverage, process, parameters being monitored). • The Strategic Management Plan for Marine Pollution Prevention and Management in Xiamen (1996) was prepared by the ITTXDP. The Strategic Management Plan for Marine Pollution Prevention and Management in Xiamen (1996) was prepared by the ITTXDP. The plan contains strategic actions and guidelines for both short- and long-term management of coastal resources in Xiamen. Among the priority action plans identified are: a) development and passage of legislation in support of ICM and ICM related activities; b) development of a functional sea-use scheme; c) protection of endangered species and preservation of scenic spots; d) development of an action plan for environmental protection and contingency planning in the West Harbor; e) strengthening of technical skills and knowledge to implement ICM; f) establishment of an integrated marine environmental monitoring, surveillance, and evaluation system;

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		g) strengthening marine environment public awareness; and h) development of financial mechanisms for environmental management. • The XDP combined existing monitoring efforts to develop a collaborative network and program. It included eight subprojects, namely: a) large-scale water quality monitoring; b) 24-hour water quality monitoring at fixed stations; c) port water quality monitoring; d) water quality monitoring in mariculture sites; e) recreational beach water quality monitoring; f) sediment monitoring; g) monitoring of bioaccumulation in bivalves; and h) monitoring during major environmental calamities.
Program monitoring, evaluation and reporting system developed, including the identification of ICM performance indicators, and operational	• Systematic program monitoring and evaluation tool drafted and operational • Regular program reports submitted • Trouble-shooting/ adjustments on program implementation done based on monitoring and evaluation.	Is there a procedure for internal monitoring, evaluation and reporting of ICM program development and implementation? Briefly describe process and how monitoring results are used for further program improvement. • An updated SEMP was prepared in 2005, which addresses issues not adequately addressed during the 1st ICM cycle, as well as new emerging ones. An evaluation of the 1st cycle's activities, based on the old SEMP, was undertaken prior to the development of the new SEMP.

Programme Sustainability and Replicability		
Headline Indicators	**Means of verification/ Verifiable indicators**	**Guide Questions and Responses**
Integration of ICM program into local and national government development program	• Local and/or national legislation adopting ICM as a national approach to coastal management adopted/ratified	Has ICM policy been incorporated into existing sectoral socioeconomic development programs of local governments? Cite specific policies/programs where ICM projects/activities are included. • From 1994 to 1997, 13 legislations concerning land-based pollution and environmental protection supportive of the ICM framework were passed. The Regulation on the Uses of Xiamen Sea Areas emphasized the cross-sectoral coordination in coastal project review and permit process, scientific decisionmaking, and the use of market-based instruments. It also paved the way for the institutionalization of the interagency coordinating mechanism for ICM. • Development of an EMS based on ISO 14001 for the XOFB as operating arm of ICM in Xiamen. • Development of management framework for the Jiulongjiang River intended to address the transboundary issues within the river estuary which affects Xiamen and nearby municipalities.
Interagency, multisectoral coordinating committee established and operational	• Established mechanism for government agencies and other sectors for project planning, direction setting, decision making and evaluation	Is there a mechanism for interagency and multisectoral coordination and harmonization to deal with coastal management issues? Briefly describe the process for multisectoral coordination. Have civil society groups been consulted, mobilized and are actively participating in program implementation and decisionmaking? • Is there a mechanism to generate and transfer scientific information and knowledge to support decision making? Briefly describe the process and areas where this is applied. • Within the MMCC, a multiagency enforcement team was formed to strengthen compliance to rules and regulations, and administer penalties to violators. • After the completion of the first phase of the ICM project in 1999, the MMCC was institutionalized within the municipal government as MMCO. The mayor of Xiamen currently heads it. The XOFB superseded the MMO and the XOFB. The MEG remains in place.

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
Legislation for ICM or amendments of existing legislation/regulations adopted and implemented	• Number of local/national legislation related to ICM implementation adopted and implemented • Budget allocation for law enforcement on ICM-related policies • Involvement of citizens in implementation of laws related to ICM	Are there any ICM related policies and/or amendments adopted and implemented? Briefly describe the amendments and/or new legislations drafted. Are there any budget allocations for the enforcement of ICM-related laws/policies? How much? Are citizens involved in the implementation of ICM-related policies? Cite examples. • The *Xiamen Regulation on Environmental Protection of Sea Areas* was revised based on the changes made to the national law concerning the protection of the marine environment on April 2001. Other legal measures revised include those concerning the nature reserves for the lancelets and aquatic breeding on tidal flats. • A revised sea-use scheme was formulated in November 2003 based on new developments and emerging needs.
Sustainable financing systems in support of ICM in place	• Annual budget allocation for ICM implementation by the local/national government and agencies • Mechanisms for accessing private sector investment and/or external financial resources in place	Is there a financing system supporting the continued implementation of ICM program? Provide amount allocated by the local/national government unit allocated for ICM and related activities. Describe financing mechanisms. • The Xiamen Municipal Government currently allocates RMB 35 million (around $4 million) to fund ICM activities including salaries of the staff of the XOFB, administrative expenses, marine planning and scientific research, marine law enforcement and marine environment monitoring. • The user fees collected from the utilization of the sea areas were earmarked as a special fund for marine management and environmental protection. • The participation of the private sector, particularly in financing of environmental facilities, is encouraged. The Xiamen Gulf Investment Company was given the right to develop and manage some of the areas around the Maluan Bay as part of the project to rehabilitate the bay.

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
Multistakeholders represented and involved in the implementation of strategic plan and action plans	• Resources and expertise provided in the implementation of strategic and action plans.	Are there any resources and/or expertise shared by the different stakeholders in the CS implementation? Identify organization and support provided. • Members of the academe and research institutes, and personnel from local government agencies who are members of the ITTXDP have contributed their expertise in identifying and developing specific action programs for the SEMP. The draft was sent to various government agencies and experts for review. The final document was adopted by the Executive Committee for the Xiamen Demonstration Project. For the updated SEMP, a similar task team was formed to prepare the draft document whihc was subsequently refined based on the results of the review and consulations organized. It was presented to the municipal government for adoption.
Mechanisms for knowledge generation, sharing and extension established and operational	• ICM mainstreamed into local/ national training education system • Number of local governments/ coastal area/ coastline replicating ICM experiences of demonstration sites	Are ICM training courses included in any educational system? Describe courses are being adopted by educational and/or any training institutions. Describe target beneficiaries. • The ITC-CSD of Xiamen University is designated as a PEMSEA ICM Training Center. It organizes and conducts national ICM training programs primarily to support other coastal communities in China that intend to adopt ICM. The Center also organized study tours for local and international participants, mostly government personnel, who are interested in knowing more about Xiamen's experience. • To date, there are 10 coastal communities in China that have indicated the desire to become ICM parallel sites.

Stress Reduction Indicators measure the degree to which program activities have contributed to changes in the sectoral activities or reducing the human behaviors that are known to contribute to the degradation of the coastal ecosystem and resources

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
Level of pollution reduced and institutional support for the reduction of pollution in place	**Pollutants** • Domestic sewage • Non-hazardous/hazardous industrial/institutional wastes • Municipal solid waste • Urban/agricultural runoff • Sea-based waste, including ship, off-shore facilities, aquaculture ground, etc. **Investments in environmental facilities and services and/or cleaner production technologies** • Annual investment in environmental facilities and services ($/year)	Are there any changes in the level of pollution in the coastal area? Describe the changes in trend and where these changes can be attributed. Are there investments for cleaner production and/ or environmental facilities? Compare the amount of investments at the start of the project and at present. Where can these changes be attributed? • **Sewage** - Generated (in tons) : 9,521 (1994); 14,347 (2001) - Treated (in tons): 2,794 (1994); 8,571 (2001) - Treatment rate (in %): 29.34% (1994); 54.74% (2001) - Volume of urban sewage generated rose, but so has the treatment rate primarily due to construction of new treatment facilities • **Industrial wastewater** - Companies are required to treat their sewage prior to releasing it. With rising treatment costs, companies have decreased water consumption and recycled some of them so the amount of industrial sewage has not increased significantly despite increasing industrial output. - The percentage of industrial wastewater meeting the standard went up from (2,455.4 tons) 32.6% in 1991 to (2,951.08) 96.83% in 2001. - The volume of released industrial sewage per 10 thousand RMB of industrial output declined from 29.72 in 1992 to 3.01 in 2001. This indicates improvement in efficiency of water use. • Agricultural runoffs, industrial and urban effluent, as well as vessel discharges from accidents have polluted the coastal waters and caused severe loss of fisheries. At present, the value of the loss is based on the claims of the victim and the subsequent negotiations with the polluter. However, while the

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
		number of accidents appears inconclusive as to the effect of ICM in reducing their occurrences, the values of the losses seem to have dropped slightly after 1996, or during the period when marine laws were promulgated. • Government and private sector investments in environmental facilities and services (in million RMB) - Sewage treatment: 21.76 (1992); 664.83 (2001) - Treatment of solid waste: 12.59 (1992); 48.53 (2001)
Reduced rate of conversion/ loss of habitats	**A. Conversion of coastal habitats to other uses** • Changes in the area of important coastal habitats including wetland, mangrove, coral reef, sea grass beds, etc. **B. Invasive Species** • Number of invasive species in ballast water	Are there any significant changes in the area covered by mangroves, corals, seagrass, etc. resulting from abuse/conversion activities? Compare baseline data with present statistics. Describe the changes in trend and where these changes can be attributed. Are there any changes in the number of invasive species in ballast water? • Causeway construction, reclamation, and intensified mariculture changed the hydrology and flushing capability of the coastal waters and led to silting in navigation channels. Together with the worsening pollution, important species such as the Chinese white dolphin, egret, and lancelet became endangered. The implementation of ICM in Xiamen contributed in the protection of marine habitats and endangered species. Reclamation and conversion of sea areas are now being controlled.
Increased efforts to protect resources	• Area designated for marine protected area • Area of restricted fishing zone (km^2) • Close season for fishing (number days per month)	Has there been an increase in efforts to protect the coastal and marine resources through establishment of Marine Protected Areas, etc.? • Compare baseline data with present statistics. Describe the changes in trend and where these changes can be attributed. • From 1,818 ha allocated for just one nature reserve in 1991, there are currently three nature reserves with a total area of 7,588 ha that have been established for the lancelet, egret, and Chinese white dolphin. • As part of the zoning scheme, a 55-km^2 area where dolphins are frequently sighted has been designated as a preservation zone. The zoning scheme has also designated a 18 km^2 area as a nature reserve for the lancelet, and the entire Dayu Islet as a nature reserve for the egrets

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Overfishing/Illegal fishing activities/incidences reduced	• Fish Catch - Annual fish catch (MT/ year) • Fishing Capacity — number of fishing vessels • Illegal, unauthorized and unregulated fishing activities — Number of cases of illegal fishing	Are illegal/ overfishing activities reduced? Compare baseline data with present statistics. Describe the changes in trend and where these changes can be attributed. • Output of marine fishery rose from 70,700 tons valued at RMB 533.7 million to 20.28 tons (RMB 837.6 million) in 2001. • Because of weak law enforcement before 1996, there were increasing incidences of illegal fish capture and the use of electricity, detonators, and other destructive methods in the Xiamen sea areas. This resulted in destruction of fishery resources. From 1985 to 1995, the number of cases of unregulated capture reached 1,764, and the fine reached 1.18 million RMB. While there are no clear records of the succeeding years, the incidence of illegal fishing is said to have been kept within limits.
Increased access to clean water and sanitation facilities	• Number of population having access to safe drinking water	Are there any significant changes in the number of population having safe access to drinking water and sanitation facilities? Compare baseline data with present statistics. Describe the changes in trend and where these changes can be attributed. • The percentage of drinking water meeting the prescribed standard reached 98 % in 1998, and has been maintained to the present, which is an improvement over the 92.8% recorded in 1995.
Reduced vulnerability to coastal hazards	• Area and/or population in a coastal hazard-prone site • Annual properly loss and casualty due to coastal hazard • Claimed damage caused by coastal hazard	Are there any significant changes in the number of population vulnerable to coastal hazards? Compare baseline data with present statistics. Describe the changes in trend and where these changes can be attributed. (No information available.)

Status/Impact Indicators measure changes in the state of environment and socioeconomic characteristics. The changes in the environmental, socioeconomic and governance attributable to programme implementation can represent the impact of programme activities.

Headline Indicators	Means of verification/ Verifiable indicators	Guide Questions and Responses
Improved environmental Quality (perception)	Visual sign of improvement in Environmental Quality as shown in: • Coastal water • Beach and other shoreline	Are there any perceived changes in environmental quality? (Perception survey to gather baseline information needed). Compare *before-after* condition. Describe the changes and in what way the ICM Project contributed to these changes (establish causality, whenever possible). • While the water quality in the East Sea and Southern West Sea is generally good, the quality in the West Harbor and Jiulongjiang River Estuary needs improvement. The main pollutants found are inorganic nitrogen, activated phosphorus and lead. Some data on annual average level of main pollutants found in Xiamen waters are available. • The return of the endangered species to their usual habitat is a sign that there has been an improvement in water quality. • Half of Xiamen's shoreline receded because of unregulated quarrying and construction. Badly damaged were the cliff areas in the north and northeast coast of Xiamen Island corresponding to a length of around 19 km from Gaoqi to Huecuo. Sandy shores of around 16 km in the south and southeast coast from Hecuo to Xiamen University was similarly affected. A proxy indicator for improving shoreline is the decline in the volume of required backfilling from 1,500 (m^3)/ year during 1992-1996 to zero at present.
Reduced level of risks based on major pollutants	**Risk Quotients including the following:** • Microorganisms • Nutrients • Organics • Oils • Heavy Metals • POPs • Others	Are there any changes in the level of risks? Compare *before-after* condition. Describe the changes and in what way the ICM Project contributed to these changes (establish causality, whenever possible). (No information available.)

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Improved biodiversity	**Biodiversity/Habitat** • Species abundance • Species composition • Productivity • Area covered by forests, mangrove areas, coral reefs, sea grass beds, tidal mudflat, etc.	Are there any evidence of improved biodiversity in the site? Compare *before-after* condition. Describe the changes and where these changes can be attributed (establish causality, whenever possible). Can these changes be attributed to the PEMSEA ICM Project? In what way? • The provision of nature-based amenities and the preservation of habitats (e.g., mangroves), key resources (e.g., fisheries), and the rare and endangered species (e.g., dolphin, lancelet, egret) have contributed in restoring and enhancing the biodiversity of Xiamen's coastal waters.
Socioeconomic Status/Impact Indicators		
Rate of population growth in coastal communities	**Population/Urbanization** • Total population in the project site (persons) • Population density in the project site (persons/km) • Urban population in coastal area (persons)	Describe the trend in population growth and the level of urbanization/development in coastal communities. Describe how these affect the coastal environment. • Population: 1.213 million (1995); 2.170 (2004) • Population density : 800.13 (1995); 1,431.40 (2004)
Reduced reliance in the fishery sector as the primary employment opportunity **Increased women participation in local development**	**Employment** • Employment per sector • Contribution of different economic sectors (e.g. agriculture. Tourism, etc.) to GDP • Proportion of unemployed • Gender employment distribution (proportion of women employed)	Has there been an increase/decrease in the number of individuals whose primary livelihood/ employment is on the fishery sector? Provide data/trend analysis. Can this be attributed to the ICM Project? In what way? Has there been an increase/decrease in the number of women employed? In what sector? In what way has the ICM project contributed to this? • From the RMB 1.2 billion GDP registered in 1984, it grew to RMB 25 billion (1995) and RMB 76 billion (2004). • Sectoral contribution to GDP - 1984: 17% (agriculture); 51% (industry); 31% (services) - 1995: 5% (agriculture); 52% (industry); 42% (services) - 2004: 2% (agriculture); 59% (industry); 39% (services).

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Reduced poverty incidence in coastal communities	• Proportion of population earning less than $1 per day (%) • Average household incomes • Average annual household income ($/year)	Has there been an increase/decrease in the number of impoverished individuals/families, particularly in the coastal areas? Provide data/ trend analysis. In what way has the PEMSEA ICM Project contributed to the poverty reduction? • Compared to 1980, disposable income of urban residents per capita had gone up 25.65 times to RMB 10,813 in 2000, while net income of rural residents per capita had gone up 18.2 times to RMB 4,030. - Per capita net income of urban residents (in RMB): 11,768 (2002); 12,915 (2003); 14,443 (2004) - Per capita net income of rural residents (in RMB): 4,722 (2002); 5,152 (2003); 5,647 (2004).
Reduced incidence of multiple-use conflicts	• Number of cases filed by different coastal use sectors, different agencies and governments areas used various coastal sectors including agriculture, port, residential and commercial settlements, aquaculture and fishery, tourism, mining, oil exploration and other industries (km^2).	Has there been an increase/decrease in the number of multiple use conflicts? Provide data/ trend analysis. Is this a direct cause of the ICM Project? Describe briefly. • Interagency conflicts were reduced as a result of the new coordinating mechanisms. • Use conflicts were resolved through the adoption of a functional marine zonation scheme. Multiple-use conflicts have been reduced as reflected in the number of legal cases resolved.
Reduced health-related risks in coastal communities	• Number of public health incidents associated with environment degradation such as water-borne diseases, seafood poisoning, etc.	Has there been a reduction in health-related risks in coastal communities? Provide data/ trend analysis. Is this a direct cause of the ICM Project? Describe briefly. • Improvement in environmental quality has likely resulted in improvement in health conditions; however, data on morbidity and mortality cases related to waterborne diseases and red tide are not available.