A Perspective on the Environmental and Socioeconomic Benefits and Costs of Integrated Coastal Management: The Case of Xiamen, PR China

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

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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 sub-regional cooperation and collaboration using a sustainable regional mechanism.

The twelve 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

COD	–	Chemical Oxygen Demand
CVM	–	Contingent Valuation Method
DPSIR	–	driving forces-pressure-state-impact-response
EBT	–	net earnings before tax
EU	–	European Union
GDP	–	Gross Domestic Product
GEF	–	Global Environment Facility
GESAMP	–	IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution
ICM	–	Integrated Coastal Management
ICZM	–	Integrated Coastal Zone Management
IIMS	–	Integrated Information Management System
IMO	–	International Maritime Organization
IOC-UNESCO	–	Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization
ITTXDP	–	Integrated Task Team for Xiamen Demosntration Project
LGUs	–	Local Government Units
MDG	–	Millennium Development Goals
MEG	–	Marine Experts Group
MMCC	–	Marine Management Coordination Committee
MPP-EAS	–	GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas
OECD	–	Organization for Economic Co-operation and Development
PEMSEA	–	GEF/UNDP/IMO Regional Programme on Building Partnerships in EnvironmentalManagement for the Seas of East Asia
PERSGA	–	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PMO	–	Project Management Office
PNLG	–	PEMSEA Network of Local Governments for Sustainable Coastal Development
POs	–	People's Organizations
PSIR	–	pressure-state-impact-response
PRT	–	selling profit rate before tax
RMB	–	Ren Min Bi (Chinese currency)
SEMP	–	Strategic Environmental Management Plan
SMP	–	Strategic Management Plan

TEU	–	Ten foot equivalent unit
UNCED	–	United Nations Conference on Environment and Development
UNDP	–	United Nations Development Programme
UNEP	–	United Nations Environment Programme
WTP	–	willingness to pay

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Executive Summary

Human activities place competing demands on coastal ecosystems which often result in resource-use conflicts. Hence, a proper balance between the different demands must be achieved and resolved by informed decisionmaking. Integrated coastal management (ICM) enables these decisions to be made, implemented and monitored in order to promote sustainable coastal development. ICM aims to improve the quality of life in 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. The introduction of an integrated program is more cost-effective and allows for greater efficiency, especially since most coastal activities are often interconnected. To convince policymakers, politicians and government analysts to apply the ICM approach for sustainable development in the coastal and marine areas, a *prima facie* rationale for government intervention has to be provided. Available information on the benefits and costs has to be presented to "get some numbers on the table" to help shed light on the effectiveness of ICM.

The successful experience of Xiamen in ICM implementation continues to attract the attention of resource managers, coastal planners and policymakers. Although several studies on the program's benefits have been previously undertaken in the city, they are related with individual coastal projects rather than on the overall effect of ICM. As ICM allows for synergy among single tasks, an impact assessment of ICM socioeconomic net benefits is warranted. The Xiamen ICM initiative called for the establishment of a cross-sectoral management mechanism, the implementation of integrated land- and sea-use planning and the active participation of scientists, the private sector and other stakeholders in resource conservation and environmental protection. The administration of an integrated management program carries with it valuable gains. With a centralized system of government, it was unique for Xiamen to implement a program that relies heavily on multisectoral participation. After ICM implementation and institutional reforms, the ICM program's achievements include: 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. These have resulted in multiplier effects, and directly or indirectly affected the sustained growth of four major coastal-related economic sectors (e.g., shipping, fisheries, tourism and property). With a sound macroeconomic and development policy, combined with environmental management strategy, Xiamen continues to attract more investors and tourists.

This paper aims to do an *ex-post* analysis of the effects of the ICM program (first phase) in Xiamen (or *in medias res* analysis as ICM is still being undertaken), utilizing a set of indicators on: a. instrumental outcomes: coastal governance,

investments in environmental infrastructure and resource protection; and b. management outcomes: reduction of externalities, sustained outputs and revenues from coastal and marine activities, and changes in attitude and perception. While all potential changes in employment and economic activity due to changes in resource utilization are significant, because of data availability, the study focused only on a limited subset of ICM program activities that yield environmental and socioeconomic impacts in the city. Nevertheless, such *ex-post* or *in medias res* analysis already contributes to 'learning' about the effectiveness of ICM, and provides figures (indicators and quantified benefits) to support the claim that the implementation of ICM would generate environmental, institutional and socioeconomic benefits not only after a long period, but even within the medium term. The Table shows the values of benefits and costs related to ICM in Xiamen.

ICM as experienced in Xiamen was evaluated based on the determination of selected indicators of outcomes and specific benefits and costs associated with ICM. The benefits focused on the gains associated with ICM, which are related to improved coastal governance, investment in environmental infrastructure and resource protection, and the reduction of externality costs. Hence, improvements in environmental quality were shown in this study. The paper also looks at the impact of the coastal and water-use zoning program and key legislation, which are enabling conditions to improve efficiency and increase productivity of key coastal-related economic activities, and attract more investments and tourists. Tangible direct values, such as an increase in the real value of output or greater physical production of key economic sectors (ports and shipping, fisheries and mariculture, tourism, and real estate) were determined.

Another major benefit from ICM is the change in attitude and perception, which has lasting effects in terms of sustaining ICM efforts. Public participation in the environmental protection of Xiamen has likewise improved through awareness programs starting in 1994 with the publication of *We Own the Sea*, a compilation of Xiamen's public awareness articles on the marine environment. A marine educational program for all ages was later developed. Public awareness and beach cleanup activities resulted in people's willingness to pay (WTP) for the preservation of endangered species, the conservation of fisheries resources and the maintenance of beach areas and sewage treatment. The local government invested in a sewerage system and the provision of nature-based recreational areas and preservation areas for rare

Environmental and Socioeconomic Benefits of ICM (1995-2001).

	Present Value (in million RMB)
Economic Sectors (adjusted net revenues)	26,292.71
Direct nature and environmental services	2,974.48
Less: Externality costs	129.46
Less: Cost of environmental infrastructure	1,711.69
Less: Investment in preservation zones	8.16
Less: ICM Program cost	52.32
Total net benefits	**27,365.56**

** Discount Rate: 4.5%*

and endangered species such as the Chinese egrets, white dolphins and the prehistoric lancelet. These are some of the benefits derived from the program that are not easily quantifiable. Hence, indicators related to changes in area and quality of habitats, protection of endangered species, changes in environmental quality (air, freshwater and seawater), and provision of environmental services (waste collection and treatment) and nature-based recreational sites have been collected, and the trends are shown.

A significant feature is the establishment of an interagency coordinating body, the Xiamen Marine Management and Coordination Committee, and the institutionalization of the ICM Project Management Office under the Xiamen Ocean and Fisheries Bureau. In having a coordinating body orchestrating all coastal and marine related tasks, Xiamen also gained in terms of the following:

- Improved decisionmaking;
- Better agreement on coastal development priorities;
- Identification of more sustainable tourism and fisheries requirements;
- Improved spatial planning; and
- Utilizing environmental monitoring and scientific inputs in decisionmaking.

Meanwhile, the estimation of cost associated with ICM has been limited to management costs of implementing the program and its various components. These include the salaries of personnel and other program expenses incurred. ICM implementation is not without social and economic costs. Huge investments are related to the construction of sewerage systems, coastal roads, redesigning existing causeways, and dredging. There are also costs related to the tradeoffs among the different activities affected by the institutional reforms and other ICM projects.

The short period covered in the study affected the results as most benefits of environmental projects tend to be realized in longer time horizons. Moreover, the non-monetized benefits (i.e., other socioeconomic benefits not covered by the valuation), such as organizational and planning improvements, which lead to savings in public funds, long-term gains due to sustainable business opportunities, and change in human behavior and institutional frameworks, are potentially substantial. Improvement in environmental quality is likely to result in improvement in health conditions. However, data on morbidity and mortality cases related to waterborne diseases and red tide are not available, thus health impacts were not estimated. Similarly, there are potential changes in employment resulting from changes in resource use and impacts across all sectors that are beyond the scope of this study.

For future endeavors on monitoring the outcomes and impacts of the ICM program, and the estimation of benefits and costs, ICM program managers (or the project management office/ PMO) should, at the onset of ICM implementation, select indicators corresponding to the activities that will be undertaken along with their expected outputs and outcomes. The integrated information management system (IIMS) can facilitate the review of existing data, the gathering of baseline data, the encoding and storing of data, and the preparation of a coastal profile. The PMO should conduct regular monitoring of the indicators and updating of the IIMS. Non-quantifiable benefits and costs should be documented to enable the inclusion of a descriptive analysis in the ICM impact assessment report.

It is apparent that funding might pose as an initial constraint to the adoption of ICM as an environmental management program. However, costs will be amply covered by the benefits arising from its implementation. Local governments can

start small and work their way up by adding programs as they build capacity and confidence. Alternatively, they can look into means to pool funds and tap other sectors for support to ensure sustainability. Sustainability is a key concern if full benefits of ICM are to be realized. This involves not only identifying perennial sources of funding, but more importantly establishing a permanent management structure that involves interagency and intersectoral coordination and cooperation, and institutionalizing ICM as a regular function and mandate of the local government.

In addition to fundamental macroeconomic policies, a sound environmental policy allows a locality to move toward sustainable development. Indicators show that Xiamen succeeded in these crucial aspects. The city leaders should be commended in recognizing early on that poor environmental quality would be bad for business, and such that their adoption of ICM has contributed to the attainment of their objectives. Even with the limited research, and absence of comparable information, there is recognition that the development of a sound ICM program can lead to socioeconomic advantages. The institutionalization of ICM has ensured its continuity. The results of this study provide indicators and initial estimates of the quantifiable and non-quantifiable benefits. Albeit there are omission errors (not all the benefits and costs have been valued) and estimation/valuation errors (attribution of the growth of four sectors to ICM), the indicators would still point toward positive net benefits.

Introduction

1 Introduction

Located in the southeastern coast of Fujian Province of the People's Republic of China, to the west of Taiwan Strait, Xiamen covers land and sea areas of 1,565 km^2 and 340 km^2, respectively. It has a coastline of 234 km and consists of the Xiamen Island proper, Gulangyu Islet and the coastal part of the north bank of Jiulongjiang River (Figures 1 to 3). The Xiamen Municipality consists of six districts and one county, namely: Kaiyuan, Siming, Gulangyu, Huli, Jimei and Xinglin districts and Tong'an County (ITTXDP, 1996). The coastal waters include the Jiulongjiang River Estuary, the West Harbor, Maluan Bay, Xinglin Bay, Outer Harbor, the Eastern channel to Xiamen Island, the northern part of the Northern Channel to Jinmen Island, and Tong'an Bay consisting of Xunjiang in the south and Dongzhuigang in the north. The population of Xiamen was close to 1.5 million by the end of 2001, which represents an increase from the mere 0.93 million recorded in the 1980s.

The Xiamen Demonstration Project was launched in 1993 under the Global Environment Facility (GEF)/United Nations Development Programme (UNDP)/International Maritime Organization (IMO) Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS). When the Programme moved to its follow-on phase, the GEF/UNDP/IMO Regional Programme on Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), the Demonstration Project was likewise continued. The municipal government, in response to

Figure 1. Location of Xiamen.

Figure 2. Xiamen and Its Coastal Waters.

emerging coastal and marine problems, adopted the ICM framework of PEMSEA. As an integrated approach, the framework allowed for the transformation of short term and usually untenable single-sector perspectives into more sustainable policies.

ICM involves a range of planning, management and support activities that must be coordinated to better address vital concerns. A significant feature of the Xiamen ICM project was the formation of an interagency coordinating body – the Xiamen Marine Management and Coordination Committee – and the interaction of scientists and decisionmakers. It is important to note that ICM is not a substitute for sectoral planning, but avoids fragmentation by focusing on the linkages between sectors (UNEP, 1995).

The municipal government undertook capacity-building activities to strengthen its planning and management capability. This contributed to the development of a critical mass of technical experts who supported the implementation of ICM strategies. The years brought about greater public awareness of environmental concerns, a stronger political will to address environmental problems and improved perception of the integrated management system among the resource managers and concerned scientific community. Interagency conflicts were reduced as a result of the new coordinating mechanisms and use conflicts were resolved through the adoption of a functional marine zonation scheme (Chua and Gorre, 2000).

The ICM model as implemented in Xiamen attracted the attention of resource managers, coastal planners and environmental practitioners worldwide. The program, which includes the establishment of cross-sectoral management, implementation of integrated land-sea use planning and active participation of scientists, private sector and other stakeholders in resource conservation and environmental protection, has reduced multiple-use conflicts; decreased risks from pollution and red tide occurrence; protected endangered species (e.g., dolphin, lancelet, egret) and habitats (e.g., mangroves); and provisioned nature-based recreational amenities for local residents and visitors. It contributed to the

promotion of long-term economic interests rather than short-term ones that can have negative impacts on the environment. In addition, the positive experience in Xiamen ICM, particularly the functional sea-use zoning scheme, served as basis for the passage of a national legislation on sea-area use in China in 2001 (PEMSEA, 2003).

It would be presumptuous to attribute all the good things happening in Xiamen to ICM. Admittedly, sound macroeconomic policies, trade policies, and other on-going and overlapping initiatives worked together in shaping what Xiamen is today. Nevertheless, the city leaders should be commended for recognizing early on that poor environmental quality would be bad for business and that their adoption of ICM has contributed in meeting their objectives. Even with the limited research, it was found that the development of a sound ICM program can lead to socioeconomic advantages.

Objectives

This study aims to provide a rationale for the implementation of the ICM program and assess the contributions of ICM to the economic and social development in Xiamen. It will utilize a set of indicators on coastal governance, environmental infrastructure and business development, externalities, coastal and marine activities, and attitudes and perceptions. To convince policymakers, politicians, government analysts and managers to apply the ICM approach for sustainable development in the coastal and marine areas, a *prima facie* rationale for government intervention has to be provided. Available information on the benefits and costs are presented in this study to "get some numbers on the table" and help shed light on the effectiveness of ICM. At the same time, this study takes off from the Coastal Environmental Profile of Xiamen, and establishes baseline data for future monitoring

Figure 3. Xiamen Districts.

of outcomes and impacts in terms of benefits and costs. The implementation of ICM in Xiamen provides the opportunity and information base for assessing the socioeconomic benefits of an ICM project.

Structure of the Study

The paper is organized as follows: *On Integrated Coastal Management* provides a brief background on ICM while *Review of Related Literature* examines some of the studies that are related and have contributed to the development of this study. *Framework and Methodology* also includes the approaches used. *ICM Outputs and Program Costs; Instrumental Outcomes: Improved Coastal Governance; Instrumental Outcomes: Investment in Environmental Infrastructure and Resource Protection; Management Outcomes: Reduced Externalities* contain the selected indicators for the benefits and costs of Xiamen's ICM program. The report closes with implications for subsequent ICM initiatives as well as recommendations for future assessment of the outcomes and impacts of ICM.

2 On Integrated Coastal Management

The coastal zone is an area of intense human activity. Proper management of coastal resources can promote sustainable use and generate maximum benefits to society. Sustainable and efficient use of coastal areas, however, remains an elusive goal for coastal nations worldwide. Institutional failures – market and policy – are root causes to many environmental problems. Where markets fail, there is rationale for government intervention. When policies fail, there is a need to find alternative policies and approaches, and demonstrate that the alternative is more efficient, i.e., its implementation will generate higher benefits compared to costs.

Market failure is defined as the failure of freely functioning markets to reflect full social costs of production in the price of traded products and inputs, and the failure of markets to exist for many inputs and outputs, especially environmental services (Pearce and Warford, 1993). Non-market/ policy/government failure arises from action or inaction by government on coastal and marine-related problems, such as: 1) allowing open- access fishery; 2) inadequately defined property rights; 3) lack of policies to control externalities and/or lax and inconsistent application of policies; and 4) failure to provide public goods. A particular example in Xiamen is the construction of jetties and causeways which reduced tidal flushing, causing serious sedimentation and water quality problems. These problems were created prior to the initiation of ICM in Xiamen, although they were later corrected, albeit at substantial costs.

What distinguishes ICM from other forms of coastal resource management is the ability to create a governance system capable of managing multiple uses in an integrated way through the cooperation and coordination of government agencies at different levels of authority and of different economic sectors (Ehler, 2003). The governance process consists of the legal and institutional framework necessary to ensure that development and management plans for coastal zones are integrated with environmental and social goals, and are developed with those affected (Post and Lundin, 1996). It unites the government, community, science and management, sectoral and public interests towards the improvement of the quality of life of coastal communities while maintaining the biological diversity and productivity of coastal ecosystems.

The application of ICM essential elements progresses from learning about ICM, the improvement of coastal governance, the creation of a critical mass of ICM practitioners, towards the sustainability of the program. Regardless of the approach chosen, there are key elements necessary for achieving sustainable coastal management that need to be satisfied, namely: 1) intersectoral and interagency coordination and collaboration; 2) policy and functional integration; 3) stakeholder consultation and participation; 4) institutional and legal arrangements; 5) scientific support; and 6) local capacity to plan and manage (Chua, Bonga and Bermas, 2004). The institutionalization of an interagency and

intersectoral coordinating body ensures that a long-term mechanism is in place for the implementation of action plans and programs with the participation of various stakeholders. Not all such initiatives are able to incorporate these elements in project development and implementation immediately and, like good wine, requires a substantial maturation period.

ICM is a dynamic, continuous, holistic and adaptive process by which decisions are made for sustainable use, development and protection of coastal, marine areas and resources (Cicin-Sain, et al., 1998). The adaptation of the ICM program focus, mechanisms and mode of operation to the changing circumstances within the ICM framework is necessary for its effectiveness, success and sustainability. The processes all contribute towards achieving an improved quality of life for the coastal inhabitants.

One gauge of an ICM program's success is through the positive changes in the behavior of people, the state of resources and the environment, and the socioeconomic benefits being accrued to various stakeholders in the site and in nearby areas. Aside from improved environmental quality, ICM helps in strengthening local institutions, provides an opportunity for enrichment of human capital and promotes harmonious working relationships among the various agencies. Moreover, it creates awareness based on practice and actions and builds local government capacity in planning and managing the coastal and marine areas in partnership with local communities, the private sector, other government agencies, civil society groups and other stakeholders. ICM creates an enabling environment for local governance in terms of developing skills to mobilize resources, create investment opportunities, formulate laws/ ordinances and apply economic instruments and incentives, and in facilitating the sharing of information and knowledge among the various sectors and agencies. Although ICM is applied at the local level, it allows the application of provisions of international conventions, protocols and agreements. The implementation of MARPOL, Basel and London Conventions can improve local port operations and reduce transport of hazardous waste and dumping of wastes at sea. To address overfishing, illegal fishing and unregulated aquaculture, the local government can adopt the Code of Conduct for Responsible Fisheries within its administrative boundaries.

Chua (2004) emphasized the development of demonstration sites for ICM programs as an effective means of increasing the confidence of local leaders and environmental managers to pursue a course of action based on sound scientific planning and management measures. Xiamen, PR China and Batangas Bay, Philippines are among the first ICM demonstration sites in East Asia and have over ten years of ICM program experience. Such ICM sites help propagate ICM programs funded by the local government and local stakeholders. Currently there are six additional demonstration sites (funded and technically supported by PEMSEA) and five parallel sites (with own sources of funding, but with PEMSEA technical support). Figure 4 shows the project development and implementation cycle, which is the framework and process applied by PEMSEA ICM sites. One of the most important outputs for each ICM site is the development of a shared vision and mission among stakeholders and the formulation of a set of strategies and actions (coastal strategy or strategic environmental management plan) designed to protect environmental, economic and sociocultural values, address issues and concerns and achieve desired changes over medium- and long-term periods. Setting in place a coastal use-zoning plan and

integrated environmental monitoring program and forging appropriate institutional arrangements are key features of these ICM sites. In addition, the environmental investment opportunities identified and initiated in the various ICM programs allow for greater public and private sector collaboration, and help towards the attainment of the Millennium Development Goals that will ultimately lead towards improvement in the quality of life.

From the completion of the first phase (1994–1999) to the present, Xiamen continues to implement the ICM program using its own resources (human and financial). Within 10 years, the Xiamen ICM Demonstration Site has achieved the following (Chua, 2003):

1. The transformation and institutionalization of the ad hoc Project Management Office (PMO) into a regular office under the Ocean and Fisheries Bureau, with staff and budget;
2. The establishment of a high-level, interagency coordinating committee which continues to be responsible for integrated policy, planning and management;
3. The development and adoption of a Strategic Environmental Management Plan (SEMP), which is being implemented;
4. The cleaning up of the Yuandang Lagoon and installation of sewage treatment plants;
5. Formulation and adoption of sea-use plan, enactment of laws and implementation of user fee and permits system;
6. Strengthening of legal provisions for environmental management and law enforcement;

Figure 4. ICM Project Development and Implementation Process.

7. Implementation of integrated environmental monitoring program to track changes in water quality and ecosystems;
8. Mitigation of sand mining and coastal erosion, nourishment and rehabilitation of beaches and sandy shores, and landscaping of coastal roads around Xiamen Island;
9. Resolution of conflicts between fishing and navigation; and
10. The establishment of protected areas for egrets, white dolphins and lancelets, and other measures for endangered species.

Currently, Xiamen is implementing the second cycle of its ICM program, which includes the updating of the SEMP, development of a management framework for Jiulongjiang Estuary, in collaboration with neighboring cities, and the initiation of ISO 14000 certification for the Xiamen Ocean and Fisheries Bureau, among other activities. This shows the sustainability of ICM in Xiamen. It launched a billion-dollar project for the rehabilitation and integrated development and management of Maluan Bay, thereby creating huge environmental investment opportunities. Moreover, it hosts the PEMSEA ICM training center (International Training Center for Sustainable Coastal Development in Xiamen University), which provides ICM practitioners, environmental managers and policymakers in the East Asian Seas region with training workshops as well as study tours and site visits for the activities undertaken, the changes and progress that have been achieved, and the benefits that were gained due to the ICM program. Furthermore, the lessons learned and the good practices are being shared not only within this region, but also with other GEF regional programmes (such as the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden or PERSGA). Xiamen has also offered to be the Secretariat for the PEMSEA Network of Local Governments for Sustainable Coastal Development (PNLG).

Review of Related Literature

3 Review of Related Literature

There is a vast and rich body of literature on ICM and coastal resource management in general. While these have served as backdrop in the current endeavor, the results of other studies are useful only in terms of providing methodological frameworks, but are of limited applicability to Xiamen. Indicators for ICM are being developed, yet still have to be implemented and monitored in ICM sites. Likewise, benefits are often described, but not quantified or monetized. Sorensen (1997), OECD (1996) and Burbridge (2004) observed that benefits derived from ICM are not always simple to define since few such projects have made the transition from planning to implementation. Moreover, a substantial period is required before an assessment of impacts can be made.

Coastal Resource Management Programs

In the small islands of the Caribbean, several confounding constraints to coastal zone management exist, namely the transboundary nature of coastal zones, unclear property rights and management institutions, limited information about benefits and costs of different uses and management approaches, uneven dissemination of that information, and diverse and often disorganized stakeholder groups (Tompkins, 2003).

A survey by Lakshmi and Rajagopalan (2000) on the impact of changes in the coastal zone indicated that mitigating coastal zone degradation leads to heightened awareness on the importance of conserving coastal ecology and in the improvement of the people's economic status. A review of some coastal and environmental management programs is presented in Tejam (1997). It looked into the experiences of clean river, protection and marine park management, and fisheries programs in Southeast Asia particularly on social and economic benefits brought about by these initiatives. Whereas there had been slight differences in their strategies, there is convergence with regard to economic and ecological benefits arising from the programs, which include increase in property values, tourist arrivals and foreign investments.

Several studies were conducted on individual ICM-related activities in Xiamen. Benefit-cost analysis (BCA) studies of the planned integrated treatment project for Maluan Bay and Yuandang Lagoon were done by Yao (1997), Hao and Peng (1998), respectively. Both yielded positive results for undertaking these rehabilitation projects. At present, the once-polluted Yuandang Lagoon is now a prime real estate property and a favored business destination in the city while the rehabilitation of Maluan Bay is on its initial stages.

Community-based management involves consultations and participation of local stakeholders in the protection and management of specific resources or habitats, such as forests and fisheries. A key feature in resource management is the importance given to social

discourse, and the need for the integration of diverse stakeholder interests into collective decisions (Davos, 1998). These consultations and consensus-building efforts involve costs, including transaction costs that are not directly recompensed. In order to understand the effect of transaction costs on community-based resource management, Sumalde and Pedroso (2001) examined the case of San Miguel Bay, site of one of the Philippines' most important coastal conservation programs. The results indicated that the transaction costs incurred by the people's organizations (POs), local government units (LGUs) and other stakeholders associated with the various program phases (e.g., capacity building and institutionalization) accounted for 37 percent of the total project cost. These costs, estimated using the value of time spent in planning, follow-up and monitoring activities, were significant, with a large proportion of which was shouldered by community groups, generally without financial compensation. More importantly, these costs were key determinants in the success or failure of the scheme's various projects. While a modest amount of the transaction costs is indicative of active community involvement, once these costs exceeded 35 percent of the total cost, it was observed that performance began to deteriorate as time is diverted from other productive activities.

Community-based resource management programs were found to be effective if the resource is located within the community's boundaries and used by one or two sectors, thereby making dialogue easier and transaction costs lower. When the community and resource is subjected to increasing population and economic pressures, and new developments take place, overexploitation, pollution and multiple-use conflicts could arise, necessitating a shift from single-sector management to a broader, intersectoral and integrated management approach. Understanding the institutional arrangements surrounding the utilization of natural resources is central to designing better management strategies (Tompkins, 2003).

Coastal resources have traditionally been managed by allocating property rights and creating exclusive areas for activities and users (Tompkins, 2003). In Apo Island, Philippines, a community-based project for the protection of coral reefs was undertaken with the mobilization of fisherfolk as stewards of this ecosystem and the marine protected area. There were initial reservations for the establishment of marine parks, which could result to the loss of livelihood from fishing since the core area of the Apo marine reserve is a no-fishing zone. Vogt (1996) assessed tourism as an additional source of income for the fishing communities. He estimated gross financial revenues or direct benefits from tourism in Apo Island to be around US$103,885/yr. The establishment of the marine park has actually resulted in the enhancement of the fishery resource and an increase in income, from both fishing and tourism as well (Alcala, 1998).

Frameworks for Assessing Benefits from ICM

Most research activities on coastal and marine resources tend to dwell on valuing individual resources per se to show the need for protection and conservation. Notwithstanding the limited number of quantitative studies on socioeconomic benefits arising from ICM, there has been ample recognition that the employment of ICM-related activities provides advantages.

In his review of the progress of ICM in the Baltic Sea Region, Burbridge (2004) cautions that measuring "success" of integrated coastal zone

management (ICZM) initiatives is not an easy task, nor can it be measured in terms of a final product and is not necessarily a fully scientific and objective process. The majority of evaluation methods and criteria used in assessing ICZM initiatives are designed to measure outputs rather that outcomes.

Another critical concern in estimating benefits from ICM is defining the baseline scenario (i.e., what happens in the absence of the program). Specifications of the baseline conditions could influence the measurement and interpretation of the results of the study. As Bower and Turner (1998) contend, a "business as usual" management strategy is not realistic because the biophysical and socioeconomic systems are not likely to be static. For example, there are some programs bearing ICM characteristics that were initiated even before ICM was formally introduced. As by its name, ICM is an integrated approach, and for study purposes, ICM-related activities, regardless of initiating institution, have been inevitably included.

ICM benefits can be derived from the attainment of objectives and outcomes, such as behavioral changes (e.g., institutional and stakeholders), investment in infrastructure, improvement in economic status, reduction in negative environmental impacts, etc. In relation to the application of valuation methods to quantify and monetize benefits from these outcomes, there is a need to distinguish outcomes that can be directly measured and valued using market prices and outcomes that are not directly measurable. Figure 5 shows a detailed classification of the benefits that can be derived from implementing ICM and the corresponding valuation methodologies typically used.

Among the latest investigative works on the subject is an evaluation of socioeconomic and environmental benefits of ICZM undertaken by the Firn Crichton Roberts Ltd and Graduate School of Environmental Studies University of Strathclyde (2000). The paper made an effort at assessing both the quantitative and qualitative impacts of ICZM activities undertaken across Europe and other EU-funded ICZM programs found elsewhere through the application of the value of ecosystem services developed by the team of Costanza (1997) and a survey of the various ICM programs. Despite the absence of comparable information, the results provide an initial estimate of the benefits of ICZM in Europe. The research team noted that the most important qualitative benefits were improvements in decisionmaking; better mutual understanding among project partners; greater awareness of planning and operational priorities; more coherent spatial planning; and more sustainable tourism.

There have been few quantified examples of socioeconomic impacts since most of the European initiatives were yet to move into the operational phase. This also reflects the analytical difficulties of separating ICZM impacts from those generated by non-ICZM policies and programs. The study suggests that for low-level ICZM (those that involve an average total project expenditure of •0.5 million plus •50/km of coastline), annual net benefits generated are estimated at •127.1 million with a benefit-cost ratio of 13.6:1. On the other hand, benefits can go up to •659.8 million for high level ICZM initiatives (those that involve •5.0 million plus •250/km coastline) with a benefit-cost ratio of 8.6:1.

Similarly, the study of Firn and McGlashan (2001) is an initial assessment to demonstrate the benefits accrued from coastal management initiatives in Scotland. It used the same technique as in the evaluation undertaken on the costs and benefits of ICZM initiatives throughout the EU. While both studies highlight the significance of

ICZM towards improving the welfare of coastal communities, it is apparent that potential benefits obtained from improved strategic management will only be fully realized if ICZM activity is coupled with increased levels of funding and support.

PSIR Framework

Calls are being made for more systematic evaluation of ICM efforts, shifting from the use of sole environmental indicators to the use of the pressure-state-impact-response (PSIR) model in the context of the ICM cycle in order to demonstrate the socioeconomic benefits of ICM. ICM consists of the policy framework and the functional integration of policy, process, action plans and programs, and activities to address various institutional failures and specific issues and areas of concern in coastal and marine areas. Integrating environmental, socioeconomic and governance aspects and developing indicators capable of capturing these processes remains one of the most difficult challenges for the ICM approach (IOC-UNESCO, 2003).

Turner (1999) utilizes a model of key environmental and socioeconomic processes to buttress coastal management institutions and practices. The research project uses the PSIR framework and identifies three overlapping procedural stages in the coastal resource assessment process. The scoping and auditing stage is implemented via the PSIR framework and details problems, system boundaries and value conflicts. The framework is based on a conceptual model stressing functional value diversity and the links between ecosystem processes, functions and outputs of goods and services deemed valuable by society. The two other stages are integrated modeling, which combines natural and social science methodologies, and evaluation of management options and related gains and losses.

In developing the environmental indicators, the Organization for Economic Co-operation and Development (OECD) followed the PSIR framework to assess the ICM program (OECD, 1993). *Pressures* include population growth, public opinion, sociocultural factors, and macroeconomic policies. Land use, resource use and waste discharges cause pressures on the natural environment. *State of the Environment* shows how natural systems (habitat, land or soil quality, freshwater quantity and quality, estuarine and marine water quality, resources) have been affected. Changes in the resource and environmental parameters, in turn, may adversely affect the functions. *Impacts* shows the effects on the use and non-use values provided by the ecosystems. In the face of these impacts, there are *Responses* from individuals, government, business or private sector. Responses include change in behavior and consumption patterns, policy and management intervention on the part of the government and change in technology, production process and resource use on the part of the private sector. The core sets of indicators developed by OECD provide a fundamental basis for the development of environmental indicators, however, when motivation for coastal managers evolves towards sustainability and improvement of management strategies, other more appropriate models and corresponding sets of indicators need to be developed (IOC-UNESCO, 2003).

Performance Indicators

Indicators are useful in assessing progress and changes. Better understanding of the linkages of socioeconomic and coastal environmental dynamics is indispensable in the development and assessment of ICM programs. Socioeconomic, ecological and management indicators go well with a linked approach to program performance assessment. With this in mind, Bowen and Riley

(2003) reviewed the evolution of the driving forces-pressure-state-impact-response (DPSIR) framework and its contribution in the analysis of such integration. Environmental indicators applicable to coastal zones have typically been developed within the pressure-state-response (PSR) or DPSIR models originally developed by OECD, but these indicators have limited use in ICM and have been diffused in monitoring the reduction of point sources of pollution, application of land-use planning techniques to coastal zones and protected areas, or provision of public access to beaches (Belfiore, 2003).

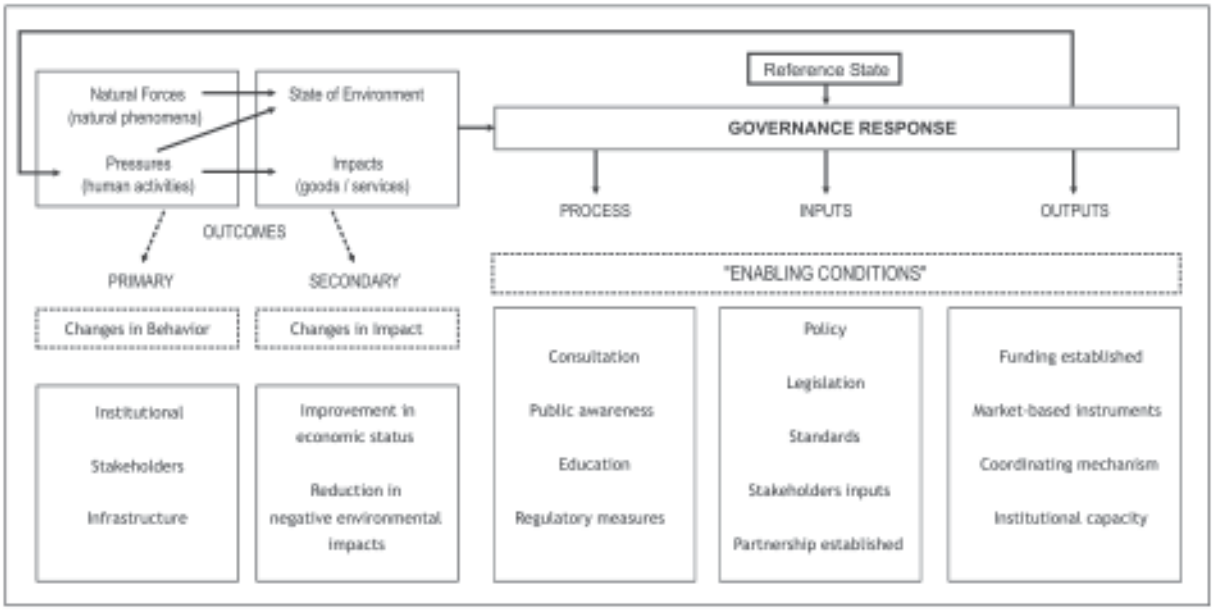
As coastal resources cannot be managed from a biophysical perspective alone, it is important to recognize the link between how the community utilizes coastal and marine resources and the community's socioeconomic perspective. Bunce and Pomeroy (2003) developed a set of guidelines for monitoring coastal communities, which can be tailored to site needs. They reiterated the importance of gathering social and economic information regarding stakeholder motivation and values in understanding the manner by which resources are utilized, why resource management problems occur and how these problems can be addressed. Monitoring socioeconomic and ecological information also provides feedback on the effectiveness of resource management strategies. They developed a set of socioeconomic monitoring indicators in coastal projects for the following purposes:

- identifying threats, problems, solutions and opportunities;
- determining the importance, value and cultural significance of resources and their uses;
- assessing positive and negative impacts of management measures in terms of:
  - livelihood
  - marketing and production
  - food security
  - attitudes and perceptions
  - coastal activities
  - governance
- assessing management effectiveness;
- building stakeholder participation and appropriate education and awareness programs;
- verifying and documenting assumptions of socioeconomic conditions in the area, community dynamics and stakeholder perceptions; and
- establishing baseline household and community profile.

The collection of socioeconomic information serves several purposes, including:

- demonstrating the importance and value of coastal resources and services to help obtain support for coastal and marine management programs;
- determining the impacts of management measures;
- assessing effectiveness of management;
- building stakeholder participation and awareness programs; and
- establishing baseline household and community profile.

As part of monitoring efforts to gauge the effectiveness of various environmental programs, including ICM, different types of indicators relating to environmental, socioeconomic and governance performance have been developed (Bowen and Riley, 2003; World Bank, 2002; Turner, Adger and Lorenzoni, 1998). Since monitoring usually gives rise to a number of indicators, an ICM indicator framework was developed (Figure 5). A list of selected environmental, socioeconomic and governance indicators associated with ICM is presented in Annex 1. Criteria, however, are



Modified from: Workshop Report, International Workshop on the Role of Indicators in Integrated Coastal Management (2002).

Figure 5. ICM Indicator Framework.

needed for the selection of the most useful indicators and to avoid having a long list of indicators that cannot be monitored. The most commonly used criteria are those which are SMART (specific, measurable, achievable, realistic, time-bound) (AIDEnvironment, et al., 2004).

Benefit–Cost Analysis

The paper of Bower and Turner (1998) outlines a methodology for assessing the potential net social benefits arising from ICM program implementation. It involved the application of a benefit-cost analysis (BCA) where the economic efficiency rule is modified by imposing constraints on the net benefit criterion to take into account other objectives. A prototype coastal system simulated the approach.

BCA is a conventional economics tool for social decisionmaking. It is a method for organizing and analyzing data as an aid to decisionmaking but it does not represent the decision itself. A BCA is designed to determine whether or not a project or policy is worthwhile from a social welfare perspective. An action is considered worthwhile or justified if social benefits outweigh costs. Hence, BCA can be used to justify a single action in terms of relative costs and benefits, or to compare the relative advantages of a series of options.

Only incremental benefits and costs attributable to the project should be included. Panayotou (1996) reminds that a "before" and "after" comparison provides estimates of values which are gross of benefits and costs and are not attributable to the project but to other activities or changes that would have taken place regardless of the project. A comparison of "the world with the policy" with "the world in the absence of the policy" provides estimates of

values that are net of these influences. Furthermore, the comparison of the costs and benefits in a BCA should draw upon estimates derived using the same baseline so the calculations of net economic benefits would yield a meaningful economic measure.

BCA is also an information support tool that can be applied to help set environmental action priorities by identifying and measuring costs and benefits of resource management strategies. An extended BCA integrates environmental and social values in an ordinary BCA wherein non-marketed goods and services are integrated to obtain fuller and more correct measures of social profitability of projects. Environmental quality affects economic variables in two ways: through direct production performance like changes in the production of goods and services for which there is a market (e.g., tourism, fisheries, shipping); and through indirect opportunities available to society for enjoyment of the less tangible environmental services such as landscape quality, ecosystem conservation and recreation.

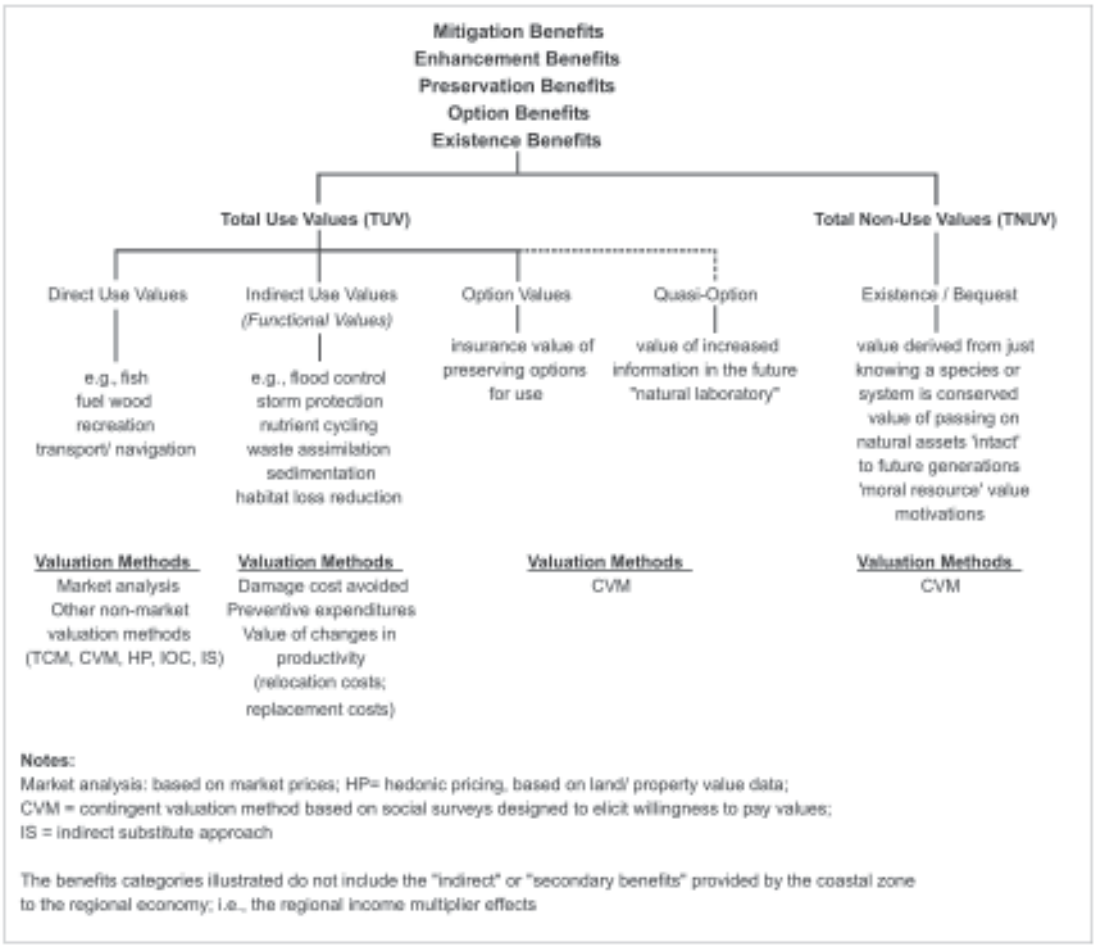
Total social cost is the sum of the opportunity costs incurred by the society due to the policy, including all costs imposed on third parties, where any externalities result directly from the policy. This can be classified in terms of real resource compliance costs, government regulatory costs, social welfare losses and other indirect costs. Calculation of costs entails the estimation of physical damages from poor resource utilization practices and assigning monetary values to those damages. Assigning monetary values to environmental damages and the potential savings from its reduction is facilitated by the application of various valuation methodologies (Risk and Policy Analysts Ltd and Metroeconomica, 1999; UNEP, 2000).

Constantinides (1992) succinctly describes the function of BCA in environmental projects as:

> *"The application of cost-benefit analysis and the use of associated estimation and measurement tools, in addition to the technical economic analysis they bring to bear on project evaluation, help build up awareness of the economic importance of coastal ecology and create a shared basis for converging responses among different stakeholders. This facilitates the gradual move towards consensus on environmental priorities seen as part the process of social and economic development and community well-being, rather than as sectoral policy concerns of limited direct importance to society at large. The application of cost-benefit analysis and its focus on the links between ecological damage from pollution and its socioeconomic costs, foster a broader framework for improving participation practices and partnerships that support a common perception of the social consequences of pollution and areas of agreement on appropriate responses."*

Hence, BCA helps in analyzing environmental impacts on the quality of the coastal and marine environment which translate into socioeconomic losses due to resource productivity changes, loss of income, health effects and cumulative impacts on living conditions, poverty and economic development. In addition, there are also institutional and procedural changes that contributed to the attainment of desired socioeconomic changes. The results of this study are expected to facilitate future decisionmaking regarding the relationship of ecological and economic interests, and the implementation of ICM.

A criticism leveled against BCA is the tendency to focus on the direct effects of a policy, which may therefore exclude considerations of indirect



Adapted from Turner (1988) and Barbier (1989) as cited in Bower and Turner (1998).

Figure 6. ICM Benefits.

effects that may be significant. For example, employment effects generated by the policy are excluded due to the assumption that the labor market is flexible.

Valuation of Ecosystems and Externalities

Recognizing the importance of ecological system services and natural capital stocks in maintaining the earth's life-support system and the need to incorporate them in socioeconomic decisionmaking, Costanza, et. al., (1997) attempted to value these services. They estimated the economic value of 17 ecosystem services for 16 biomes using results from previous scientific studies. Ecosystems were divided into marine and terrestrial, with marine further subdivided into open ocean and coastal. It was shown that the average global value of annual ecosystem services emanating from marine ecosystems is around US$577/ha. Specifically, open ocean and coastal resources are valued at US$252/ha and US$4,052/ha, respectively. The controversial work can be considered as one of the first quantitative studies in the "macroeconomics of the environment" vis-à-vis the usual studies on the environment done on the microeconomic level. The methodology and results arising from the study have been applied in China where the estimated value of the marine ecosystem is placed at RMB 2.17 trillion per year (Chen and Zhang, 2000). For coral reefs in Southeast Asia, the annual value is estimated at US$112.5 million (Ruitenbeek, 1999). Recent studies show that net potential benefits (e.g., fisheries,

coastal protection, tourism/recreation and biodiversity value) from the world's coral reefs amount to around US$30 billion per year (Cesar, et al., 2003). Various studies conducted in Trinidad, Fiji and Puerto Rico show that the value of a complete mangrove ecosystem ranges from US$500 to US$1,550 per hectare per year (Hamilton and Snedaker, 1984). Ocean services worldwide are estimated at US$23 trillion per year (GESAMP, 2001).

Dixon and Hufschmidt (1986), and Dixon, et al., (1994) discussed extensively the various valuation methods and presented a number of case studies showing the valuation of resources — the benefits to be derived from use and non-use values and/or the direct and externality costs if these resources are affected by development projects and other human activities — and the resulting BCA.

Various case studies focusing on the application of economic analysis of common problems and threats affecting coral reefs, policy and management solutions, and marine parks have been undertaken (Cesar, 2000). A study done in Indonesia estimated the cost of 'inaction' on blast fishing at US$3.8 billion over the past 25 years while climate change will cause losses of US$109.9 million in the Caribbean (Cesar, et al., 2003).

Spurgeon (1998) illustrated how economic valuation can be utilized to support ecosystem rehabilitation and protection in coastal and marine habitats. He emphasized that any coastal development scheme or management plan must investigate all potential coastal-related uses, non-use values and their associated costs. Through such careful comparisons of benefits and costs, net benefits from a combination of market and non-market services provided in coastal areas can be best optimized. In Europe, some UK results broadly suggest a "clustering" of value estimates in the range of £10 to £25 per household per annum in terms of river quality improvements and loss of beach and coastal recreation and amenity (Pearce and Turner, 1992). Pendleton (1995) estimated the value of coral reefs protection at the Bonaire National Park by applying the travel cost method. Socioeconomic benefits also arise from protecting marine resources through savings from avoided losses in reef value that could result from the absence of protection. Based on 20-year period estimates, the present value of local benefits from protection and of consumer surplus is around US$74.21 million and US$179.7 million, respectively. In the island of Saba, which is part of the Netherlands Antilles, user fees of $1 per dive in the Saba Marine Park are collected from scuba tour operators (Sherman and Dixon, 1991).

Framework and Methodology

4 Framework and Methodology

Coastal areas face significant socioeconomic pressures. Maximizing overall economic returns derived from coastal resources entails balancing between promoting income-generating activities and protecting the resources to continue providing significant but non-market products and services. ICM is designed to promote sustainable development. It has been observed that behavioral changes in the players led to reduction in multiple-use conflicts and contributed in revitalizing economic activity and improving environmental quality in Xiamen. ICM works best when public support is developed by raising public awareness on priority issues, enabling stakeholders to take an active part and see how concerns affecting their welfare are dealt with as a result of their participation in the ICM process. Welfare economics requires that for a policy option or decision to be justified, it should result in a "Pareto" improvement (i.e., gainers from an action would be able to compensate those who would lose and still be better off).

The aim of this paper is to apply selected indicators of benefits and costs and show the environmental state of the coastal zone, the socioeconomic conditions and the effectiveness of the ICM program in Xiamen. Since the 1992 UNCED, efforts towards sustainable forms of coastal development have been translated into program goals that are expressed as specific improvements in: 1) the bio-physical environment; and 2) the quality of life of the human population in the area of concern (Olsen, 2003). Various indicator frameworks have been developed and proposed to assess the effectiveness and benefits to be derived from ICM. Difficulties, however, have been most apparent in developing indicators that would capture the processes and effects of integrating environmental, socioeconomic and governance aspects, and then isolating the contribution of each. For instance, the use of governance performance indicators is still relatively new and has faced difficulties in tying ICM efforts to on-the-ground outcomes, thus the attribution of effects to ICM programs remains an open issue (Belfiore, 2003). In addition, getting the necessary data to show indications or measures of performance, outcomes and impacts in terms of net benefits of ICM has been a challenge. Whereas all potential changes in employment and economic activity resulting from changes in resource use are of interest, the study will be focusing only on a limited subset of ICM activities that generate socioeconomic impacts in the city. This study, therefore, attempts to present only certain dynamic parts of an overall portrait of ICM in Xiamen.

A perspective on the costs and benefits associated with the implementation of ICM is presented in this study using information from environmental monitoring reports, government agency reports, research studies, publications, periodicals and interviews. Data collected were from 1994 to 2001, representing the period when ICM implementation began. For illustrative purposes, data from earlier years were shown

whenever available. In addition to data from key economic sectors, indicators related to changes in area of habitats, existence of endangered species, natural resource and environmental services and other externalities were also collected.

The broad purpose of BCA is to help social decisionmaking (Boardman, et al., 1996). Whereas BCA is the right approach to assess the effectiveness of ICM, it has to show the comparison of the impacts *with* an ICM program in place and the impacts *without* the ICM program over the same period. *Ex ante* BCA assists in decisionmaking concerning the allocation of resources for the ICM program, i.e., make 'go' decision versus 'no go' decision. Thus, *ex ante* BCA is usually done prior to the start of the project or implementation of a policy. BCA can also be conducted during the course of the life of the project or program (*in medias res*) or at the end of the project (*ex post*). As the program or policy progresses, more information becomes available about its value. *Ex post* BCA imparts information about the policy intervention or project as well as the effectiveness of such policy and project. Thus, *in medias res* and *ex post* analyses contribute to learning values and potential benefits, and assist in decisionmaking, whether it is worth undertaking or not. *Ex post* analysis also provides information for analysts conducting *ex ante* analysis of similar projects (Boardman, et al., 1996).

Placing socioeconomic values on indirectly quantifiable benefits is challenging. Unquantifiable benefits often pale in comparison with costs, which are usually measurable and have political ramifications. Furthermore, these costs must often be met in the short run while benefits tend to accrue in the long run. This difficulty is seen as one of the challenges that ICM practitioners worldwide would have to address (Box 1).

Conceptual Framework

Using available past data, this study is an *ex-post* analysis (or *in medias res* analysis since the ICM program in Xiamen is still ongoing) of the socioeconomic impacts of ICM, and related benefits and costs. The outcomes and impacts are based on the list of selected environmental, socioeconomic and governance indicators (Annex 1). A framework for determining the benefits and costs of implementing the ICM program in Xiamen is developed, wherein the ICM program implementation is considered as moving towards improving coastal governance, which has resulted in positive outcomes and impacts (changes in institutional arrangements, infrastructure and stakeholder behavior), and toward sustainability. The outcomes are distinguished between instrumental outcomes and management outcomes. Figure 7 shows these linkages. The information generated will indicate and describe the effectiveness of ICM policies and decisions and efficiency of investments undertaken, and show the benefits accruing to various sectors and to the natural system from 1994–2001. Other local governments planning to establish ICM sites can learn from this study about the potential benefits from ICM.

The creation of an enabling environment in which the ICM process can be implemented, such as training of staff, establishment of coordinating mechanism and legal system, and development of monitoring system and information system, is instrumental in achieving ICM objectives. In this study, the *instrumental outcomes* of ICM are related to improved coastal governance, and increased investment (public and private) in environmental infrastructure and resource protection.

Box 1. ICM Costs, Benefits and Their Incidence among Stakeholders.

- **The "tragedy of the commons."** Many coastal resources are common property (such as fish, coastal aquifers and coastal waters) and therefore selfishly exploited without appropriate regard for other users, or for maintaining a level of sustainable use.
- **Placing socioeconomic values on not-directly-measurable qualities** (e.g., rare and endangered species, biodiversity and aesthetics). These not-directly-measurable qualities are usually benefits. Non-quantifiable benefits are usually at a disadvantage — or dismissed — at public policy and decisionmaking meetings when they are compared with the costs that are usually directly measurable and have evident political implications (e.g., employment, income generation).
- **The incidence and significance of benefits and costs among stakeholders**. Usually the costs are large and significant (such as a reduction in property value or diminished profits anticipated if proposed coastal development were allowed) to a small number of influential stakeholders (commonly the elite). By contrast, the benefits are usually spread broadly to the public-at-large and/or to relatively non-influential stakeholders (since they are usually not organized into institutions with skillful lobbying capabilities).
- **The disparity in the flow and appearance of costs and benefits over time.** Costs are usually immediate (such as loss of existing or potential employment) and benefits that usually takes years to become evident (such as rebuilding a fishery or an endangered species' population).
- **Elected governments' reluctance to consider costs and benefits beyond their term in office**. Many, if not most, of the benefits from integrated environmental planning and management take many years to demonstrate results that the public can readily see and appreciate, such as reforested watersheds or matured mangrove plantations. ICM, like integrated environmental programs in general, do not have the immediate "turn-key effect" of a highly visible structure or product, such as when politicians gather around for a photo opportunity and flip the switches that release water from the new reservoir (and the new dam) to shoot into generators that can light up a town.
- **Lack of high-level support for ICM — particularly in terms of powers and budget —** because the benefits of the effort are not conveyed in compelling socioeconomic terms that resonate with the interests of voters and the officials they elected.

Source: Sorensen, 2002.

The subsequent results from improved coastal management and governance are the *management outcomes*. Coastal and water-use zoning program, key legislation, and investment in wastewater and solid waste management are enabling conditions that led to improved efficiency, increased productivity and more investments and tourists. These outcomes and impacts are measured in terms of physical and monetary (as data permit) accounting of net benefits to the environment, key coastal-related economic sectors and community amenities.

Following Lundin (1993) and Emeis (1992), the benefits from ICM are achieved and measured through the reduction of damages due to pollution and resource overexploitation, enhancement of coastal zone productivity and outputs and the preservation of unique ecosystems and endangered species. Production changes were measured through productivity changes in shipping, tourism and fisheries output, and corresponding changes in revenues and net income. On the other hand, indirect impacts of

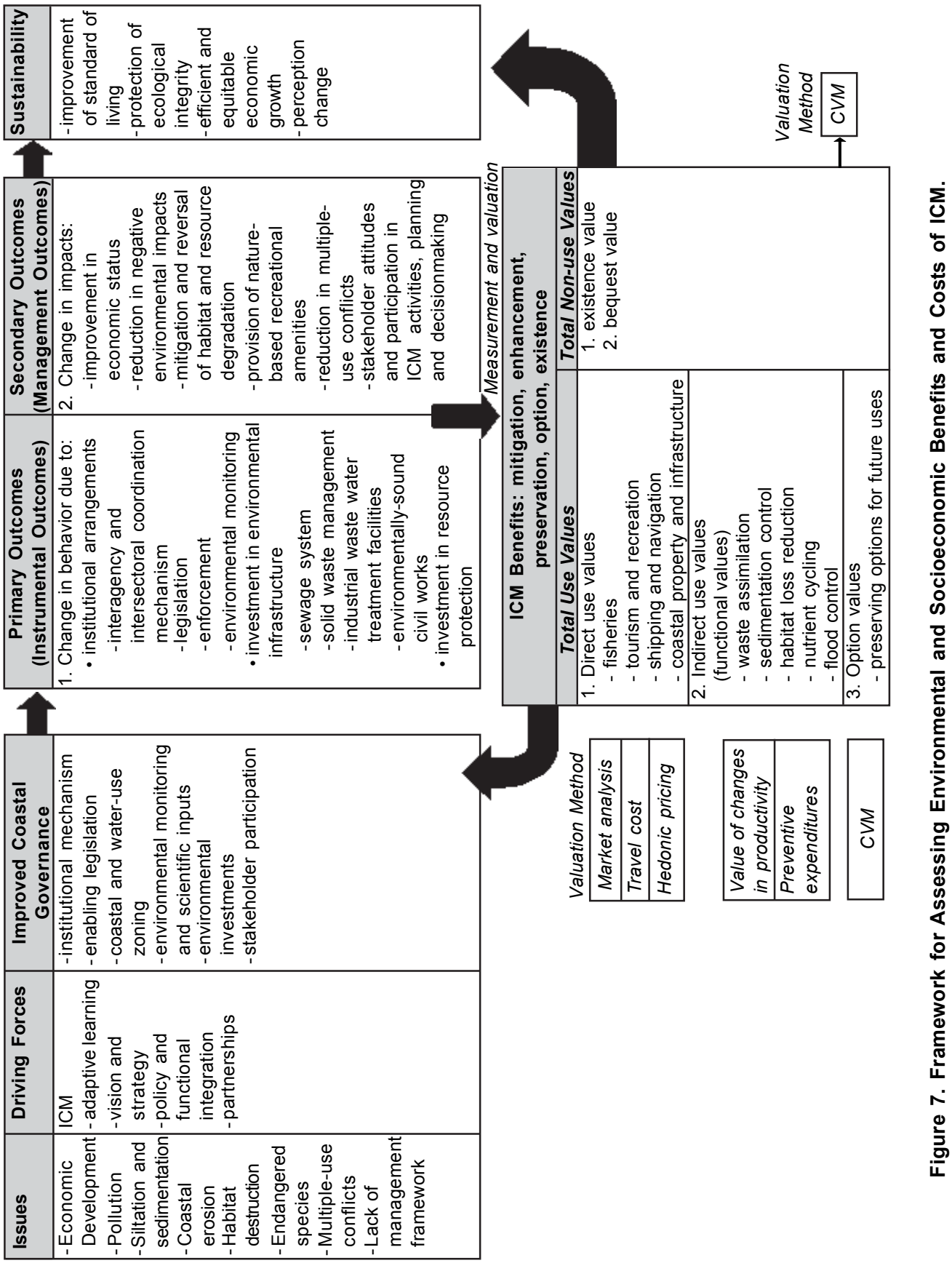


Figure 7. Framework for Assessing Environmental and Socioeconomic Benefits and Costs of ICM.

resource use that are not reflected in market prices and quantities have to rely on estimates of people's valuation of the environment (i.e., the social demand for environmental quality). Benefits from ICM also include other non-monetary benefits, such as option and existence values of natural resources (Figures 6 and 7). By accounting for the economically valuable services of natural resources and the environment as a medium for disposal of wastes, a supplier of recreational services, aesthetics and the life support of species, the information is provided for the assessment of ICM and the overall economic and environmental policies that are likely to affect the ability of the natural environment to provide these goods and services.

Various methods often address different subsets of total benefits and use of multiple methods would enable a comparison of alternative measures of value. Double counting is a significant concern when applying more than one method. As such, any overlap must be considered and appropriately cited in the results. Moreover, despite the existence of alternative valuation methods, it is not always possible to quantify or put meaningful monetary values on all benefits and costs from project-related activities due to the lack of required information. For these indirect use and non-use values or the other 'unquantifiable' benefits of ICM in Xiamen, this report includes a description to show the changes and the progress being made and the use of the willingness-to-pay estimates.

Methodology: Assessment of Socioeconomic Benefits and Costs

ICM Program Outputs and Costs

The major outputs of the ICM project were accomplished through capacity-building efforts and the organization of the multi-disciplinary Integrated Task Team for Xiamen Demonstration Project (ITTXDP) which prepared the *Coastal Environmental Profile of Xiamen* and the *Strategic Environmental Management Plan*. In addition, the *Environmental Risk Assessment of Pesticides* was completed, and the water-use zoning scheme, enabling legislation, and the integrated environmental monitoring system were put in place.

Implementation of ICM is not without costs. Financial resources are needed to effectively develop and implement ICM, especially during the early years. From 1994–1999, the ICM project in Xiamen was financed through the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas or MPP-EAS (PEMSEA's precursor), with counterpart funding from the local government. The financial contribution of the Regional Programme helped jumpstart various activities primarily in strengthening technical capability and research needs. In subsequent years, there has been additional financial support from PEMSEA. Set-up costs include planning, consultations, capacity building, research and other preparatory activities undertaken. Later, as ICM-related legislation took effect, additional funds were needed to strengthen enforcement and augment administrative costs, most of which came from the local government coffers.

Instrumental Outcomes: Improved Governance

Coastal and marine resource use in Xiamen can be grouped into: 1) economic activities, such as industrial, commercial, port and shipping, tourism and recreation, fishing and mariculture, mining and quarrying, and real estate development; 2) coastal land use for causeway construction and reclamation; 3) reception and assimilation of waste (solid and wastewater); and 4) natural ecosystems and habitats for fish and wildlife diversity.

Institutional reforms to improve governance and management of coastal and marine areas include the setting up of an interagency coordinating mechanism, institutionalization of the ICM Project Management Office and the establishment of the Marine Experts Group. Through the water-use zoning scheme and key legislations, which were started through the ICM program, multiple-use conflicts have been reduced as reflected in the number of legal cases resolved as well as the reduction of externalities, e.g., siltation and erosion. Likewise, with the formation of a multi-agency council overseeing the coastal and marine resource management, administrative costs and duplication of efforts have been reduced.

In assessing the socioeconomic benefits related to improved governance, the cases of conflicts among industries, settlement of conflicts/disputes and administrative and legal cases, reduction of externalities, and the transactions and legal costs were reviewed. Attempts were made to look into lawsuits and administrative cases in related marine management sectors such as Environment Protection Bureau, Marine Administrative Office, Fisheries Administrative Bureau, etc. Similarly, cases of disputes due to externalities in coastal areas were examined by sifting through the records of the courts, Marine Administrative Office, Fisheries Administrative Bureau, Environmental Protection Bureau, Harbor Administrative Bureau and other agencies.

Instrumental Outcomes: Investments in Environmental Infrastructure and Resource Protection

The PEMSEA ICM program recognizes that the sustainable management of the coastal and marine environment requires the mobilization of investments in environmental infrastructure and services and protection of habitats and resources. As such, investments and financing opportunities are promoted through intersectoral partnerships. This study looks into the value of these investments. Government and private investments were made for the treatment of sewage and solid waste. The Xiamen government also invested in coastal road networks, while ensuring shoreline protection, and in the rehabilitation of causeways and redesigning new ones to improve water circulation. Recognizing the value of habitats and endangered species, preservation areas were designated, with government investments allocating for their establishment and maintenance.

Management Outcomes: Reduction of Externalities

The implementation of ICM resulted in the improvement of the state of the environmental quality, habitats and resources. Although there are still externalities associated with human consumption and production, major environmental concerns are being addressed and the externality costs have gradually been reduced. Externalities in coastal areas in Xiamen that have been managed or reduced include:

- Causeway construction and reclamation which changed the hydrology and flushing capability of the coastal waters that led to the degradation of habitats and siltation of navigation channels;
- Intensified coastal land uses and construction activities which increased the quantity of sand and pollutants in the sea and altered the navigation channel;
- Overexploitation of fisheries resources which destroyed nearshore living resources;
- Discharge of oil and wastes into coastal waters, which affected fisheries;
- Industries which discharge nutrients and metals that put human health and ecosystems at risk;
- Urban effluent discharge which polluted the coastal waters and affected residents' health

through the consumption and use of aquatic products;
- Extensive gathering of eel fry and intensified mariculture, which polluted its surroundings and affected navigational safety; and
- Sand quarrying and unregulated construction on beaches which resulted in erosion and coastal retreat, and damage to coastal infrastructures and ecosystem.

Management Outcomes: Enhancement of Coastal and Marine Activities

The potential impacts of the ICM intervention were assessed on the following four major economic sectors: marine fisheries sector; port operations and shipping/sea transportation; tourism; and real estate.

The socioeconomic benefits of these sectors focus on the more tangible direct values such as an increase in the volume and real value of output (greater physical production). Since there are no published data on costs (capital cost, operating and maintenance costs), the profit rates were used to get the share of the total cost from the gross revenues, and net revenues are subsequently estimated. Net revenues are used as indicators for the economic performance of these sectors.

By considering only four sectors, it may seem that a sectoral management approach was undertaken. The integrated management approach and other interventions have greatly affected the performance of these sectors. Admittedly, there may be positive changes that could have occurred in other sectors or non-coastal activities, and other multiplier effects, which were not covered in this study. Costs related to the tradeoffs among the different activities that were affected by the institutional reforms and other ICM projects may also have been incurred. For example, 'pollutive' industries have been removed from Gulangyu and Xiamen islands, and the cost of relocation of manufacturing establishments, and the dislocation of workers were not estimated. This is beyond the scope of this study.

Management Outcomes: Change in Attitudes and Perceptions

In a willingness-to-pay (WTP) survey, using the contingent valuation method, the change in perception regarding the role and value of coastal resources is reflected by the willingness of the residents and stakeholders to support and participate in various ICM programs, and the value placed for the improvements in the general environment of the city and provision of nature-based recreational amenities. Information for the 'non-valued' services, such as rehabilitation and maintenance of habitats, resources and endangered species, and the value of the benefits are estimated from the WTP survey results.

Habitats and Ecosystems

Coastal and marine ecosystems provide food (major protein sources), building materials (sand and rocks), firewood, recreational opportunities, protection and buffering from coastal hazards, carbon sequestration, economic development opportunities (e.g., tourism, commercial fishery, mariculture, transportation), and important life-support functions (breeding and feeding grounds, nursery areas). The WTP survey indicates the importance that Xiamen places on fishery resources and beaches. Mangrove conservation areas were also delineated and mangrove planting activities have been undertaken.

Endangered Species

One important contribution of ICM in Xiamen is the protection of endangered species, such as the Chinese white dolphin, egret and lancelet, including the designation and zoning of preservation areas. The WTP survey shows that the people of Xiamen value the existence of these species.

Environmental services

Water bodies provide a value in terms of being used as a receptacle of waste from human activities. This service is usually not recognized nor valued, resulting in the dumping of waste beyond the carrying capacity of the environment. In environmental and resource accounting (such as those applied in Chesapeake Bay and the Philippines), proxy for the value of waste disposal services is employed, using costs that often rely on engineering pollution-control costs. The environmental service value can also be estimated by looking at the demand side. Based on the WTP survey, the people of Xiamen recognized this environmental service, and were willing to pay for sewage treatment to reduce environmental and health damages. The local government, on its part, has invested and put in a system for the collection, treatment and proper disposal of waste.

ICM Outputs and Program Costs

5 ICM Outputs and Program Costs

Key Issues

Pollution

Prior to the 1980s, when industrial activity was still at its infancy, the Xiamen economy was heavily reliant on agriculture and fisheries. Pollution associated with land-based activities was limited and the waters of Xiamen, in general, were considered unpolluted and clean. With the designation of the city as one of the country's earliest special economic zones, the annual average GDP growth rate reached 23.28 percent from 1981 to 2004. This was accompanied by an increase in population (due to migration), which in turn further accelerated industrialization and urbanization. The utilization of coastal and marine resources not only became more diversified, but was also intensified, resulting in severe space competition, resource-use conflicts and pollution. The desire to achieve economic development significantly altered the coastal environment. Through those years, monitoring data and analysis of the concentration of COD, fecal coliform count, total inorganic nitrogen, inorganic phosphorus, oil in the seawater and sulfide and organic matter in sediment, indicated serious pollution in areas such as the Yuandang Lagoon and Maluan Bay (Chua and Gorre, 2000). The adverse consequences of unregulated economic growth and population increase led to the reduction and deterioration of natural habitats and living resources, siltation and erosion, shoreline retreat, and blocking of navigation channels.

Multiple-Use Conflicts

Use conflicts arose among the various sectors relying on the bounties of Xiamen's coastal and marine resources, with the conflicts more pronounced between the fisheries and port construction sectors. Other conflicts include mariculture, land reclamation, maintenance of scenic tourism resources and marine environmental protection. There was also a strong contention between the need for environmental protection and the issue of waste generation due to economic activities. These conflicts and the resulting problems are summarized in Table 1.

Inadequacy of Resource Management System

Since Xiamen's economy depends on the sea as the resource base for its survival and progress, the socioeconomic development and well-being of stakeholders are closely linked with the marine environment. While efforts were undertaken to manage the coastal environment and its resources, China's traditional coastal management system could not keep up with the challenges of economic growth.

There are three basic reasons why the previous environmental management program was not sufficient in dealing with the deteriorating environmental conditions. First, there were conflicting administrative jurisdictions and weak coordination among the various government agencies tasked to protect coastal and marine

Table 1. Resource-Utilization Conflicts in Xiamen.

Type of Conflict	Specific Problem
Use conflicts	Multiple use of coastal zone and marine space • Oyster culture and fish cages versus navigation • Eel fry gathering versus navigation
Conservation and economic activities	• *Amphioxus* or lancelet fishing • Coral reef fish harvesting • Protection of white dolphin and egret • Coastline preservation versus sand/tin mining • Coastline preservation versus reclamation
Degradation of water quality	• High nutrient loading • High level of heavy metals • High level of coliform bacteria *(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.

resources. These were sectoral in nature and hence, tend to work at cross-purposes. These agencies carry out their respective functions without integrated planning and coordination, resulting in fragmented policymaking and sometimes administrative conflicts.

Second, there was weak environmental consciousness and poor law enforcement. The predisposition towards prioritizing marine resource development and exploitation over marine environmental protection was primarily attributed to low environmental awareness. Although basic marine environmental legislation and some specific management measures have been developed, these were inadequate and usually not enforced due to the absence of enforcement mechanisms.

Third, scientific information was largely unorganized and underutilized. Although there is constant data gathering by various agencies and research institutions, these are often not shared. There was also a tendency to focus on study areas such as the West Harbor and neglect other equally important areas and issues.

The Onset of the ICM Program

As a special economic zone, Xiamen has provincial-level authority in economic administration and possesses local legislative power. This eased the adoption of ICM in the city. Practitioners would define ICM as a continuous and multidisciplinary process which blends levels of government and the other sectors of society, public and sectoral interests in the development and implementation of a program geared towards

the protection and sustainable development of coastal and marine resources and its environs. It seeks to contribute in uplifting the quality of life of households relying on coastal resources through the provision of much needed development without compromising the biological diversity and productivity of coastal ecosystems.

As a coastal and marine management program, ICM is not static. The program is intended to produce a "socially desirable" mix of coastal products and services. The optimal mix is expected to respond to changes in market demand, knowledge and pressures. Given the continuous interactions taking place in human and natural resource systems, the ideal management process has to be dynamic and adaptive (Bower and Turner, 1998). The success of ICM in Xiamen is attributed to the strong leadership and united efforts through the establishment of an integrated and coordinated mechanism to oversee an assortment of sub-programs. This is aptly supported by the scientific and technical community as well as the general public. The result is an enviable top-down and bottom-up approach to environmental and resources management that is hardly the norm in a centralized system prevailing in China (Li, 1999).

The Xiamen municipal government formed a multidisciplinary team that prepared its *Strategic Management Plan* (SMP) in 1996, after completing the comprehensive *Coastal Environment Profile* of Xiamen. The *Profile* described the resource, environmental and socioeconomic conditions of Xiamen before 1995 and outlined institutional and management problems. On the other hand, the SMP identified issues and areas of concern, prioritized problems and determined appropriate management options and actions that will address them. The general vision is that "by the beginning of the 21st century, Xiamen will become a socialist, modern, international, scenic port city, with an industrial-based economy and per capita GDP equivalent to that of medium-income countries in the world" (ITTXDP, 1996). The general objective as stated in the SMP is the implementation of a series of medium- to long-term action plans for the mitigation of marine pollution through strengthening of the ICM system; and maintaining balance between environmental protection and socioeconomic growth to achieve sustainable development and making coastal areas productive, clean and safe. The municipal government adopted the SMP and moved towards its implementation. Thus, the ICM objectives became the government's objectives as well. The SMP is currently being updated to reflect recent developments and challenges.

In addition to the Profile and the SMP, other outputs include the *Environmental Risk Assessment of Pesticides* that generated recommendations for appropriate management interventions; water-use zoning scheme; and the setting up of the integrated environmental monitoring system and the Xiamen Marine Experts Group as a way of integrating science into policymaking and management. The water-use zoning scheme and supporting legislations are instrumental in the reduction of multiple-use conflicts and other externalities. The Training Center for Sustainable Coastal Development was likewise established in Xiamen University to provide training workshops and study tours for building capacity for ICM, creating environmental awareness, and disseminating/ sharing good practices and lessons learned.

Costs of ICM Implementation

ICM program development and implementation requires political will and the allocation of financial and human resources. The reluctance of some leaders, particularly elected

Table 2. MPP-EAS Contribution (in RMB).

Item	1995	1996	1997	1998	1999	2000	2001	1995 to 2001
Initiative Management (PMO Operations)	425,405.25	74,052.88	146,889.60	33,137.75	0	0	7,444.47	686,929.95
Public Awareness (Promotion and Information)	27,202.50	10,300.00	4,160.00	0	0	0	0	41,662.50
Capital Expenditures	192,744.36	5,150.00	0	0	0	0	0	197,894.36
Research and Planning	1,378,020.06	2,704,470.18	1,611,783.68	1,468,783.77	116,931.9	0	441,191.52	7,721,181.10
TOTAL	**2,023,372.17**	**2,793,973.06**	**1,762,833.28**	**1,501,921.52**	**116,931.9**	**0**	**448,635.99**	**8,647,667.91**

Table 3. Local Government Contribution (in million RMB).

	1994	1995	1996	1997	1998	1999	2000	2001
Marine Management Office and its precursors	3	4.2	5.7	13.5	10.5	12	3	3.8

Source of data: Xiamen Financial Bureau.

officials, to undertake such initiatives is often traced to costs being immediate whereas benefits usually take years to become evident. ICM does not have the immediate "turn-key effect" of a visible structure or product. Implementing ICM had negative impacts on some industries as workers have been displaced, such as fisherfolks from their usual fishing grounds. While compensations for the loss have been provided, it was noted that efforts for a more comprehensive alternative livelihood program be established as a complementary action plan.[1]

In Xiamen, the ICM program was jointly financed through MPP-EAS (and continued under PEMSEA) and the municipal government (Tables 2 and 3). These estimates are ballpark estimates of the costs associated with ICM program implementation. The bulk of the expense, particularly during the initial stages, went into research and planning activities (including costs for capacity building). Note that MPP-EAS was officially completed in late 1999; there were no PEMSEA allocations in 2000 as negotiations for the second cycle ICM program in Xiamen were only being initiated.

The Xiamen Marine Management and Coordination Committee was put up to provide policy advice, coordinate the various marine uses and review progress of the activities. Meanwhile, the Xiamen Ocean and Fisheries Bureau (where the Xiamen ICM PMO is subsumed) was established to be the operational arm of the interagency committee.

It is difficult to break down actual program expenditure by the local government since most of the contributions are in kind and program personnel sometimes perform other tasks. However, Table 6 provides an estimate of the counterpart funding for starting up the program

[1] *This is included in the updated version of the Strategic Management Plan (2005).*

Table 4. Expenditures of Concerned Agencies (in million RMB).

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Environmental protection	2.3	2.5	2.7	3.1	3.5	3.8	5.33	6.21	23.86	40.42
Aquatic and fish management	3.8	4.2	5.4	6.5	7.2	9.4	11.07	12.43	12.2	10.96
Marine management	0	0	0	0	0	1.6	2.09	3.45	3.15	2.54
Port supervision	0.6	0.75	0.95	1.05	1.25	1.3	1.58	1.21	1.44	1.57
Marine affairs	0.25	0.35	0.50	0.65	0.7	0.8	0.87	0.95	1.27	1.36
Total	**6.95**	**7.80**	**9.55**	**11.3**	**12.65**	**16.9**	**20.94**	**24.25**	**41.92**	**56.85**

Source of data: Xiamen Financial Bureau.

particularly in the development of the necessary legislations and other ICM-related activities.

After the ICM framework and its implementing guidelines were developed, it was time to put the plans into action. Funds were allocated primarily for purchasing equipment, employing and training personnel. Table 4 shows a notable increase in expenditures. As various agencies are involved in several ICM activities, there is a significant probability that some portions of the growth in expenses are due to ICM.

Instrumental Outcomes: Improved Coastal Governance

Marine Supervision Brigade

6 Instrumental Outcomes: Improved Coastal Governance

In relation to ICM, governance refers to the structures and processes used to govern behavior, both public and private, in the coastal area and the resources and activities it contains (Ehler, 2003). ICM, as a new approach to sustainable development of coastal resources and protection of the marine environment, requires a fundamental change in philosophy, way of mind, as well as government structure and management system (Li, 1999). This section discusses the key environmental and governance issues in Xiamen, the contribution of the ICM program in initiating legislation and institutional reforms and some indicators of the benefits associated with improved governance. Admittedly, the ICM program in Xiamen, particularly the improved coordination structure, had other significant but unquantifiable benefits. The same situation prevails in other studies that attempted to do a socioeconomic valuation of ICM in their respective areas (Firn Crichton Roberts Ltd and Graduate School of Environmental Studies University of Strathclyde, 2000).

Interagency Coordinating Mechanism

Through the ICM program, an interagency body, the Marine Management Coordination Committee (MMCC), was formed to synchronize all related environmental management efforts in the coastal and marine areas to avoid duplication of efforts, functions and overlapping jurisdictions, and share resources (Figure 8). In the long run, this could result in cost savings for the local government and the different agencies. The executive vice mayor, and now the mayor, served as director of the MMCC, and the other vice mayors (in charge of transportation, agriculture, science, and city construction) serve as deputy directors. Heads of various departments and agencies serve as committee members.

The Marine Supervision Brigade — a supervisory force, consisting of harbor, fishery, water police and environment supervisors, was formed within the MMCC and organized into an integrated law enforcement group (McCleave, et al., 2003). This group resolved a number of coastal-use conflicts.

Marine Experts Group

In 1996, the Marine Experts Group (MEG) composed of selected marine scientists, legal experts and economists was constituted by the municipal government as a way to integrate science into policymaking and decisionmaking. The MEG is part of the MMCC and provides technical, scientific, legal and economic advice to policymakers to maximize benefits from development projects while costs are minimized. Among its accomplishments include the establishment of an integrated environmental monitoring system, enactment of the Xiamen functional zoning scheme, the completion of the comprehensive marine economic development plan, improvement of financial mechanism for management-oriented scientific research, and operation of the Xiamen Coastal Sustainable Development Training Center (McCleave, et al., 2003).

Enabling Legislations and Improved Governance

Coastal and Sea-Use Zoning

In China, although the law states that the marine area is the nation's patrimony, the exploitation of the coastal and marine area have been virtually uncontrolled. Since the 1980s, the national government adopted major strategies to address the country's environmental degradation, namely, devolving more power to local governments to implement new environmental laws and tapping financial and technical support from the international community (Chen and Uitto, 2003). To harmonize with existing national legislations, Xiamen developed a set of legislations to govern integrated management of resource and promote environmental protection (Li, 1999). At the same time, economic instruments were employed specifically to promote more efficient resource use and pollution control. The user-fee system as part of the *Xiamen Marine Use Regulation* and the functional zoning scheme is an example of economic instrument working in tandem with regulatory instruments.

Figure 8. Marine Management and Coordination Committee of Xiamen.

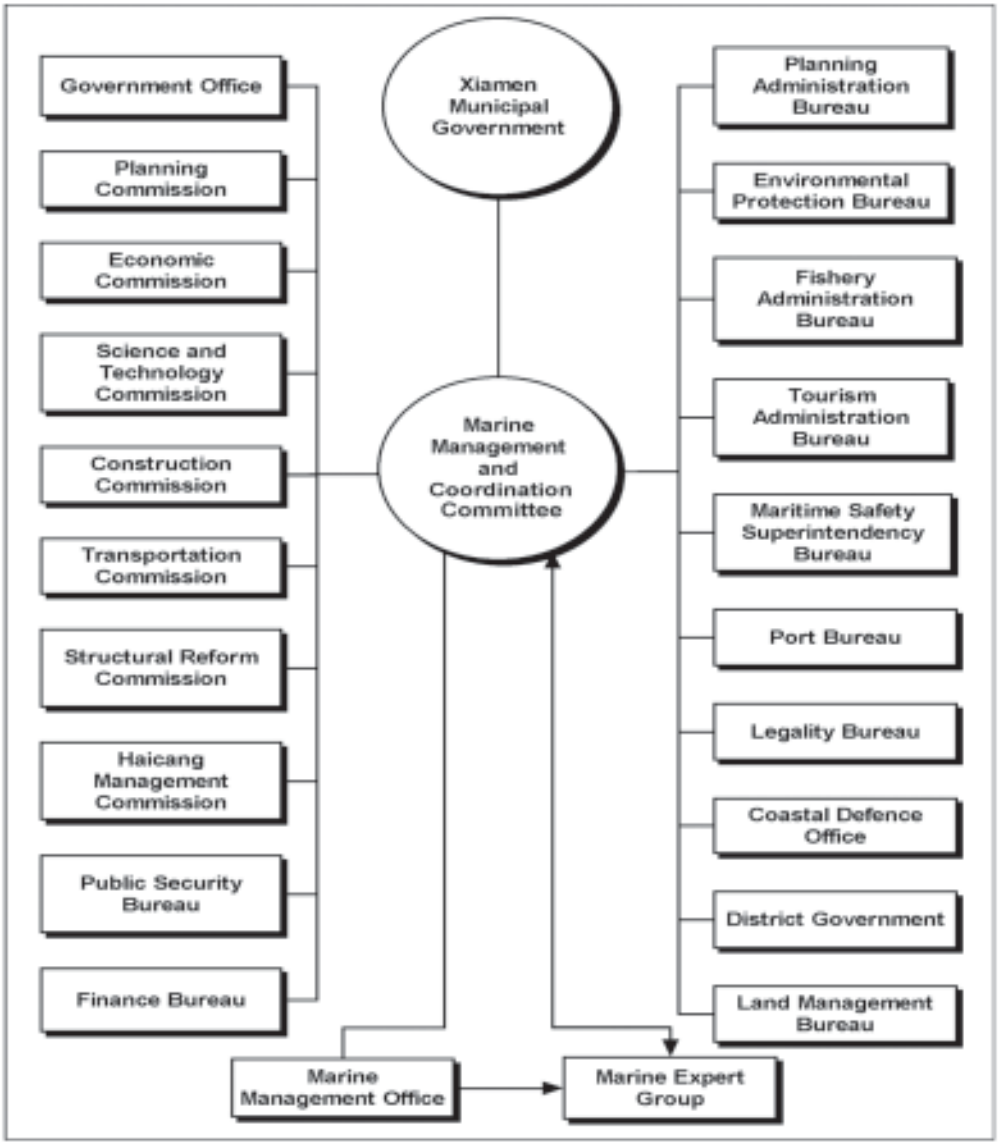


Table 5. Xiamen Marine Use.

Function	West Sea	East Sea	Tong'an Bay	Dadeng Sea
Dominant	Shipping/Port	Tourism	Aquaculture enhancement	Aquatic resource
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.

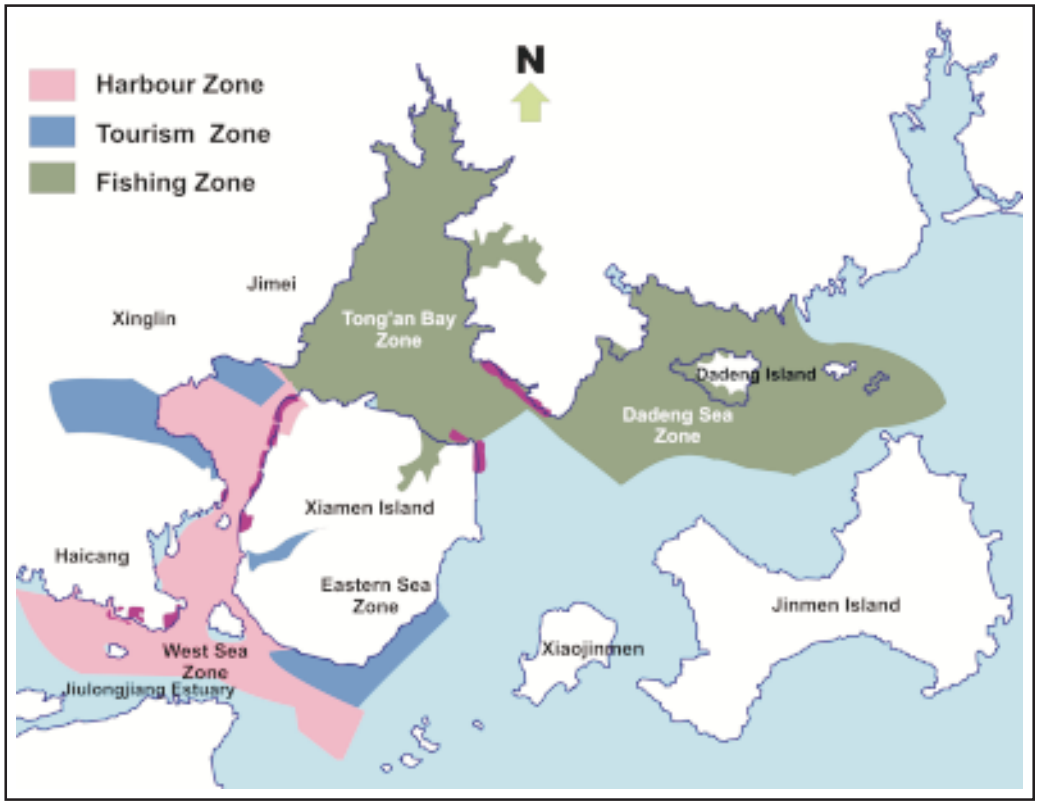
In 1997 the municipal government of Xiamen issued the administrative order on Xiamen Marine Use Regulation, adopting the scheme to reduce use conflicts, to maximize the socioeconomic benefits derived from coastal and marine resource use, to conserve biodiversity and to ensure the sustainable development of Xiamen waters. To complement this regulation, two related legislations — the Xiamen Marine Functional Scheme and Xiamen Marine Use Fee System — were implemented as well. A marine functional zoning scheme defines the uses of a given sea area by order of priority (Figure 9). The coastal waters were divided into nine functional zones, namely, shipping/port zone, tourism zone, aquaculture zone, coastal industrial zone, ocean engineering zone, mining zone, nature reserve zone, special function zone and rehabilitation zone. Prioritization was determined based on estimated benefits and related environmental impacts of the uses, taking into account the traditional uses in certain areas (Ruan and Yu, 1999). Based on the assessment of effects, zoning defined use priority in terms of "dominant, compatible or restricted" functions. "Dominant" function is assigned to the use(s) considered high priority, while an activity is classified "compatible" if it has no significant adverse effects on priority use. "Restricted" function is given to uses that need to be reduced, moved out or closed due to their detrimental effects on the priority and other functions. Table 5 presents the zoning results with regard to four sub-areas in Xiamen.

The zoning scheme is considered an effective mechanism that could minimize adverse environmental impacts through judicial allocation of sea space based on the merits of the functional characteristics of a given sea area. According to Hong and Xue (1999), in the process of defining the zones, the current and potential cumulative environmental impacts of the marine areas in Xiamen were assessed and these provided the scientific basis for the establishment of the zoning scheme. Meanwhile, the user-fee system provided an incentive for the rational use of the resources. These three measures (Xiamen Marine Use Regulation, Xiamen Marine Function Scheme and Xiamen Marine Use Fee System) collaborated in controlling access and unregulated development in the city. The range of charges per activity, size of operations and affected area in the four sub-areas are shown in Table 6. Depending on the nature of the activity and the designated function of the sea area, fees are levied. Higher charges are imposed on the activities that are considered incompatible to the designated function of a particular location.

Benefits Related to the Resolution of Administrative and Legal Disputes and Cases

Before the adoption of ICM in Xiamen, the system of marine management was sector-oriented. Twelve marine-related departments from the central, provincial and local governments performed independently, resulting in fragmented

Figure 9. Coastal-Use Zoning Plan.



Source: Xiamen Municipal Government.

policymaking and sometimes, even aggravated coastal-use conflicts. The implementation of the sea-use zoning scheme as part of the ICM program was expected to facilitate the resolution of multiple-use conflicts and impose order in previously unregulated marine resource utilization. With the formation of a multi-agency council overseeing the coastal and marine resource management, administrative costs are foreseen to drop, at least in the long run.

a. Number and Nature of Conflicts

Concerned government agencies first try to settle conflicts, such that very few disputes and administrative and legal cases are actually elevated to the courts. The discussion focuses on those cases under the jurisdiction of the local agencies. Use conflicts have been settled and recorded by various marine-related management sectors.

From Tables 7 and 8, it is obvious that the number of settled complaints and legal cases did not decrease as expected. This does not mean, however, that implementation of ICM even caused an increase in the number of legal cases. The reasons for the increase of the number of the recorded cases are as follows:

Prior to ICM, there was no integrated marine management department in Xiamen, and there was no government department to supervise, settle and record disputes and cases. Some cases related to use conflicts caused serious problems, but these were not settled and recorded due to lack of legal basis. For example, the use of marine resources was virtually free for all and no sector had priority over the others. The limited resources and absence of a clear governing body to handle the cases discouraged most complainants from filing.

Table 6. Marine User-Fee System (RMB).

Uses/ Activities	Unit	West Sea			East Sea			Tong'an Bay			Dadeng Bay		
		I	II	III	I	II	III	I	II	III	I	II	III
Reclamation	RMB/m^2	30	45	60	30	37.5	45	7.5	15	22.5	1.5	2.25	3
Docking	RMB/m^2/yr	0.3	0.75	1.5	0.75	1.5	2.25	0.25	0.45	0.75	0.15	0.3	0.4
Laying of underwater pipelines	RMB/m^2	5	4.5	3	7.5	5.	3	4	3	2.5	3	2.5	1.5
Manufacture and maintenance of boats	RMB/m^2/yr	0.45	0.75	1.5	1.5	3	4.5	0.45	0.75	1.5	0.25	0.4	0.45
Mining	RMB/m^2/yr	1.5	0.75	0.45	4.5	3	1.5	1.5	0.75	0.45	0.45	0.4	0.25
Water sports	RMB/m^2/yr	1.5	1.2	0.75	0.75	0.4	0.45	0.15	0.25	0.25	0.15	0.15	0.15
Recreation and hotel facilities	RMB/m^2/yr	1.5	3	4.5	1.5	2.25	3	0.6	0.9	1.2	0.3	0.45	0.6
Mariculture													
Net-box in shallow marine	RMB/m^2/yr	3											
Pell-mell in shallow marine	RMB/m^2/yr	30											
Mariculture in shoal	RMB/m^2/yr	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

Source: Xiamen Marine Use Fee System, 1997.

Table 7. Number of Settled Administrative and Legal Cases under the Xiamen Marine Surveillance Team.

Year	Unregulated quarrying	Unregulated sand casting to the sea	Unregulated sea use	Total
1991	No data	No data	No data	No data
1992	No data	No data	No data	No data
1993	No data	No data	No data	No data
1994	No data	No data	No data	No data
1995	No data	No data	No data	No data
1996	No data	No data	No data	No data
1997	1	0	0	1
1998	1	4	3	8
1999	1	5	4	10
2000	5	4	9	18
2001	5	6	17	28

Source of data: Xiamen Marine Management Office, Xiamen Marine Surveillance Team.

Table 8. Number of Settled Cases under the Environment Bureau.

Year	Registered Cases[1]	Complaints[2]	Complaints Settled (%)[3]	Noise Pollution Cases (%)	Air Pollution Cases (%)	Water Pollution Cases (%)
1991	No data	435	91.3	No data	No data	No data
1992	No data	241	78.8	No data	No data	No data
1993	No data	261	100	No data	No data	No data
1994	No data	476	92.2	No data	No data	No data
1995	No data	765	90	No data	No data	No data
1996	150	404	86.6	No data	No data	No data
1997	283	1,132	84.0	No data	No data	No data
1998	97	3,770	98.6	No data	No data	No data
1999	129	4,409	98.6	52.9	21.7	2.3
2000	136	5,904	100	63.7	19.5	16.8
2001	247	6,562	100	36.3	50.2	3.5

[1] Registered cases are those formally filed in the environmental bureau.

[2] Complaints are considered of lesser degree compared to those registered cases.These are usually complaints regarding noise from construction, lampblack pollution from small restaurants, etc.

[3] This refers to the percentage of settled complaints. All the registered cases have been settled.

Source of data: Xiamen Environmental Quality Report, (1991-1995), (1996-2000), Xiamen Environmental Situation Report, 2001, Xiamen Environmental Protection Bureau.

After the implementation of ICM, more enforcement resources were put into marine management, and enforcement was thereby strengthened. In 1997, the Xiamen Marine Management Office through its Xiamen Marine Supervision Brigade was established to supervise and settle the disputes, complaints and administrative and legal cases, and more resources were put at their disposal. The legal basis for enforcement was also reinforced after ICM.

The increase of allocated resources for law enforcement, the fortification of enforcement capacity and the completion of the necessary legislation triggered the increase in the number of complaints and recorded cases. It is important to note that the resolution of the cases after the ICM program took effect contributed to the increase in efficiency of coastal resource use. It is expected that the number of cases will decrease with better enforcement.

b. Cases Related to Illegal Fishing

Because of weak law enforcement before 1996, there were increasing incidences of illegal fish capture, through the use of electricity, detonators and other destructive methods, in

Table 9. Occurrence and Penalty for Illegal Fishing.

Time	Fish capture using electricity	Fish capture using detonators	Other illegal methods	Fines (million RMB)
1991-1994	No data	No data	No data	No data
1995	52	3	172	0.235
1996	88	88	250	0.51
1997	40	4	80	0.11
1998-2001	No data	No data	No data	No data

Source of data: Xiamen Fisheries Bureau.

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. The incidence of illegal fishing was kept within limits in the succeeding years. The fine amount cannot be used as a proxy to the value of the loss to fisheries due to illegal activities. In the absence of existing valuation of the loss, we simply present the fine, the number of the illegal fishing incidents recorded and the amount of fine imposed (Table 9).[2]

[2] *To estimate the loss of fisheries resources due to illegal harvesting, the data of volume of fisheries resources of several years is needed, which was unavailable. Moreover, additional information representing the other factors affecting the stock of the fisheries resources would be needed.*

Instrumental Outcomes: Investment in Environmental Infrastructures and Resource Protection

7 Instrumental Outcomes: Investment in Environmental Infrastructures and Resource Protection

Key issues

Reception and Assimilation of Waste

The increasing volume of waste discharged to sea aggravates pollution impacts. Oil and rubbish from vessels, as well as organic pollution from mariculture and domestic sewage are serious sources of pollution. In the West Sea area alone, fecal coliform count reached 3,914 ind/liter and exceeded the standard for recreational seawater (ITTXPD, 1996).

Causeways and Reclamation

From the 1950s to 1970s, the causeway of Gaoji (connecting Xiamen Island to the mainland), Xinglin (connecting Jimei and Xinglin), Maluan (connecting Maluan and Xinglin) and Yuandang were constructed for reclamation and transportation purposes. There have been 47 reclamation projects affecting a reclamation area of 90.13 km^2 since 1955 (Figure 10). These reclamations led to 58.3 percent decrease of the tidal flushing capacity of West Sea, the most extensively developed body of water in Xiamen. As a result, the West Sea experienced increased heavy siltation posing a threat to the shipping industry and required frequent dredging.

Ecosystems and Habitats

Xiamen's marine ecosystem is prolific. Chlorophyll-a averages at 2.5mg/m^2. Over 1,300 marine species are found in its coastal waters, including some endangered species such as prehistoric lancelet (*Branchiostoma belcheri*), egrets (*Egretta eulophotes*) and the Chinese white dolphin (*Sousa chinensis*). The major changes and threats to the ecosystem were: 1) habitat alteration and degradation; 2) deterioration of seawater and sediment quality; and 3) damaged wetlands and mangroves.

Environmental Infrastructure

Water bodies provide a value in terms of being used as a receptacle of waste. In environmental and resource accounting (such as those applied in

Figure 10. Causeway and Reclamation Projects in Xiamen: Cumulative Impacts.

Source: Xiamen Ocean and Fisheries Bureau.

Chesapeake Bay and the Philippines), waste disposal services are proxied by costs that often rely on engineering pollution-control costs. The PEMSEA ICM program recognizes that the sustainable management of our environment requires the mobilization of investments in environmental infrastructure and services, and as such, promotes investments and financing opportunities through inter-sectoral partnerships. Table 10 shows both the government and private sector investments in environmental facilities. This has resulted in cleaner environment and in the attraction of more investments, thereby creating a multiplier effect on the economy.

Sewage Treatment

With the successful implementation of the Yuandang Lake Treatment Project, which involved an extensive wastewater treatment system including the construction of secondary wastewater treatment plant and wastewater collection/interception system, the Xiamen Municipal Government continued to prioritize environmental initiatives for the entire city. Given the demand for environmental facilities and services as shown by the results of the WTP survey in the section on *Management Outcomes: Change in Attitudes and Perceptions*, the government's program of constructing and operating sewage treatment plants was well received. The Yuandang project paved the way for the establishment of sewage waste treatment facilities in Xinglin, Jimei and Haicang as well as solid waste management projects. As part of the ICM program, seven sewage plants were established to treat the increasing volume of urban domestic sewage. Other sewage treatment facilities to service other parts of Xiamen are planned. In addition to the construction of new plants in Huli and East Tongan, the existing plants will also be expanded to accommodate the growing requirements of the entire city. Table 11 presents the major wastewater treatment plants in Xiamen and their respective capacities. While the treatment rate is not a hundred percent, it rose from 42.3 percent in 1993 to 60 percent in 2001 (Figures 11 and 12).

The companies were also required to treat their sewage to meet the standard prior to release. Increase in treatment costs led companies to

Table 10. Investments in Environmental Services (million RMB).

Year	Government Investment		Private Investment		Total
	Sewage Treatment	Treatment of Solid Waste	Sewage Treatment	Treatment of Solid Waste	
1992	10.91	12.29	10.85	0.3	**34.35**
1993	22.84	5.7	24.5	0.24	**53.28**
1994	18.17	3.4	11.3	0.39	**33.26**
1995	24.64	21.7	27.93	0.39	**74.66**
1996	198.43	21.89	16.34	0	**236.66**
1997	147.17	19.93	28.29	25.5	**220.89**
1998	218.35	81.05	25.18	0.15	**324.73**
1999	281.92	28.22	56.01	0.4	**366.55**
2000	123.56	23.01	31.41	0.51	**178.49**
2001	499.26	26.73	165.57	21.8	**713.36**

Source of Basic Data: Xiamen Statistics Year Book, 1992-2002; Xiamen Environmental Statistics, 1995-2001.

decrease water use and also to recycle it. Hence, the amount of industrial sewage did not increase significantly even with the increase in industrial output. The volume of industrial sewage meeting the standard went up from 32 percent in 1991 to 99.3 percent in 2001. The volume of released industrial sewage per 10,000 RMB of industrial output significantly declined from 1992 to 2001 (Figures 13 and 14). This is an indicator of improved water-use efficiency.

Figure 11. Volume of Urban Sewage Generated and Treated.

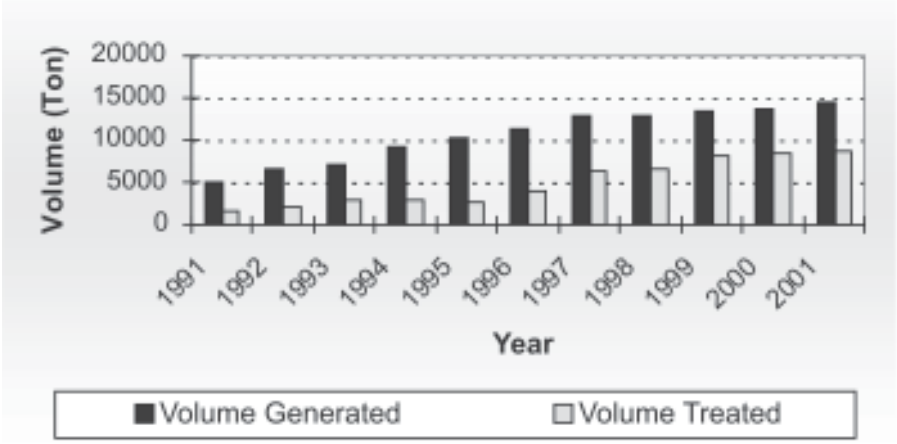


Figure 12. Treatment Rate of Urban Sewage.

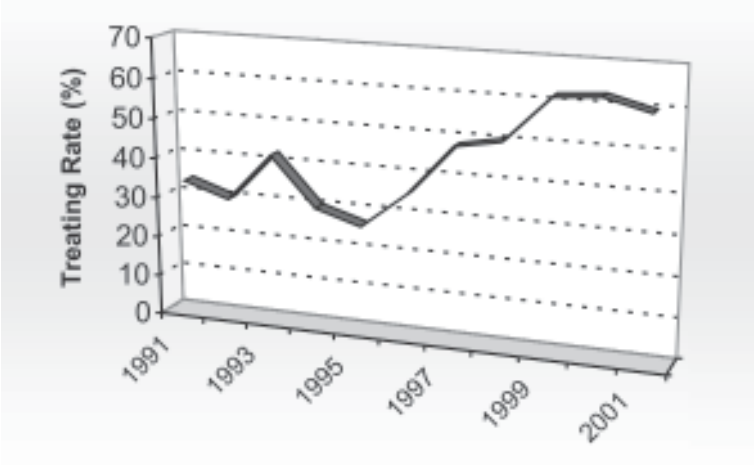


Figure 13. Volume of Industrial Sewage Produced and Released.

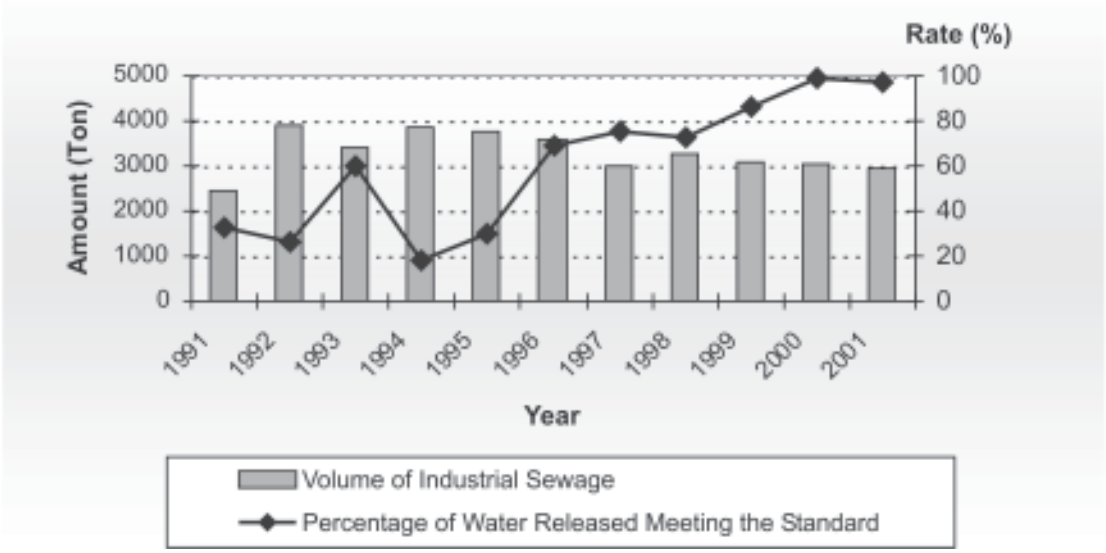


Figure 14. Volume of Industrial Sewage Released per 10,000 Industrial Output.

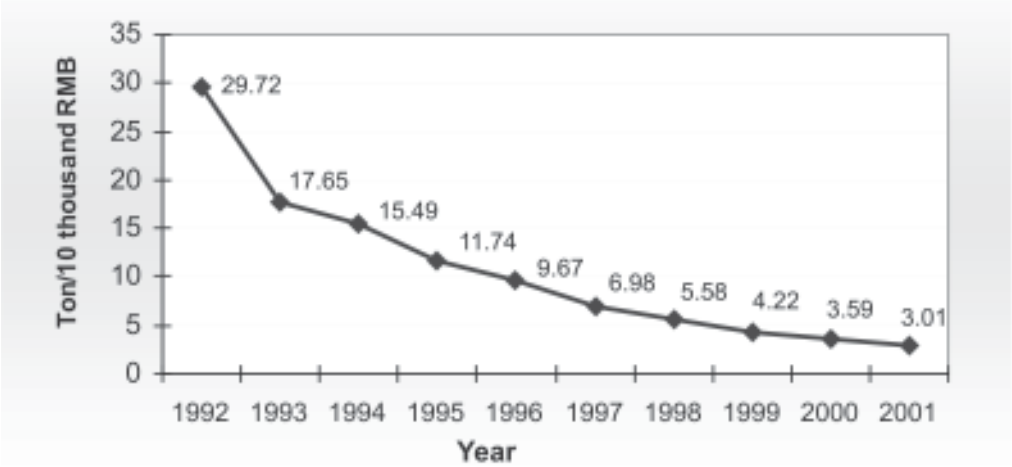


Table 11. Large-Scale Wastewater Treatment Plants.

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	520.00
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		430.00
Tong'an Wastewater Treatment Plant	2003	50,000		91.00

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

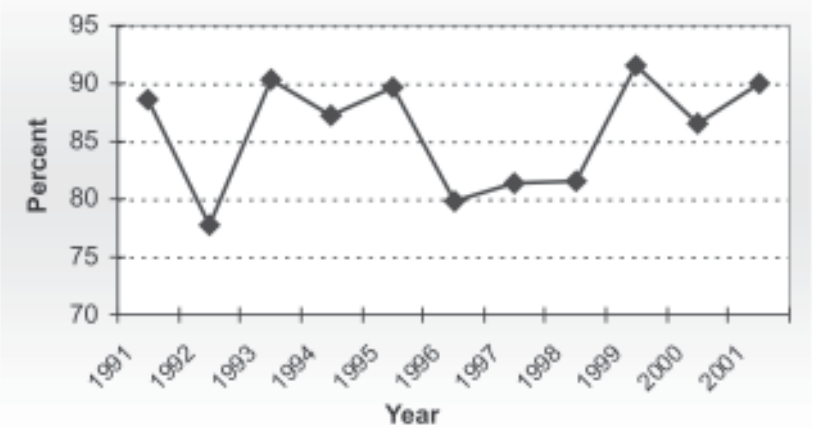
Solid Waste Treatment

With the increase in population, the amount of urban solid waste also multiplied. Table 12 shows detailed information on the volume of various solid wastes. The volume of industrial waste grew rapidly from 1994 to 1995, and then the volume of industrial waste stabilized at about 500,000 tons.

The amount of waste generated by households/domestic sources needs to be monitored more closely; the growth rate was about 2.8 percent from 1991–1995, but almost quadrupled and reached about 11 percent from 1996–2001. The volume of hazardous wastes is relatively small but this still requires appropriate and adequate treatment.

Xiamen is managing its solid waste through recycling and operation of sanitary landfill. The city has factories that take used newsprint, beer bottles and selected types of plastics (Estcouns, 1999). The recycling rate for industrial waste is rising (Figure 15). The treatment rate for domestic waste is also improving and has reached 95 percent in 2001 (Figure 16).

Figure 15. Recycling Rate of Industrial Solid Waste.



Redesign of Causeways

Due to the construction of causeways in the 1970s, the West Sea and the Yuandang estuary became heavily polluted bodies of water. Yuandang Harbor in the 1970s was used as shelter for fishing vessels. The total area of the Yuandang estuary was around 10 km^2, with a length of 6.28 km. The constructed causeway closed the estuary with a sluice gate, thus losing the Yuandang Harbor. The decline in water exchange capacity, compounded by the large volume of sewage discharged led to the deterioration of water quality from 1980s to the early 1990s. The integrated treatment of Yuandang Lagoon began

Table 12. Volume of Solid and Hazardous Waste (in 10,000 Tons).

Year	Total	Domestic waste	Industry waste	Hazardous waste
1992	34.69	12.19	22.5	No data
1993	45.8	21	24.8	No data
1994	50.6	23	27.6	No data
1995	70.7	23.6	47.10	No data
1996	67.34	26.6	40.7	0.04
1997	77.66	27.35	50.27	0.039
1998	80.18	28.64	51.52	0.024
1999	80.87	31.15	49.63	0.089
2000	84.4	34.46	49.7	0.24
2001	84.72	40.02	44.33	0.37

Source of basic data: Xiamen Environmental Quality Report, (1991-1995), (1996-2000), Xiamen Environmental Situation Report, 2001, Xiamen Environmental Protection Bureau.

in 1991 beginning with the expansion of the sluice gate, the construction of water channels and the circulation of the lagoon's water through tidal exchange. This continued with the excavation of deposited sediments and the construction of a sewerage system. The main objective of the rehabilitation program was to improve the water quality of the lagoon. By successfully achieving this goal, Xiamen not only enhanced the environmental condition of Yuandang Lagoon and the surrounding area, but also attracted investments and promoted economic development — providing a model for future urban planning and development. Moreover, the Egret islet was maintained, and recreational parks were developed, thus providing sanctuary for the endangered species and amenities for the local communities and visitors as well.

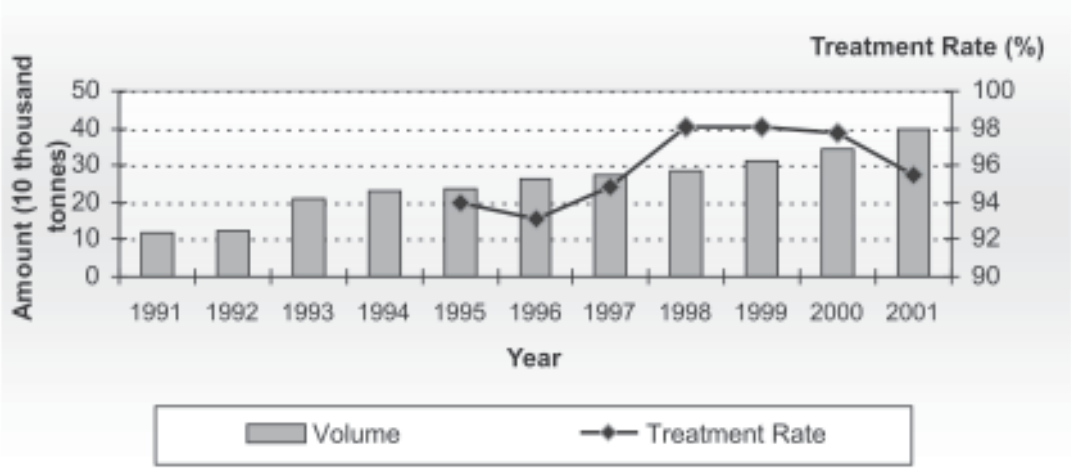
Source: Xiamen Yuan Dang Lake Administrative Office, China

Improvement in Road Networks and Shoreline Protection

The 42-km Round-the-Island Road is an extensive circumferential road network in Xiamen that connects the downtown area, the seawaters in the west and the development zones in the east. Its construction contributed in the management of increasing traffic flows, development of the local tourism industry and improved the investment environment. The road is parallel to the natural shoreline and as such, construction had to consider shoreline protection and preservation and planting of greenery. Even service facilities and establishments put up along the shore had to comply with specific environmental requirements.

The monitoring results of the Fujian Oceanographic Research Institute covering the period 1999–2001 indicate that except for some local scouring (primarily in the middle and low tidal zones), sand beaches along the eastern coast of Xiamen have generally remained stable. The area is now a favorite recreation and relaxation destination.

Figure 16. Volume and Treatment Rate of Domestic Solid Waste.



An important component of the road project is the involvement of the public. This is one of the early examples in the city where the public have been actively participating and were consulted by the agencies spearheading the project.


Chinese Egret


Chinese White Dolphins

Investment in Resource and Habitat Protection

The coastal waters of Xiamen are teeming with marine life. Some species, such as the prehistoric lancelet (*Branchiostoma belcheri*), egrets (*Egretta eulophotes*) and the Chinese white dolphin (*Sousa chinensis*) are considered national endangered species. The implementation of ICM in Xiamen played an important role in the protection of marine habitats and endangered species, including the establishment of nature reserves for the said species. Government investment in the establishment and maintenance of preservation zones has increased and remained steady during the ICM implementation period (Table 13). Table 15 shows the number, area of nature reserves and the year they were established.

A 55-km^2 area where dolphins are frequently sighted have been designated as a preservation zone. The nature reserve for the white dolphins was initially in conflict with shipping, but through consultations with the scientific community, dolphin reserve proponents and other

Table 13. Government Investment in Preservation Zones (million RMB).

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	1.2	0.3	0.3	1.8	0.8	2.2	1.2	1.2	1.2	1.2

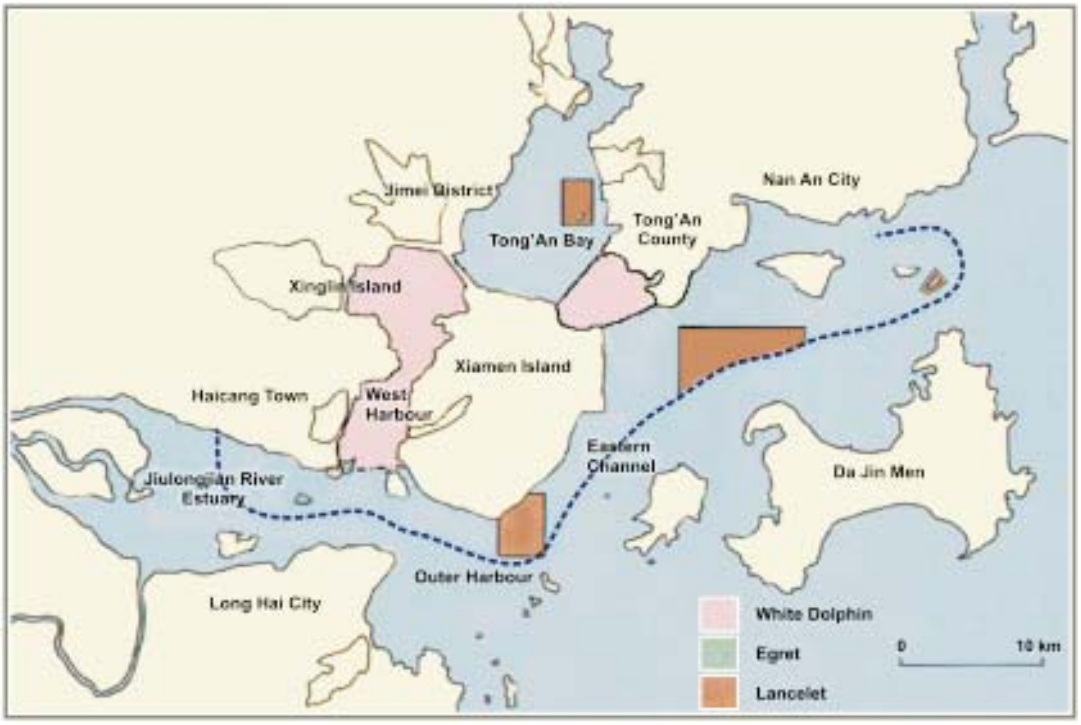
Source of Basic Data: Xiamen Statistics Year Book, 1992-2002; Xiamen Environmental Statistics, 1995-2001.

Table 14. Number and Area of Natural Reserves of Xiamen.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Number	1	1	1	1	2	2	3	3	3	3	3
Area (Ha)	1,818	1,818	1,818	1,818	2,034	2,034	7,588	7,588	7,588	7,588	7,588
Name of Reserves Established	Lancelet nature reserves				Egret		Chinese White Dolphin				

Source of data: Xiamen Environmental Quality Report, (1991-1995), (1996-2000), Xiamen Environmental Situation Report, 2001, Xiamen Environmental Protection Bureau.

Figure 17. Xiamen Conservation Areas.



Source: ICM Xiamen Project.

stakeholders, the municipal government issued a special ordinance to implement the Xiamen Municipal Regulations for the Protection of Chinese White Dolphin (Ruan and Yu, 1999). It specified the speed of ships and boats, restricted reclamation, and prohibited effluent discharge above the standards, trawling, use of gill nets, underwater explosion, recreational boating and surfing in the reserve areas. The zoning scheme has also designated a 18-km^2 nature reserve area for the lancelet and the entire Dayu Islet as nature reserve for the egrets, which is considered by the local people as Xiamen's symbol. Figure 17 illustrates the nature reserve locations.

Moreover, the zoning scheme designated the remaining pockets of mangroves and former mangrove sites as a nature reserve where mangrove reforestation can be implemented (Ruan and Yu, 1999). Mangrove planting was done, covering 14 ha since 1994, which has enhanced the feeding grounds for the egrets. The Executive Committee for Xiamen ICM Demonstration Project organized stakeholder consultations to explain the rationale for the reserve and overcome resistance, and has worked together with developers for alternative sites.

Management Outcomes: Reduction of Externalities

8 Management Outcomes: Reduction of Externalities

Improvement in Environmental Quality

The environmental quality of Xiamen has undergone vast improvement in the past decade. Since 1997, Xiamen received various awards such as the *National Model City of Environmental Protection, National Garden City, National Excellent Tourism City,* among others. In 2002, Xiamen won the top prize in the Nations in Bloom competition.

Air Quality

The city devised a series of measures to encourage the use of public transportation and gradually introduced measures, which 1) ban diesel-powered vehicles in the city center; 2) removed motorcycles from the city center and retired old motorcycles; 3) required taxis to have emission control equipment; and 4) encouraged the conversion of taxis and commercial vehicles in the city to cleaner burning liquefied natural gas (Estcouns, 1999). The city is actively substituting coal with oil and natural gas in the boilers of the city. It has moved 'pollutive' industrial establishments out of the residential and scenic areas, and expanded parks and green areas. Table 15 summarizes the air quality status in Xiamen.

Water Quality

a. Quality of Drinking Water

Sources of water for the city are the Beixi water diversion (diverted from the river) and the Bantou reservoir. All of the urbanized areas have running water. Water from the river and reservoirs move in sealed pipes to the city water treatment plant, with continuous monitoring of the inflow water quality. The percentage of drinking water meeting the prescribed standard reached 98 percent in recent years (Table 16). Annex 2 presents the

Table 15. Major Air Pollutants.

Year	SO_2 (mg/m^3)	No_x (mg/m^3)	TSP (mg/m^3)	Dust (t/km^2/month)
1991	0.007	0.011	0.094	No data
1992	0.006	0.013	0.090	No data
1993	0.009	0.018	0.100	No data
1994	0.008	0.018	0.079	No data
1995	0.010	0.023	0.066	No data
1996	No data	0.020	0.075	5.23
1997	No data	0.024	0.081	3.93
1998	0.02	0.031	0.076	3.63
1999	0.028	0.029	0.074	4.69
2000	0.019	0.028	0.085	4.97

Source of data: Xiamen Environmental Quality Report, (1991-1995), (1996-2000), Xiamen Environmental.

National Surface Water Environmental Quality Standards, wherein Classes II and III are applicable to drinking water.

b. Quality of Sea Water

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. The seawater quality standards are shown in Annex 3 while Table 18 shows the annual average level of main pollutants found in Xiamen waters.

Reduced Siltation in the Sea Areas

Causeway construction, reclamation and intensified mariculture changed the hydrology and flushing capability of the coastal waters and led to silting in the navigation channels. Sand quarrying, unregulated casting of sand into the sea and construction in the coastal areas also aggravated the situation. This had a negative effect on sea transportation, and subsequently necessitated dredging. The annual siltation estimate is based on monitoring results and studies in the West Sea, Jiulongjiang River Estuary and the South Sea. Table 17 shows the estimated average annual volume of silt.

The implementation of ICM contributed in decreasing the problem in three ways: 1) by regulating and improving the hydrology and flushing capability of the coastal waters; 2) controlling quarrying; and 3) regulating the casting of sand in the sea and means of construction. As a result there had been a reduction in the dredging expenses. These figures are used as a measure of the decline in the externality costs. After 1997, there was a considerable yearly saving of 7.3 million RMB in dredging costs (Table 18).

Resolution of Conflict between Shipping and Fisheries

As noted, there are serious conflicts between the mariculture, fish capture and sea transportation sectors. Mariculture and fish capture tend to interfere in shipping routes. This has put sea transportation at risk and also affected its operations and efficiency. As most of these conflicts mainly affected cargo vessels, the study concentrated on them.[3]

While there were no reports of shipping accidents occurring due to mariculture and fish capture, their presence delayed the schedule and travel time of the vessels. According to the Xiamen Port Bureau, the vessels spent more time in the port and channels because of these interferences,

Table 16. Quality of the Sources of Drinking Water.

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Rate of reaching standard	-	-	-	-	92.8	98.1	97.2	98.2	98.13	98.18	98.11

Source of data: Xiamen Environmental Quality Report, (1991-1995), (1996-2000), Xiamen Environmental Situation Report, 2001, Xiamen Environmental Protection Bureau.

[3] *The number of passenger lines is relatively small and are less affected by the problem.*

Table 17. Water Quality in Various Areas of Xiamen.

Sea Area	Item	1996	1997	1998	1999	2000
West Harbor	Inorganic nitrogen (mg/L)	0.423	0.495	0.53	0.59	0.591
	Activated phosphorus (mg/L)	0.025	0.028	0.031	0.039	0.031
	Total lead (10^{-3} mg/L)	8.8	4.2	9.9	9.2	4.46
Jiulongjiang River Estuary	Inorganic nitrogen (mg/L)	0.33	0.359	0.404	0.467	0.378
	Activated phosphorus (mg/L)	0.019	0.022	0.024	0.023	0.022
	Total lead (10^{-3} mg/L)	10.7	5.6	11	12	16.9
Southern West Sea	Inorganic nitrogen (mg/L)	0.24	0.365	0.368	0.416	0.378
	Activated phosphorus (mg/L)	0.014	0.022	0.21	0.21	0.018
	Total lead (10^{-3} mg/L)	1.48	5.6	13.7	12.4	5.21
East Sea	Inorganic nitrogen (mg/L)	0.205	0.234	0.329	0.304	0.234
	Activated phosphorus (mg/L)	0.02	0.018	0.021	0.02	0.018
	Total lead (10^{-3} mg/L)	10	9.2	18	12.4	4.75
Tong'an Bay	Inorganic nitrogen (mg/L)	0.174	0.221	0.315	0.274	0.24
	Activated phosphorus (mg/L)	0.016	0.02	0.024	0.024	0.021
	Total lead (10^{-3} mg/L)	14.8	8.4	18.2	11.8	4.18

Source of data: Xiamen Environmental Quality Report (1996-2000).

Table 18. Dredging Cost.

Year	Volume of siltation (million m^3)	Average dredging cost (RMB/m^3)	Total dredging costs (million RMB)
	(1)	(2)	(3)=(1)*(2)
1992	1.225	20	24.5
1993	1.225	20	24.5
1994	1.225	20	24.5
1995	1.225	20	24.5
1996	1.225	20	24.5
1997	1.225	20	24.5
1998	0.86	20	17.2
1999	0.86	20	17.2
2000	0.86	20	17.2
2001	0.86	20	17.2

Source of data: Fujian Port Sea Route Reconnaissance and Design Institute (2001).

Figure 18. Shoreline Erosion.

Source: Xiamen Ocean and Fisheries Bureau.

particularly from March to May — the height of the season for gathering eel fry. Table 19 includes the losses absorbed by the shipping and sea transportation group involved in the use conflict with the fisheries group. The longer the delay, the greater the expenditure in terms of wages, fuel and other fixed costs by the shipping companies, with the average loss for a delayed hour at 1,733 RMB.[4] This issue was addressed by the zoning scheme, and since 1998, there were no reported delays due to conflict with fisheries.

Reduced Economic Losses Due to Erosion

Half of Xiamen's shoreline receded as a result of unregulated quarrying and construction. Cliff areas in the north and northeast coast of Xiamen Island corresponding to a length of around 19 km from Gaoqi to Huecuo were badly damaged. Sandy shores of around 16 km in the south and southeast coast from Hecuo to Xiamen University was similarly affected (ITTXPD, 1996). Other places that experienced erosion are marked in Figure 18. The worsening situation was one of the priorities identified in Xiamen's Strategic Management Plan and have been addressed through a series of rehabilitation activities particularly on the shoreline. An estimate of the loss due to different types of coastal erosion is presented below.

Loss of Sandy Beach

As a tourist destination, maintaining the quality of the beach is important. Large quantities of sand had to be backfilled to restore beaches to their original condition. The backfilling expense was used to measure the burden brought by erosion (Table 20). The success of the subsequent erosion prevention projects is evident in the decline in the amount spent for backfilling.

[4] According to COSCO, a survey of sea transportation companies showed that they incur an average fixed cost per hour of 1,333 yuan while the variable costs per hour is 400 yuan (including wages 333 yuan and fuel cost 67 yuan).

Table 19. Shipping/Sea Transportation Losses Due to Use Conflict.

Year	Cargo vessel trips	Delayed vessels per year	Average number of hours delayed	Average loss per hour delayed (RMB)	Total loss (million RMB)
	(1)	(2)	(3)	(4)	(2)*(3)*(4)/1,000,000
1991	1,033	270	4	1,733	1.87
1992	1,345	342	4	1,733	2.37
1993	1,474	385	4	1,733	2.67
1994	1,780	402	3	1,733	2.09
1995	2,137	496	3	1,733	2.58
1996	2,200	502	2	1,733	1.74
1997	2,976	578	2	1,733	2.00
1998		0	0	0	0
1999		0	0	0	0
2000		0	0	0	0
2001		0	0	0	0

Source of basic data: Column (2), (3) and (4) are from the Xiamen Port Bureau.

Table 20. Loss Due to Sand Beach Erosion.

Year	Volume of backfilled (m^3)	Average Backfilling Cost (RMB per m^3)	Total costs (million RMB)
	(1)	(2)	(3)=(1)*(2)/1,000,000
1992	1500	200	0.30
1993	1500	200	0.30
1994	1500	200	0.30
1995	1500	200	0.30
1996	1500	200	0.30
1997	800	200	0.16
1998	0	200	0
1999	0	200	0
2000	0	200	0
2001	0	200	0

Source of basic data: Xiamen Environmental Protection Bureau.

Loss Due to Cliff Erosion

Unlike erosion of the sandy beaches, the loss due to erosion of the cliffs is measured through the value of the land. Table 21 provides information on the area affected and estimated value of the loss.[5] Since natural occurrences and human activities both contributed to the erosion, there is a need to isolate the impact of the latter. Experts from the National 3rd Marine Research Institution, puts this to around 30 percent (Xie, 1998).

Table 22 shows that externality costs between 1992 and 2001 have declined by 40 percent. Thus, there were savings derived in terms of dredging, backfilling of eroded areas, and shipping and port operations during the period with ICM in place compared with the period prior to the implementation of ICM.

[5] *The price of coastal land (1,000 yuan/m2) is used as a proxy for the price of lost land due to erosion.*

Table 21. Loss Due to Cliff Erosion.

Year	Area Lost (m^2)	Price of land (RMB per m^2)	Total loss (10,000 RMB)	Loss due to human activities (million RMB)
	(1)	(2)	(1)*(2)/10,000	(1)*(2)*30%/1,000,000
1992	1,600	1,000	1,600	0.48
1993	1,600	1,000	1,600	0.48
1994	1,600	1,000	1,600	0.48
1995	1,600	1,000	1,600	0.48
1996	1,600	1,000	1,600	0.48
1997	1,400	1,000	1,400	0.42
1998	1,000	1,000	1,000	0.30
1999	0	1,000	0	0
2000	0	1,000	0	0
2001	0	1,000	0	0

Source of basic data: Xie, 1998.

Table 22. Externality Costs (in million RMB).

Year	Dredging cost	Cost of delays in shipping/sea transportation	Beach erosion	Cliff erosion	Total Externality Costs
1992	24.5	2.37	0.3	0.48	**27.65**
1993	24.5	2.67	0.3	0.48	**27.95**
1994	24.5	2.09	0.3	0.48	**27.37**
1995	24.5	2.58	0.3	0.48	**27.86**
1996	24.5	1.74	0.3	0.48	**27.02**
1997	24.5	2	0.16	0.42	**27.08**
1998	17.2	0	0	0.3	**17.5**
1999	17.2	0	0	0	**17.2**
2000	17.2	0	0	0	**17.2**
2001	17.2	0	0	0	**17.2**

Other Effects

Reduced Losses in Fisheries Due to Pollution

Agricultural runoffs, industrial and urban effluents 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 victims and the subsequent negotiations with the polluter and under the supervision of the local authorities.[6] Table 23 provides an estimate of the loss of fisheries due to these pollution accidents. Whereas the number of accidents appears inconclusive as to the effect of ICM in reducing their occurrences, the values of the losses have slightly dropped after 1996, or during the period when marine laws have been promulgated.

[6] *A better means of estimating the losses would be to estimate the amount of fish yield in each area affected, corresponding fish prices and other related information. It is assumed that the claims and the fines paid are equal to the quantity and value of the damaged fish yield or production.*

Impact on Human Health

Environmental quality improvements are expected to yield positive impact on the status of human health. In addition, the increase in income experienced by the households, in general, would translate to better access to health care. In the absence of concrete documentation on morbidity and mortality associated with water and air quality as well as red tide, this aspect was not quantified.

Impact on Employment

The change in resource use has also brought about changes in the employment structure. Inevitably, jobs were lost as a result of the removal of mariculture in certain places. The municipal government compensated these displaced workers, but it is not clear if they were able to find gainful employment or alternative means of livelihood after. While there would be new employment opportunities created in Xiamen, there is a distinct possibility of a job mismatch with the skills required and those possessed by those displaced. In this case, it would be difficult to assess if the gains in employment would suffice to compensate for the losses. Likewise, the removal of 'pollutive' industries in Gulangyu and Xiamen islands indicate that there are relocation costs for these manufacturing establishments and displacement costs on the part of the workers. Nonetheless, per capita income in Xiamen has increased over the years (Annex 4 shows the per capita income in nominal terms. This should be in real terms, but data was unavailable.).

Table 23. Loss of Fisheries Due to Pollution Accidents.

Year	Location	Reason of Accidents	Loss (million RMB)
1992 July	Huoshao Islet	Sewage discharged from shrimp pool	0.12
1994 August	Undetermined	Oil leak from vessel	0.33
1995 April	West Sea	Oil leak from vessel	0.50
1995 August	Haicang	Oil leak from chemical factory	0.16
1996	Xiamen Island	Chlorine leak from chemical factory	0.15
1997 January	Xinglin Bay	Pollution associated with increased density of mariculture	0.10
1998 July	West Sea	Sewage discharged from printing and dye factory	0.146
1999	Tong'an	Sewage	0.4
2001	Qingyu Sea route	Oil leak	0

Source of data: Xiamen Environmental Quality Report, (1991-1995), (1996-2000), Xiamen Environmental Situation Report, 2001, Xiamen Environmental Protection Bureau.

Management Outcomes: Enhanced Performance of Coastal and Marine Activities

9 Management Outcomes: Enhanced Performance of Coastal and Marine Activities

Xiamen has played a prominent part in the economic history of China as it has been one of the important coastal cities since the 17th century. From one of the five ports designated for international trade after the First Opium War, to being one of the first special economic zones created in the 1980s, Xiamen has become a modern city with an international seaport and scenic environment (ITTXDP, 1996).

Coastal Resource Uses

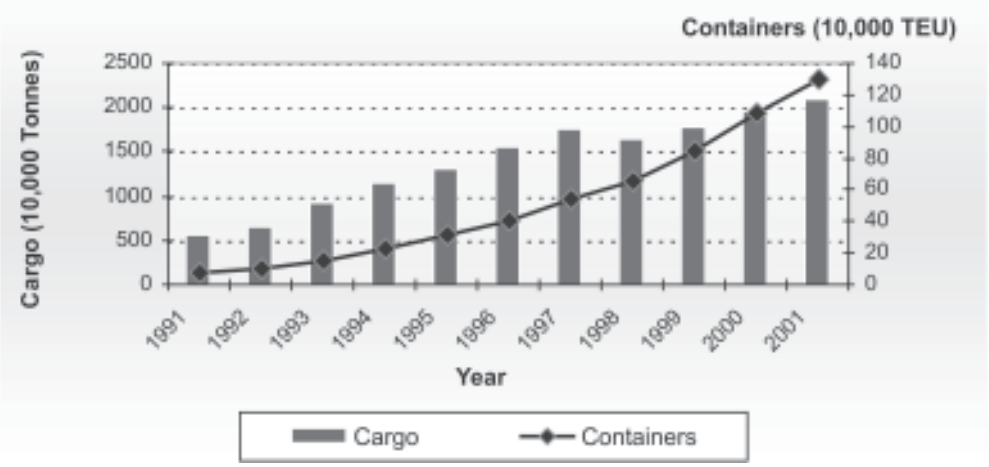
This section focuses on the ICM benefits in terms on increased efficiency and revenues from four key sectors: shipping, fisheries, tourism and real estate. The performances of the main economic sectors have been enhanced by the implementation of the functional sea-use zoning scheme. Zoning enabled better coordination and more efficient utilization of specific areas in the coast. Environmental monitoring, waste management and enforcement of regulations have been significant in enhancing productivity.

Port Operations and Shipping/Sea Transportation

Port services and shipping are foremost industries in Xiamen. Xiamen is an important port hub located along the route between Shanghai and Hong Kong. The coast line in the harbor area stretches for 30 km with water depth reaching up to 17 meters. Xiamen Port is a first-class port, is the 7th largest container port in China and ranks 40th among the world's Top 100. In 2002, the port handled 27.35 million tons of cargo and 1.75 million TEUs of containers. Port activities in Xiamen may have been historically vibrant, however, along with shipping and sea transportation, it expanded even faster in the late 1990s due to improvements in operations and increase in foreign capital. Xiamen Port has become a major international port. The volume of containers handled grew by as much as 30 percent (Figure 19). The world's top 20 shipping companies have set up their businesses in the city, establishing Xiamen as a major provider of shipment services. It services a total number of 57 shipping routes leading to almost all the major ports in the world and brings an average of 415 ship calls at the port each month. In 2001, revenues from shipping and port operations amount to RMB 6.3 billion and RMB 1.1 billion, respectively.

The port service industry includes more than 10 types of companies, such as loading and unloading, deposit, goods agency and land transportation. According to the Xiamen Port

Figure 19. Volume of Handled Cargo and Containers.



Bureau, in 2001 alone, more than a hundred foreign and domestic companies were involved in the various aspects of the industry.

Over 20 major domestic and international shipping companies operate in Xiamen Port and services over 50 international shipping routes. The records indicate that there are more than 250 sailings per month connecting 60 ports in 40 countries.

There are revenue data from the above industries but owing to the huge number of companies involved, it was not possible to directly obtain the costs in their operations. Hence, the earnings before taxes were estimated indirectly by applying the average selling profit rate before tax obtained from the Xiamen Sea Transportation Companies Association and from 20 sea transportation companies. The same procedure was applied to look into the performance of the port services companies. The absence of data for more appropriate cost measures necessitated the use of a proxy variable such as profit rate, which has its limitations. [7]

The following equation was used to estimate the earnings before tax:

$$EBT = PRT * R$$

where: EBT = net earnings before tax
R = revenue
PRT = selling profit rate before tax

As shown in Table 24, it becomes apparent that the profit rate of the port services have decreased. This is attributed to the increase in the number of domestic competitors as well as developments in the global market. Nevertheless, the revenue for the sector as a whole remained high and continually rises (Figure 20).

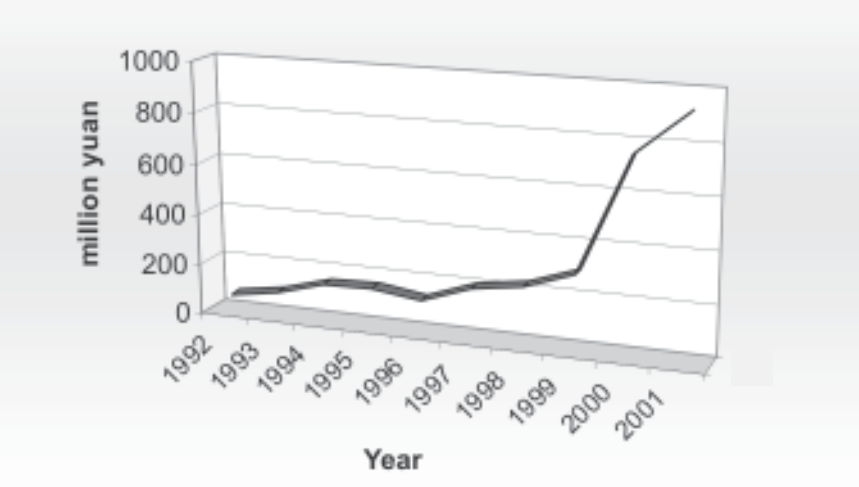
[7] *Since tax is simply a transfer, we use profit before tax as an indicator. In this simple procedure, and by definition of the selling profit rate, only the operating costs are covered. There was an attempt to obtain capital investment such as those to expand berths and cargo moving facilities but these were not available. Note that the costs used by private companies to compute their profit rates are most likely not pure economic costs and therefore, the net earnings before taxes are not a true reflection of total revenue – total cost in the strict economic sense. Since BCA should be based on economic efficiency utilizing pure economic values, then to the degree that these companies are using accounting instead of economic costs, these are only gross approximations and would likely need adjustment downwards.*

Table 24. Earnings of the Port and Sea Transportation (in million RMB).

Year	Sea Transportation				Port Service				Combined Revenue	Combined Cost	Combined EBT
	Revenue (million RMB)	PRT (%)	Cost (million RMB)	EBT (million RMB)	Revenue (million RMB)	PRT (%)	Cost (million RMB)	EBT (million RMB)	(million RMB)	(million RMB)	(million RMB)
	(1)	(2)	(3)	(4)=(1)*(2)	(5)	(6)	(7)	(8)=(5)*(6)	(9)= (1)+(5)	(10)=(3)+(7)	(11)=(4)+(8)
1992	146.43	14.00	125.93	20.50	114.50	44.20	63.89	50.61	260.93	189.82	71.11
1993	255.04	14.00	219.33	35.71	186.75	32.80	125.50	61.25	441.79	344.83	96.96
1994	408.21	14.00	351.06	57.15	280.74	35.82	180.18	100.56	688.95	531.24	157.71
1995	562.70	9.61	508.62	54.08	400.21	26.29	294.99	105.22	962.91	803.62	159.29
1996	784.52	3.71	755.41	29.11	410.25	26.20	302.76	107.49	1,194.77	1,058.18	136.59
1997	977.95	7.38	905.78	72.17	464.62	28.35	332.90	131.72	1,442.57	1,238.68	203.89
1998	1,025.58	10.85	914.30	111.28	555.73	22.06	433.14	122.59	1,581.31	1,347.44	233.87
1999	2,249.91	6.80	2,096.92	152.99	721.22	20.59	572.72	148.50	2,971.13	2,669.64	301.49
2000	4,524.88	12.69	3,950.67	574.21	922.25	20.29	735.13	187.12	5,447.13	4,685.80	761.33
2001	6,289.46	11.44	5,569.95	719.51	1,096.0	19.12	886.49	209.56	7,385.51	6,456.43	929.08

Source of basic data: Xiamen Port Bureau.

Figure 20. Net Revenues: Ports and Shipping Sector.



Recognizing that Xiamen's innate geographical advantage and the growth impetus experienced by the tradable sector have undoubtedly triggered the expansion in port and shipping operations, the estimates are not claimed as solely due to ICM. Nonetheless, ICM contributed in improving the port operations through the reduction of externalities associated with delays. At the same time, Xiamen is a more attractive port destination due to the effective zoning scheme, enforcement and interagency monitoring program, which are all related to ICM.

Fisheries Sector

Similar to typical coastal communities, fishing is a prime industry. Mariculture in shallow waters and tidal flats and capture fisheries are also major income sources in the coastal areas of Xiamen. In 2001, the mariculture area reached 171.38 km^2, which accounts for half of the total sea area. The value of fisheries output reached almost 46 percent of the total value of agricultural sector's output (Xiamen Ocean and Fisheries Bureau, 2003).

With the implementation of the functional zoning scheme, the location and utilization of specific areas were altered. In the case of West Sea, which used to be a main mariculture base, its dominant function had been switched to port and sea transportation. Similarly, the East Sea is now devoted to tourism. Fishery production fell in 1999 due to relocation of aquaculture farms from the East Sea to Jinmen coastal area, and a severe typhoon also hit the area, which created further devastation. As such, there was a decline in the revenue and output, although it is now on an uptrend (Figures 21 and 22).

As in the port and sea transportation industries, there was also a dearth of data on the expenditures involved in fishing. Hence, the same procedure used for that sector was employed to calculate the earnings before taxes for fishing. The initial step involved the estimation of the selling profit rate. Based on interviews of some people involved in mariculture, the average profit rate in the sale of marine aquatic products was around 25 percent from 1991 to 1995, but this decreased to 12 percent from 1996 to 2001.[8] Estimates are shown in Table 25.

Tourism Industry

Xiamen's tourism industry likewise benefited with the improvement of environmental quality and preservation of resources and enhancement of scenic spots. As a result, a growing number of local and foreign tourists flocked to Xiamen (Figure 23). As a tourist and recreation destination, Xiamen receives an average of 8 million visitors annually. In 2000, there were more than 7,350,400 domestic and 558,800 foreign tourists. While growth in tourism is mostly

[8] *In the approximation of the selling profit rate, inquiries with mariculture folk were undertaken. They have indicated that it was more profitable in the years prior to 1997 (i.e., the rate was about 20-30 percent before 1995 and about 10-15 percent after 1995). The results were subsequently verified with the officers of the Xiamen Aquatics Industry Association.*

Figure 21. Revenue and Output of Marine Fishery.

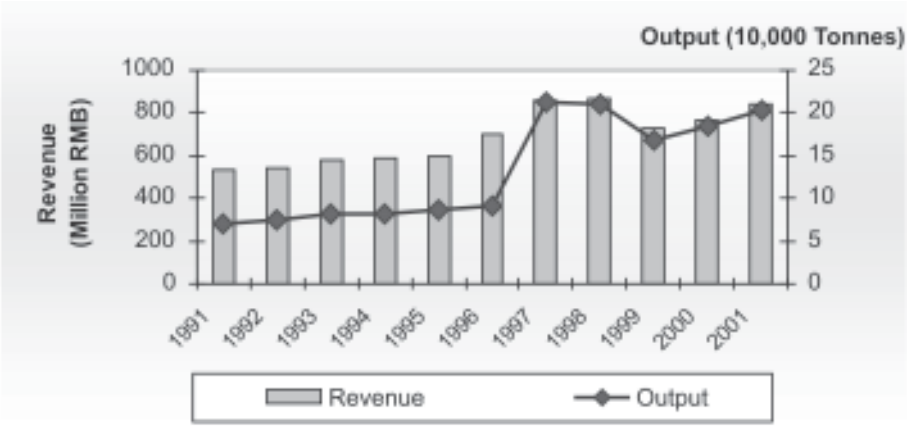


Figure 22. Net Revenues: Marine Fisheries.

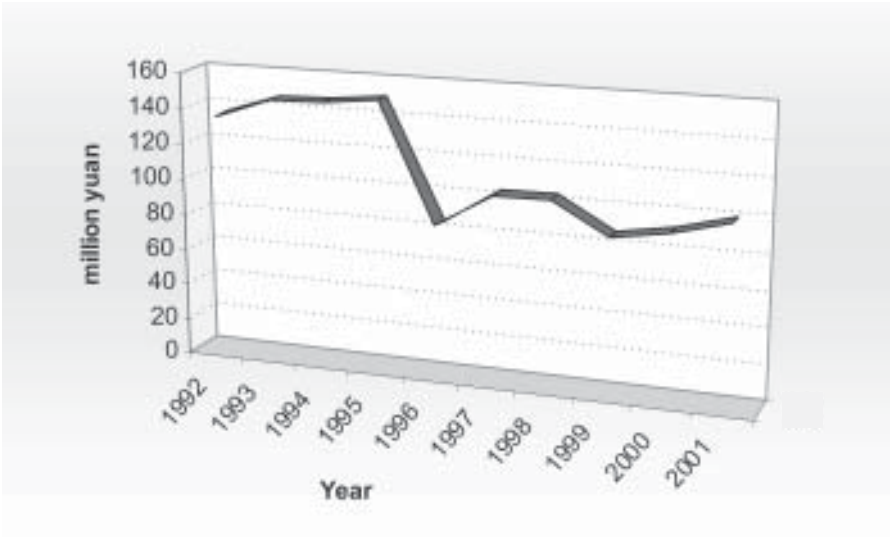


Table 25. Earnings of the Marine Fisheries Sector.

Year	Revenue (million RMB)	PRT (%)	Cost (million RMB)	Net Revenue (million RMB)
	(1)	(2)	(3)	(4)=(1)*(2)
1992	540.30	25%	405.23	135.08
1993	584.00	25%	438.00	146.00
1994	587.60	25%	440.70	146.90
1995	601.90	25%	451.43	150.48
1996	701.40	12%	617.23	84.17
1997	862.50	12%	759.00	103.50
1998	870.00	12%	765.60	104.40
1999	725.20	12%	638.18	87.02
2000	769.10	12%	676.81	92.29
2001	837.60	12%	737.10	100.51

Source of basic data: Xiamen Yearbook, 1993-2002.

accounted for by domestic tourists, there are a growing number of overseas guests. Xiamen's income from tourism reached RMB 15.81 billion in 2001. The tourist arrivals in 2001 reached 9.09 million, which is almost double that of the 1996 figure. While majority are still local tourists, foreign visitors grew by about 50 percent from 1996 to 2001 (from 0.26 million to 0.57 million). The income of tourism-related industries also grew in tandem with the increase of tourist arrivals (Figure 24).

To estimate the earnings before taxes from tourism, the data of tourism income and the selling profit rate was again utilized. Most of the information used was obtained from the Xiamen Tourism Bureau although interviews were also conducted with some hotels, travel agencies, transportation companies and operators of scenic spots.[9] The responses indicated that the average profit rate was between 20–25 percent before 1996 but this dropped to 15–20 percent after 1996. One can hypothesize that the profitability is affected by the increase in competition. The study of Zhu, et al. (2001) showed that the average selling profit rate is 20 percent and 15 percent before and after 1996, respectively. This average selling profit rate is used in the analysis as presented in Table 26. Net revenues from tourism are still increasing (Figure 25).

Real Estate and Property Sector

As the country's economy opened up, overseas Chinese were permitted to buy homes and live in Xiamen, the original target being Taiwanese pensioners and retirees. However, it primarily attracted real estate speculators who bought luxury flats and commercial spaces in the hope of selling them later for a tidy profit. Speculation caused a construction boom, and real estate prices in Xiamen rose. When the property bubble burst in 1997, the prices dropped.

With numerous construction and infrastructure taking place all over Xiamen, real estate projects have followed suit. As a result of limited land area on Xiamen Island, the available supply of commercial and housing spaces had difficulty meeting the growing demand. During the 9th Five-Year Plan, investments to real estate amounted to 33.98 billion RMB. By 2001, 2.82 million m^2 of commercial real estate projects were completed and over 90 percent of which have since been sold. Real estate development has been significant around Yuandang Lagoon and along the coast. Presently, the sector only contributes 5.8 percent of the city's GDP, but this is expected to rise even further.

[9] *There had been some statistical discrepancies in the revenue of the tourism industry before and after 1996. Prior to 1996, the revenue data only included expenses of tourists in meals, hotel accommodations and entrance fees to scenic spots. This coverage was expanded in 1996 to include expenses in local transportation, shopping and entertainment. As a result, the revenue data during the relevant years would be incomparable. Revenues should therefore be adjusted using data for average expenditures of tourists obtained from the Xiamen Tourism Bureau. Non-tourist related expenditures have to be deducted as well to separate out the value of the tourism services provided by the coastal and marine resources.*

Figure 23. Number of Tourists Visiting Xiamen.

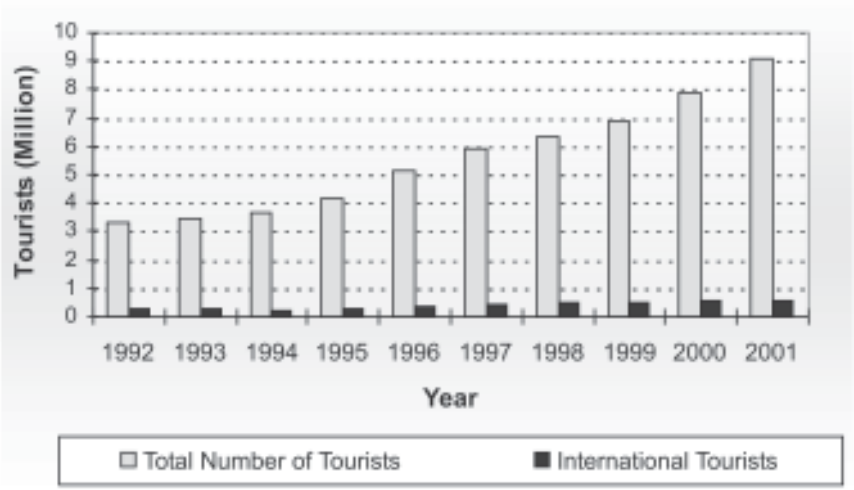


Figure 24. Income of Tourism Industry.

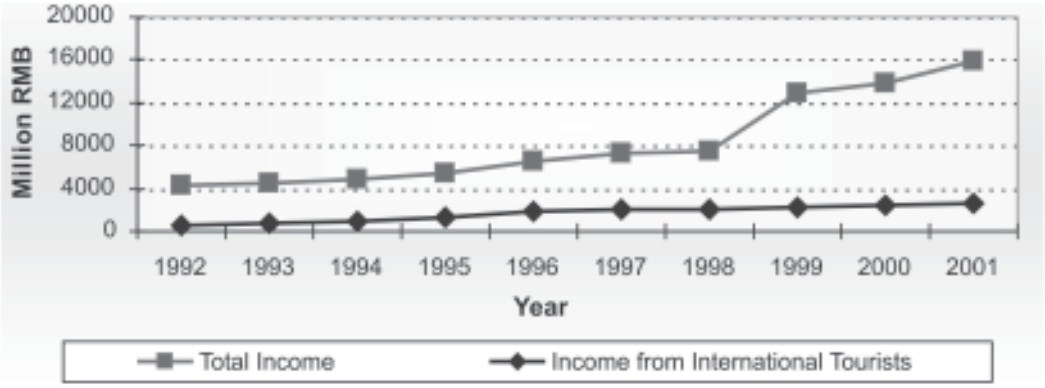


Figure 25. Net Revenues: Tourism Sector.

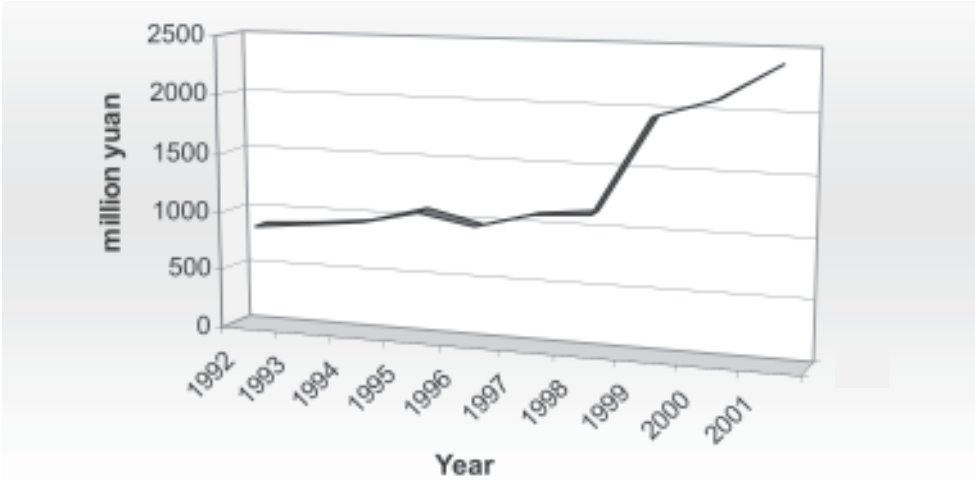


Table 26. Earnings of the Tourism Sector.

Year	Revenue (million RMB)	PRT (%)	Cost (million RMB)	Net Revenue (million RMB)
	(1)	(2)	(3)	(4)=(1)*(2)
1992	4,330	20%	3,464.00	866.00
1993	4,520	20%	3,616.00	904.00
1994	4,780	20%	3,824.00	956.00
1995	5,360	20%	4,288.00	1,072.00
1996	6,510	15%	5,533.50	976.50
1997	7,330	15%	6,230.50	1,099.50
1998	7,550	15%	6,417.50	1,132.50
1999	12,910	15%	10,973.50	1,936.50
2000	13,910	15%	11,823.50	2,086.50
2001	15,810	15%	13,438.50	2,371.50

Source of basic data: Xiamen Tourism Bureau.

The property sector has benefited from the improved environmental quality in Xiamen. One concrete example of the positive impact to real estate development is the case of Yuandang Lagoon (Box 2).

The success of Yuandang Lagoon serves as a model for the rehabilitation program being developed for Maluan Bay, the mariculture basin of Xiamen. Due to numerous fish cages and the draining of sewage in the area, it became the most severely polluted water in Xiamen. In the feasibility study for the bay's planned rehabilitation, real estate sales have been projected as a major source of revenue. The market for quality residential and commercial areas is an attractive venture given the high demand for these types of facilities and limited supply at hand. Some indicators to show trends in real estate development are shown in Tables 28 and 29.

The available information does not offer concrete indications if the areas affected by pollution have suffered loss of value. However, it is generally known that properties near polluted water bodies become undesirable and either lose value or do not appreciate. Long-time residents would attest to the cities transformation in the recent years (Brown, 2004). A GESAMP statement concerning marine pollution problems noted that improved environmental quality in the Thames River in England, Boston Harbor in the United States and Xiamen Harbor in China show that determined, coordinated action can produce benefits even in large urban areas, where development and population pressures are concentrated (GESAMP, 1998). From a drab and dirty city with poor infrastructure and services, Xiamen became one of China's model cities and received recognition worldwide, the latest being the UN Habitat Scroll of Honor Award in 2004.

Benefits to the Major Economic Sectors

Table 30 summarizes the estimated revenue values of the selected economic sectors. Ideally, it would have been better to know how each of the key sectors would have grown without ICM during the period 1994 to 2001, as these sectors would inevitably grow due to other factors but no data was available. The next best thing is to consider the existing growth rates, adjust these

Box 2. Yuandang Lagoon Cleanup.

The Yuandang Lagoon area has emerged as a center for international and domestic investment, tourism and residential development in Xiamen. More investments came in as investors chose Yuandang Lagoon as the site of their business for aesthetic reasons. A survey under the Xiamen ICM Demonstration Project found that over 53 percent of 173 investors located in the area listed "beautiful environment" as a major reason for their choice of investment location. Such investment decisions have resulted in an estimated US$1.23 billion in current value to the Xiamen economy (Hong and Peng, 2002). Although total investment for the cleanup project was high (around US$43.75 million for the two phases), enormous economic benefits have been realized upon completion of the project. According to a study by Hao and Peng (1998), the total cost of the project since the first phase was initiated in 1998 is estimated at US$135.5 million. The benefits, on the other hand, range from US$12 million to US$1.23 billion.

The direct economic benefits resulting from the project include land upgrading wherein 70 hectares of land was reclaimed and leveled. As a result of the improvement in the lake environment, land and house prices in the vicinity of the lake rose tremendously. At the average land price of US$240/$m^2$ range, the value of the total reclaimed land is roughly US$168 million, exceeding the total capital investment cost. The cleanup project also helped in improving the techniques for commercial use of biogas, sludge and recycling of wastewater.

In addition, the successful cleanup stimulated the awareness of the general public and various government departments on the importance of a healthy environment in enhancing urban economic development.

Table 27. Status of Real Estate Market of Xiamen.

Year/Item	1996	1997	1998	1999	2000	2001
Investment (Capital Costs) in Real Estate (billion RMB)	6.43	6.78	7.62	6.94	6.21	5.66
Construction Area of Commercial Estates (million m^2)	7.76	8.51	11.27	12.84	11.21	10.30
Completed Area of Commercial Estates (million m^2)	0.90	2.13	1.63	2.32	2.97	2.82
Volume of Sales of Commercial Estates (million m^2)	0.66	1.24	1.38	1.73	2.50	2.57
Gross Sales of Commercial Estates (billion RMB)	1.66	3.30	4.33	5.36	7.37	7.31
Volume of Sales of Dwelling House Estates (million m^2)	0.55	1.06	1.20	1.42	2.13	2.15
Gross Sales of Dwelling House Estates (billion RMB)				4.10	6.31	6.46

Source of basic data: Real Estate Trade Center of Xiamen.

Table 28. Estimated Value of Commercial Property.

Year	Sales of Commercial Estate (million m^2)	Gross Sales (million RMB)	Average Selling Price (RMB/m^2)	Average Cost (RMB/m^2)	Total Cost (million RMB)	Net Revenue (million RMB)
1996	0.66	1,656	2,509.09	828.61	546.88	1,109.12
1997	1.24	3,295	2,658.76	796.71	987.36	2,307.64
1998	1.38	4,330	3,137.23	676.13	933.20	3,396.80
1999	1.73	5,362	3,104.09	540.50	933.66	4,428.34
2000	2.50	7,372	2,950.69	553.97	1,384.04	5,987.96
2001	2.57	7,312	2,840.82	549.51	1,414.40	5,897.60

Source of basic data: Real Estate Trade Center of Xiamen.

Table 29. Estimated Net Benefits of the Economic Sectors (million RMB).

Year	Net Revenue of Port	Net Revenue of Sea Transportation	Net Revenue of Marine Fishery	Net Revenue of Tourism	Net Revenue of Property	Total Net Revenues	Annual Growth of Net Revenues	GDP Growth Rate	Growth Rate Attributable to ICM		Total Net Revenues Attributable to ICM
	a	b	c	d	e	f=a+b+c+d+e	$g_t=f_t-f_{t-1}$	h_t	$i_t= 1-h_t$	$j_t=g_t * i_t$	$k_t=k_{t-1}+j_t$
1994	100.56	57.15	146.90	956.00	—	1,260.61		0.27			1,260.61
1995	105.22	54.08	150.48	1072.00	—	1,381.77	121.16	0.23	0.77	93.29	1,353.90
1996	107.49	29.11	84.17	976.50	1,109.12	2,306.38	924.61	0.15	0.85	785.92	2,139.82
1997	131.72	72.17	103.50	1,099.50	2,307.64	3,714.53	1,408.15	0.18	0.82	1,154.68	3,294.50
1998	122.59	111.28	104.40	1,132.50	3,396.80	4,867.57	1,153.04	0.15	0.85	980.09	4,274.59
1999	148.50	152.99	87.02	1,936.50	4,428.34	6,753.35	1,885.78	0.15	0.85	1,602.91	5,877.50
2000	187.12	574.21	92.29	2,096.50	5,987.96	8,928.08	2,174.73	0.15	0.85	1,848.52	7,726.03
2001	209.56	719.51	100.50	2,371.50	5,897.60	9,298.68	370.60	0.12	0.88	326.13	8,052.15

using the growth rate of GDP, and attribute the rest of the growth to ICM. The estimated percentage of growth rate was used in estimating the amount of net revenues that can be attributed to ICM. This simplistic (and heroic) assumption is most likely to exaggerate the role of ICM in Xiamen's growth as the individual sectors could have performed better for other reasons, but this is beyond the scope of the study. The impressive growth in the tourism and real estate sectors, however, has much to do with the improvement in the environmental state of Xiamen. The functional zoning system, which was established through the ICM program, resulted in 'controlled' but much more sustainable development. The reduction in use conflicts has likewise reduced the delays in the shipping industry, thus improving this sector's performance and productivity. It can also be observed that despite the drop in net revenue in some years for the marine fisheries sector, overfishing was reduced, compensated by growth in other sectors.

Management Outcomes:
Change in Attitudes and Perception

10 Management Outcomes: Change in Attitudes and Perceptions

Xiamen officials realized that negative environmental consequences would create serious discord and ultimately threaten the city's future economic growth. Perception changes occur when people are convinced of the values and significance of ICM initiatives (Hallak, 1990). Public participation in environmental protection of Xiamen has improved through awareness programs starting in 1994 with the publication of *The Sea and Xiamen* and *We Own the Sea,* a compilation of Xiamen's public awareness articles on marine environment. A video and a marine educational program for all ages were later developed. The successful rehabilitation of Yuandang Lagoon stimulated the awareness of the general public and various government departments on the importance of a clean environment in enhancing urban economic development.

With the information, education and awareness campaigns, the various stakeholders have been encouraged to participate in the various ICM related activities. Consequently, the people of Xiamen were willing to pay positive amounts of yuan for resource and environmental goods and services, based on a survey using the contingent valuation method (CVM) conducted in July 1998, four years after the start of the ICM program implementation. As such, the perception and attitude changes could have led to stronger political commitments and allocation of financial resources for resource protection and environmental management projects. The ICM and awareness-building activities also facilitated the participation of other stakeholders in the decision-making process. Public consultations were conducted for the establishment of nature reserves for the endangered species and for the construction of Round-the-Island road. Tree-planting activities and mini-summer camps were also conducted.

CVM is an approach that can be used to derive people's demand and estimate the value they place for 'hypothetical' goods and services. It provides a means of assigning monetary values to resources and service flows that are unpriced or under-priced by the market. The CV survey undertaken in Xiamen in 1998 was primarily to determine people's support, priorities and WTP for resource and environmental management programs. With close to 1, 500 respondents, the factors affecting WTP include monthly income, level of educational attainment and place of residence. Additional information regarding the conduct and design of

Tree-planting day: 12 March 2000

the CVM survey is found in Annex 5 while Table 30 summarizes the results obtained from the survey.

If WTPs are the gauge for what environmental program should come first, then in Xiamen, the utmost importance is attached to sewage. Residents hope that they can contribute to maintaining Xiamen's reputation as a model city for environmental protection and economic development. The residents of Xiamen also exhibited a high degree of awareness and concern for endangered species. The survey also indicated a wide support for different environmental projects and that the citizens prefer integrated programs with clear expected outputs. Over 90 percent of the respondents recognize the high cost of the extinction of egrets and dolphins and are in favor of setting up of preservation zones. A similar concern for the recreational sites was put forward by those surveyed, wherein the majority have taken part in beach cleanup and other activities designed to protect beaches.

Nature-Based Recreational Sites

The nature-based recreational sites became very popular in the past decade. Results of the survey using CVM showed that people in Xiamen are willing to pay, on average, 47 RMB per month per person for the preservation of endangered species and 77 RMB per month per person for the beach areas (Abansi, 1999). The number of public gardens rose from 20 in 1993 to 36 in 2001 with total area increasing from 168 ha in 1993 to 451.4 ha in 2001. The area allocated to public green land also tripled from 1993 to 2001. Public access to beach areas was also made possible. Coastal roads were constructed, giving commuters a scenic view of the coast and sea. Table 31 traces the growth of public recreational sites.

Valuation of Environmental and Nature-Based Services

Table 32 shows the value of environmental services using WTP for sewage treatment or water quality improvement, the value of direct nature services using WTP estimates for beaches and endangered species, and extrapolating WTP estimates using population and income adjustments (1998-2001). The most notable improvement in water quality so far is in Yuandang

Table 30. Average WTP for Environmental Goods and Services.

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

Source: Abansi, 1999.

Table 31. Nature-Based Public Recreational Sites.

	Unit	1993	1994	1995	1996	1997	1998	1999	2000	2001
Number of Public Gardens		20	25	29	30	31	31	31	36	36
Garden	ha	168	233	375	408	428.4	433.4	443.4	451.4	451.4
Scenic Spots	km^2	2.7	2.8	4	246	245	246	246	246	246
Green Land	ha	1,158	1,335	2,044	2,286	2,439	2,573	2,713	2,993	3,194
Public Green Land	ha	204	288	424	471	537.8	559.4	596.7	654.6	676.5
Rate of Urban Greening	%	25.9	26.3	33.17	33.61	35.41	35.15	35.42	35.77	34.94
Number of Sandy Beaches		5	6	7	8	8	14	14	14	14

Source of data: Xiamen Year Book, 1993-2002.

Table 32. Gross Benefits from Environmental Quality Improvement and Resource Protection (million RMB).

Year	Water Quality	Beach	Endangered Species	Total
1998	29.08	673.90	106.51	809.49
1999	29.22	673.81	108.17	811.20
2000	30.97	697.14	112.99	841.10
2001	33.12	708.32	117.12	858.56

Lake. The water quality in the lake has changed from nitrogen-rich to boatable water. The gross benefit of improved water quality is calculated as individual's WTP for sewage treatment or boatable water times the total number of users of the lake.[10]

The benefit of sandy beaches is the major component in the total benefits associated with various nature-based recreational sites. The gross benefit of sandy beaches for each year is the total WTP by all users for the total number of beach days in that year.[11] The sharp increase in benefit estimates in 1998 reflects expansion of total beach areas, resulting from the integrated treatment and development of the east coast of Xiamen Island (Ou and Yang, 2001).

The gross benefit associated with protecting endangered species is computed as individual's

[10] *Residents of Xiamen Island were used as the proxy of the users.*

[11] *In this case, the number of beach days is a function of the number and size of beaches.*

WTP times the total number of stakeholders of these species.[12] WTP is also adjusted for the level of protection in a specific year, since the nature reserves for different species were set up over several years.

As often said, WTP figures should be considered with a grain of salt. While it may be an indicator of the affected sector's openness to the imposition or increase in fees, it is subjective and requires further evaluation. In particular, the concern that CV surveys do not require respondents to make actual payments has led critics to argue that responses to CV surveys are biased because of the hypothetical nature of the goods.

[12] *We use the total population of Xiamen as the number of stakeholders. In fact, the stakeholders of endangered species may not be limited to the people in Xiamen.*

Conclusion and Recommendations

11 Conclusions and Recommendations

Based on the foregoing, ICM provides benefits that outweigh the costs. Despite the absence of comparable information, the results provide an initial estimate of the benefits of ICM. The indicators used for quantifiable and non-quantifiable benefits and costs of ICM in the case of Xiamen are presented in Table 34. The short period of time covered in the study affected the results as most benefits of environmental projects tend to be realized in longer time horizons. The gains will undoubtedly grow even more in the years to come. Nevertheless, the *ex post* analysis of the first phase of ICM in Xiamen (or *in medias res* analysis since Xiamen is undertaking the second cycle or phase of ICM) contribute to "learning" by government managers, politicians and academics about the effectiveness of the ICM approach for sustainable development of the coastal and marine areas as well as the broader socioeconomic benefits that are being generated. This study, albeit its limitations, provides directions for future research on this area.

There are valuable gains in administering an integrated management program. In a centralized system of government, it was unique for Xiamen to implement a program that relies heavily on multisectoral participation. A number of institutional and procedural changes enabled the socioeconomic improvements to take place. The success of ICM in Xiamen owes much to the organizational framework established. It contributes to promotion of long-term economic interest rather than short-term ones that can have negative impacts on the environment. The benefits where monetary values are available are presented in Tables 33 and 34. The present value of net benefits from 1995 to 2001 amount to more than RMB 27 billion (or US$3.3 billion at the exchange rate of US$1 = RMB 8.266).

The close interaction between the policymakers and the scientific community strengthened decisionmaking. Through extensive collaboration, monitoring networks have been optimized. In having a coordinating body orchestrating all coastal and marine related tasks, Xiamen also gained in terms of the following:

- better understanding stakeholders;
- improved public awareness of the importance of the coastal resources;
- improved decisionmaking;
- reduced multiple-use conflicts;
- better agreement on coastal development priorities;
- identification of more sustainable tourism requirements; and
- improved spatial planning.

ICM contributed by way of providing an investment climate conducive to private sector participation in the provision of environmental goods and services. As such, private investments in the areas of sewage and solid waste facilities have been growing. This has decreased risks from pollution and red tide occurrence. Other externalities caused by the design and construction of causeways and coastal roads, intensified coastal land use, reclamation, sand quarrying, beach and cliff erosion, delays in shipping due to conflict with

mariculture activities, and intensified fishing and mariculture have been addressed as well.

Public participation in environmental protection of Xiamen has likewise improved due to awareness-building programs, such as the publication of articles on marine environment, video and tree planting, and through marine educational program. A WTP survey conducted in 1998 showed that the people of Xiamen value the preservation of endangered species, and the government has set up preservation zones. A similar concern for beaches and nature-based recreational sites was put forward by those surveyed, majority of them have taken part in beach cleanup and other activities designed to protect beaches. In addition, capacity-building activities brought about the exchange of experiences and development of partnership for the increased awareness on the applications and uses of ICM. These led to the development of a social constituency for ICM based on the realization of common community benefits and their contribution to poverty alleviation resulting from the reduction of coastal and marine resource damages.

While it is apparent that funding might pose as an initial constraint to the adoption of ICM as an environmental management program, local governments can start small and work their way up by adding programs as they build up capability and confidence. Alternatively, they can look into means to pool funds and tap other sectors for support to ensure sustainability. Sustainability is a key concern if full benefits of ICM are to be realized. This not only involves identifying perennial sources of funding, but perhaps more importantly, establishing a permanent management structure. Xiamen succeeded on this crucial aspect. Even perhaps more significantly are the unquantified benefits (i.e., other socioeconomic benefits not covered by the valuation) which includes organizational and planning improvements leading to savings in public funds, long-term gains due to sustainable business opportunities, change in human behavior and institutional frameworks, positive health impacts, 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).

Caveats

The assessment is hounded by difficulties in establishing cause-effect relationships and attributing outcomes to specific program actions. For example, the tourism, fisheries and shipping sectors have greatly benefited from ICM — through the coastal and sea-use plan, interagency coordination mechanism, legislation and enforcement, and investments in environmental infrastructure and habitat and resource protection — but how much of the growth can be attributed to ICM is open to contention, since other factors such as sound macroeconomic, investment and trade policies, and global demand also play a large role in the impressive growth of Xiamen.

In the absence of a well-developed methodology and/or data for relevant indicators, one has to rely on professional judgment. As such, it becomes vulnerable to criticism typical of value judgments. However, this initial attempt can be of use in demonstrating what has been achieved in Xiamen and support the development of ICM elsewhere. At the same time, results generated bring about important information concerning a key cluster of costs and benefits that would otherwise remain vague or ignored and left out of the decisionmaking process.

There are also costs related to the tradeoffs among the different activities that were affected

by the institutional reforms and other ICM projects. For example, with the execution of coastal and water-use zoning scheme, production and revenues from fisheries decreased during the period of relocation and reduction of area for mariculture activities. Although fisheries production eventually increased with the reduction of multiple-use conflicts and the improvement in water quality, the social costs associated with displacement and loss of jobs/ livelihood for fisherfolk and aquaculture workers are not covered in this study. Likewise, "pollutive" industries have been removed from Gulangyu and Xiamen islands, and the cost of relocation of manufacturing establishments, and the dislocation of workers were not estimated.

The study brought forth the importance of gathering baseline information as part of the ICM initiative. There is a variety of valuation methodology at hand, but they require substantial information. The dearth of data available at the site and/or inaccessibility of data hampered the conduct of the study and the limited information had been unable to capture all the aspects of benefits and costs of ICM. In addition to the data for the Coastal Environmental Profile (which is done at the onset of ICM), it is recommended that baseline information related to the valuation of benefits and costs of ICM be collected at the onset to facilitate the assessment of how effective the ICM program will be to other sites adopting it. A socioeconomic mapping should be included in the Environmental Profile of the ICM site. PEMSEA developed the IIMS to facilitate gathering of necessary data, processing and storing these data, and accessing these data to provide support to decisionmaking in the PEMSEA ICM sites. Xiamen and other ICM sites can benefit from using IIMS.

The findings of the study, despite its limitations, still augur with the call for support for the replication and implementation of ICM among the local governments in the East Asian Seas region.

Recommendations

The constraints faced in the conduct of the study, which originally intended to do a benefit-cost analysis of ICM, highlighted the need to establish baseline information, for both the households and the community. While these are tedious and time-consuming, they are necessary. Information collected at the onset of any coastal resource management program will not only provide managers and policymakers an understanding of the people affected, but also better means to assess trends/changes and provide input to decisionmaking. The Coastal Environmental Profile of Xiamen provided the baseline information for environmental indicators, institutions and economic activities, but it lacked quantification or monetized data on use and non-use values and threats. A socioeconomic mapping should also be included in the Coastal Environmental Profile. Income per capita should be in real terms, and the indicators for economic activities should include the 'Gross Value-Added' figures, also in real terms. Similarly, availability of time-series data will allow for future comparison of how a management intervention program has been performing.

A monitoring and evaluation system with a corresponding set of indicators need to be put in place during the planning stage of the ICM program and data on these indicators should be regularly collected and monitored. Annex 1 provides a list of environmental, socioeconomic and governance indicators associated with ICM. Criteria, however, should be established for the selection of the most useful and applicable indicators for the ICM site, onset of ICM implementation, select indicators corresponding

Table 33. Quantified Benefits and Costs.

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.*

Table 34. Environmental and Socioeconomic Benefits of ICM (1995-2001).

	Present Value (in million RMB)
Economic Sectors (adjusted net revenues)	26,292.71
Direct nature and environmental services	2,974.48
Less: Externality costs	129.46
Less: Cost of environmental infrastructure	1,711.69
Less: Investment in preservation zones	8.16
Less: ICM Program cost	52.32
Total net benefits	**27,365.56**

** Discount Rate: 4.5%*

to the activities that will be undertaken in the site and their expected outputs and outcomes. Table 36 shows which of the indicators have corresponding data and values of benefits and costs in the case of Xiamen. In addition, non-quantifiable benefits and costs should also be documented, so that even descriptive analysis can be included in the ICM impact assessment report.

To supplement the study, a socioeconomic impact assessment can also be undertaken to examine how a proposed development will change the lives of the current and future residents of the community.

As BCAs are primarily undertaken *ex ante*, sites that are considering developing and implementing their own ICM programs, or any other variants of coastal management initiatives, may want to undertake a BCA. Given a set of mutually exclusive intervention packages, it is necessary to demonstrate the superiority of a specific intervention relative to the others, including status quo. It involves a clear definition of the various scenarios and the desired changes with corresponding measurement indicators, physical estimation and valuation of the impacts to get the benefits, and estimation of the costs of achieving the desired changes.

For the benefits, there are a number of methods that can be applied. Various methods often address different subsets of total benefits and use of multiple methods would enable a comparison of alternative measures of value. On the other hand, the total social cost is the sum of the opportunity costs incurred by society due to the policy. Costs can be classified in terms of:

- real-resource compliance costs;
- government regulatory costs;
- social welfare losses; and
- indirect costs

In designing the BCA, the following need to be considered:

- the scale and relative magnitude of direct policy effects and the potential of such effects to lead further indirect and secondary effects;
- level of integration of affected industry sectors and potential for impact on related markets;
- the degree to which equity considerations are of concern, given the likely divergence between those who would gain and those who would lose;
- the relative significance of both environmental and human health effects, where this includes both the negative and positive effects of the policy;
- the inter-relationship with other policies and policy areas; and
- the timing and duration of policy measures.

Table 35. Selected Indicators of Benefits and Costs Associated with ICM in Xiamen.

	Indicator	Monetary Value
INPUTS		
ICM program cost	✔	✔
Instrumental Outcomes		
Improved coastal governance		
• Legislation and enforcement mechanism	✔	X
• Coastal and sea-use zoning plan	✔	X
• Users fee and permits system	✔	X
• Inter-agency and intersectoral coordinating mechanism	✔	X
• Integrated environmental monitoring system	✔	X
Investment in environmental infrastructure (costs)		
• Wastewater and solid waste management system	✔	✔
• Redesign of causeways	✔	X
• Coastal roads (construction, design, and modifications)	✔	X
Investment in preservation zones (costs)	✔	✔
OUTPUTS AND OUTCOMES		
Management Outcomes		
Enhancement of institutional capacity	✔	X
Institutional and procedural improvements		
• Coordinated decisionmaking	✔	X
• Stakeholder/community participation	✔	X
• Rational spatial planning	✔	X
• Filing and resolution of cases	✔	X
• Reduced multiple-use conflicts	✔	X
Increase in level of public awareness	✔	X
Change in attitudes, behavior and perception	✔	✔
Reduction in externality costs		
• Reduced delays in port and shipping operations	✔	✔
• Treatment of eroded areas (beach and cliff areas)	✔	✔
• Dredging of silted areas	✔	✔
• Reduced losses of fisheries due to decreasing oil spill incidents and other pollution accidents	✔	X
Environmental services (benefits)		
• Improvement in air quality	✔	X
• Improvement in water quality	✔	✔ /1
• Improvement in health	X	✔ /1
Direct nature services (benefits)		
• Increase in nature-based recreational sites	✔	✔ /1
• Preservation zones for endangered species	✔	✔ /1
Increased output and revenue of economic sectors (benefits)		
• Port and shipping	✔	✔
• Marine fisheries and aquaculture	✔	✔
• Tourism	✔	✔
• Real Estate/Property	✔	✔
• Other sectors	X	X
Effects on employment	X	X
Increase in per capita income	/2	/2

Note:

✔ *- data available*

x - no data

/1 - valued using WTP estimates

/2 - available data on GDP per capita are in nominal terms

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Annexes

Annex 1

Selected Environmental, Socioeconomic and Governance Indicators

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
Coastal zone extent and characteristics	Coastal zone extent: - land area - sea area - coastline	x	x	x
	Demographics: - total population - population density - population growth - age-sex structure	x	x	
	Coastal population: - % population living in coastal area - population within 100 km of coast - coastal population density - coastal population growth	x	x	
	Population coastal hazard area		x	x
	Natural vs. altered land cover within 100 km of coastline	x	x	x
	Coastal erosion extent	x	x	
	Area of land owned by public/government	x	x	x
	Public access areas	x	x	x
	Area of protected coastal areas and marine protected areas	x		x
	Quality of coastal landscape	x	x	
	Unemployment rates		x	
	Main sources of income and livelihood		x	
	Literacy and educational levels		x	
	Perceived 'quality of life'		x	
	Availability of affordable housing		x	
Biodiversity	Coastal and marine habitats - dune vegetation - mangroves - mudflats - seagrass beds - intertidal reef - coral reef - sandy beach and rocky shores - etc.	x		x
	Area of coastal and marine habitats	x		x

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
	Percent cover of habitats	x		
	Species inventory of habitats	x		
	Rare, endangered, threatened and/or protected coastal and marine species	x		
	Condition (composition, structure and biotic interactions of populations)	x		x
	Threats to habitats, ecosystem structure, resources and species	x		
	Disturbance of benthic communities	x		
	Alien, exotic and invasive species	x		
	Landscape context (dominant environmental regimes influencing composition of populations and the connectivity between populations and environment)	x		x
Water Quality	Pollution inputs - amount of pollutant loading to coastal systems	x		x
	Ecosystem effects (consequences of changes in water quality in terms of coastal resources)	x		x
	Physical parameters: - salinity - turbidity - temperature - pH - sedimentation	x		
	Solid waste parameters: - accumulation on beach - dumping at sea - disposal density at sea	x		
	Eutrophication parameters - nutrient levels - dissolved oxygen - chlorophyll-a levels - algal bloom events - red tide occurrences - occurrence of hypoxic zones - etc.	x		
	Coliform - total coliform levels - fecal coliform discharges and levels in water column - fecal coliform in fish and shellfish tissue	x		

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
	Pathogens, biotoxins, and disease agents - discharges and levels	x		
	Heavy metal and persistent organic pollutants parameters - discharges of heavy metals - heavy metals in sediments - bioaccumulation in organisms	x		
	Halogenated organic compounds - discharges and levels	x		
	Oil and grease - discharges and levels	x		
Global Processes	Sea surface temperature variability	x		
	Sea level changes	x		
Fisheries	Major target fish species (commercial and recreational)	x	x	
	Total annual catch: size and numbers	x	x	
	Annual catch per target species	x	x	
	Fishing methods/gears used and fishing effort	x	x	
	Level of overfishing - MSY - MEY - catch per unit effort	x	x	
	Change in species composition	x		
	Level of by-catch or incidental mortality	x	x	
	Illegal and destructive fishing - blast or dynamite fishing - poison or cyanide fishing - trawling - etc.	x	x	
	Aquaculture and mariculture annual production	x	x	
	Shellfish and mollusks - major species - catch/production per major species	x	x	
	Seafood quality - contaminants in fish and shellfish	x	x	
	Percentage of household income derived from fisheries and aquaculture		x	

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
Tourism	Tourism intensity - total tourist arrivals - number of tourists per km of coastline - visitor recreational days - number of tourists during peak season	x	x	
	Coastal recreation - type of recreational activities (land-based and water-based) - facilities	x	x	
	Value of tourism - revenues - costs (capital and operating and maintenance) - daily expenditures for coastal and recreational activities		x	
	Number of hotels, guest houses, etc.		x	
	Public areas and access points to beach and waterfront recreational facilities	x	x	
	Importance of tourism to the local and national economy		x	
	Trends in the use of the coastal zone in relation to economic value		x	
	Employment in the coastal tourism sector		x	
	Equitable distribution of tourism benefits – leakage of tourism revenues		x	
Shipping	Ports - number and location - port/harbor equipment ratio - shore reception facilities	x	x	
	Amount of shipping traffic - passenger ships - cargo ships	x	x	
	Navigational lanes	x		
	Value of port and shipping sector - revenues - costs (capital and operating and maintenance)		x	
	Employment in the ports and shipping sector		x	
	Importance of shipping industry to the local and national economy		x	

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
Oil and Gas	Oil tanker traffic ratio	x	x	
	Oil spill contingency plan			x
	Oil spill - frequency - location - volume of oil spilled	x	x	
	Oil and gas exploration	x	x	
	Oil and gas mining	x	x	
	Oil and gas pipelines	x	x	
	Petroleum refineries and depots	x	x	
Other Economic Activities	Eco-tourism - sites - facilities - revenues or income - capital and annual operating and maintenance cost - number of visitors - daily expenditures	x	x	
	Seaweed culture/production	x	x	
	Shipyard: ship building and repair	x	x	
	Other coastal and marine activities	x	x	
	Value of and employment in coastal and marine activities		x	
	Community-based alternative livelihood		x	x
	Income of communities from community-based alternative livelihood		x	
Coastal Community Development	Environment, land use and sea use - nature/types of development in the coastal area - artificial coastline/ total coastline - extent of human settlements and industry in the coastal area	x	x	x
	Economic - economic diversity and positive/negative growth - diversity of industrial base on the coast - proportion of development projects taking place in brownfield land as opposed to greenfield land	x	x	x

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
	Social - engagement of communities, civil society groups and private sector - partnership arrangements between government and private sector		x	x
	Investment and infrastructure - public investment levels - types of infrastructure development - alignment of investments and incentives - private sector investment rates and levels		x	x
Public Access Areas	Legal availability: legal mechanism ensuring public access		x	x
	Area by type			
	Access points: - types of physical access - areas of access points	x	x	x
	State of public access areas and surrounding environment	x	x	
	Usability of public access points		x	
	Quality of experience		x	
Service needs and provision	Number of facilities and percentage of population served		x	x
	Health		x	x
	Education		x	x
	Welfare		x	x
	Housing	x	x	x
	Water and sanitation	x	x	x
	Electricity	x	x	x
	Sewage and wastewater treatment	x	x	x
	Rain/storm water drainage	x	x	x
	Solid waste management	x	x	x
	Roads, airports, harbors and railways		x	x
	Telecommunications and postal service		x	x
Coastal Dependent Uses	Types of uses	x	x	x
	Net benefits from each type of use		x	x
	Trends in economic development		x	x
	Planning and management mechanism - planning and policymaking agencies - authority to enact laws and ordinances to protect public health, safety and welfare		x	x

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
Public information and awareness	Public awareness of coastal and environmental issues		x	x
	Public awareness of sustainable development		x	x
	Public awareness of ICM		x	x
	Types of information transfer and medium used		x	
	Mechanism for public opinion on coastal and marine environmental issues			
	Public education programs		x	x
	Coastal profiles			
Community Participation and Stewardship	Mechanisms for public participation and extent of mobilizations			x
	Number of people involved in ICM, and resource and environmental management program activities and extent of participation		x	x
	Business/private sector participating		x	
	Participation in volunteer activities that protect/restore and enhance coastal habitats and resources		x	
	People involved in stewardship organizations and activities		x	x
	Level of personal involvement in community groups		x	
Waterfront Revitalization	Amount of citizen time and cash/in-kind donations to coastal management activities		x	
	Number of participants/ volunteers contributing time to activities associated with waterfront revitalization		x	
	Public expenditures for waterfront infrastructure/ facilities		x	x
	Public expenditures for waterfront communities		x	x
	Private sector investment in waterfront infrastructure/ facilities and communities		x	
	Percentage of (deteriorated) waterfront revitalized		x	x
	Number of community goals and objectives achieved		x	x

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
Coastal Hazards	Types of coastal hazards and frequency of occurrence	x	x	x
	Vulnerability - population in coastal high hazard areas - property in high hazard areas - land use and transportation		x	x
	Level of awareness of coastal hazards		x	x
	Emergency response plan	x	x	x
	Emergency evacuation shelter demand and capacity		x	x
	Restoration and recovery	x	x	x
	Mitigation measures	x	x	x
	Land acquired for hazard mitigation	x	x	x
Health	Waterborne diseases	x	x	x
	Diseases and infirmities associated with contaminated water, fish and other species	x	x	x
Institutional Structure and Capacity	Progress in ICM initiatives-management plans formulated, adopted and implemented			x
	National and local government capacity and commitment - number of ICM sites - number of government-funded ICM sites - institutionalization of ICM program and staff - staff trained in ICM program implementation - education and training programs			x
	Interagency and intersectoral coordinating mechanism for ICM and coastal and marine affairs			x
	Implementation of ICM plans and activities			x
	Implementation of integrated land- and sea-use plan			x
	Implementation of environmental and resource monitoring			x
	Use of information management system for data gathering, processing, storage and retrieval, and for support to policymaking and decisionmaking			
	Use of RA, EIA/IEIA and SEA procedures for coastal areas	x	x	x

ICM Characteristics	Indicators	Environment	Socioeconomic	Governance
	Use of economic incentives to apply clean technologies, conserve resources, and implement 'polluters pay' principle		x	x
Policy Development	National ICM legislation			x
	Policies and legislation addressing the management of coastal and marine areas			x
	Rules and regulations embodied in laws and ordinances			x
	Formulation of land and water-use and siting plans and policies			x
	Policy studies			x
Monitoring and Evaluation	Monitoring and evaluation system			x
	Use of coastal indicators			
	Participation of stakeholders in monitoring and evaluation			x
	Usage of monitoring and evaluation results			x
Development Funding	Level of financing from donor agencies, multilateral institutions and other international financing institutions		x	x
	Financing instruments used		x	x

Source: International Oceanographic Commission - UNESCO (2003). A Reference Guide on the Use of Indicators for Integrated Coastal Management, ICAM Dossier 1, IOC Manuals and Guides, no. 45. UNESCO.

Annex 2

PROC National Surface Water Environmental Quality Standards

**Unit: mg/L unless otherwise noted*

Item	National Standard Classes				
	I	II	III	IV	V
pH (standard units)	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–9
Copper, total	<0.1	1	1	1	1
Zinc, total	0.05	1	1	2	2
NH_3-N	0.02	0.02	0.02	0.2	0.2
CODMn	2	4	6	8	10
Dissolved Oxygen	90% saturation	6	5	3	2
BOD_5	<3	3	4	6	10
Chromium VI	0.01	0.05	0.05	0.05	0.1
Lead, total	0.01	0.05	0.05	0.05	0.1
Volatile phenol	0.002	0.002	0.005	0.01	0.1
Petroleum	0.05	0.05	0.05	0.01	0.1
Coliform(MPN/L)	200	2,000	10,000	20,000	40,000

Source: State Environmental Protection Agency, Surface Water Quality Standard, GB 3838-2002.

Note:

The water bodies are divided into five classes according to the utilization purposes and protection objectives. The water bodies with various functions are classified based on the highest function, and those with seasonal functions may be classified by seasons.

- *Class I* is applicable to water from its sources, and the national nature reserves.
- *Class II* is applicable to first class protected areas for centralized sources of drinking water, the protected areas for rare fishes, and the spawning fields of fishes and shrimps.
- *Class III* is applicable to second class of protected areas for centralized sources of drinking water, protected areas for the common fishes and swimming areas.
- *Class IV* is applicable to the water areas for industrial use and recreation, which are not directly touched by human bodies.
- *Class V* is to the water bodies for agricultural use and landscape requirements.

Annex 3

Sea Water Quality Standards

*(Unit: ml/L unless otherwise noted)

Item	Category 1	Category 2	Category 3	Category 4
Floating matter	No oil film, floating foam and other debris on water surface			No obvious oil film, floating foam and other debris on water surface
Color, Odor, Taste	No abnormal color, odor and taste should be present in sea water			No disgusting color, odor and taste should be presented in sea water
Suspended matter	Man-made increment < 10		Man-made increment ≤100	Man-made increment ≤150
Coliform index (count/L)	10000; 700 for shellfish culture zone			–
Faecal coliform (count/L)	2000; 140 for shellfish culture zone			–
Pathogen	Should not be present in the water for shellfish culture zone			
Temperature (a°C)	Man-made increment should not exceed 1 in summer and 2 in other seasons		Man-made increment should not exceed 4	
pH	7.8 - 8.5 and change in pH level should not exceed 0.2 pH unit as compared to the ambient level		6.8 - 8.8 and change in pH level should not exceed 0.5 pH unit as compared to the ambient level	
Dissolved oxygen	> 6	> 5	> 4	> 3
Chemical oxygen demand (COD)	≤ 2	≤ 3	≤ 4	≤ 5
Biochemical oxygen demand (BOD_5)	≤ 1	≤ 3	≤ 4	≤ 5
Inorganic (as N)	≤ 0.20	≤ 0.30	≤ 0.40	≤ 0.50
Non-ionic ammonia (as N)	≤ 0.020			
Activated phosphate (as P)	≤ 0.015	≤ 0.030		≤ 0.045
Mercury	< 0.00005	< 0.0002		≤ 0.0005
Cadmium	≤ 0.001	≤ 0.005	≤ 0.010	
Chromium (VI)	≤ 0.005	≤ 0.010	≤ 0.020	≤ 0.050
Lead	≤ 0.001	≤ 0.005	≤ 0.010	≤ 0.050
Total Chromium	≤ 0.05	≤ 0.10	≤ 0.20	≤ 0.50

Item	Category 1	Category 2	Category 3	Category 4
Arsenic	≤ 0.020	≤ 0.030	≤ 0.050	
Copper	≤ 0.005	< 0.010	≤ 0.050	
Zinc	≤ 0.020	≤ 0.050	≤ 0.10	≤ 0.50
Selenium	≤ 0.010	≤ 0.020		≤ 0.050
Nickel	≤ 0.005	≤ 0.010	≤ 0.020	≤ 0.050
Cyanide	≤ 0.005		≤ 0.010	≤ 0.020
Sulfide (as S)	≤ 0.02	≤ 0.05	≤ 0.010	≤ 0.25
Volatile phenol	≤ 0.005		≤ 0.010	≤ 0.050
Oils	≤ 0.05		≤ 0.30	≤ 0.50

Source: State Environmental Protection Agency, GB3097-1997

Note:

- Category 1 represents marine fisheries zone, marine natural reserve area and critically endangered marine habitat protection area.
- Category 2 represents marine cultural zone, marine bathing water, secondary contact or marine recreation area, and marine water which is directly related to human consumption.
- Category 3 represents marine water for general industrial use and marine scenic area.
- Category 4 represents marine harbour area and marine development area.

Annex 4

Gross Domestic Product of Xiamen in Nominal Terms (x10^4 RMB)

Year	Total GDP	Primary Sector	Secondary Sector	Industry (Mftg)	Architecture	Tertiary Sector	Average GDP (RMB/Person)
1991	719,963	64,521	334,165	285,248	48,917	321,277	6,262
1992	976,748	80,651	413,675	341,927	71,748	482,422	8,294
1993	1,323,163	93,334	590,942	478,040	112,902	638,887	10,945
1994	1,870,381	129,044	910,166	744,110	166,056	831,171	14,964
1995	2,505,505	157,043	1,307,178	1,074,700	232,478	1,041,284	19,743
1996	2,999,395	203,045	1,534,505	1,314,400	220,105	1,261,845	23,241
1997	3,587,107	210,131	1,804,405	1,568,500	235,905	1,572,571	27,324
1998	4,031,676	217,445	2,027,514	1,701,400	326,114	1,786,717	30,596
1999	4,405,368	210,026	2,282,657	1,942,500	340,157	1,912,685	33,389
2000	5,018,706	212,378	2,650,203	2,329,896	320,307	2,156,125	38,021
2001	5,583,268	220,348	2,966,751	2,633,514	333,237	2,396,169	41,111

Annex 5

The Application of Contingent Valuation Methodology in Xiamen, PR China

Environmental benefits, such as the improvement of environmental quality and providing the natural based recreational site, are among the important benefits of ICM. One challenge facing researchers on the monetary value of environmental benefits is the absence of a market for most environmental improvements. Since "cleaner air" or "cleaner water" are not usually bought or sold, market data are generally not available for valuation purposes. Methods for eliciting values for these goods rely either on information from the markets for related goods (revealed preference methods) or on direct information on people's preferences (stated preference methods).

The environmental management program under ICM includes four components designed to improve the management of municipal and industrial wastewaters and solid waste; to clean up polluted water bodies, such as Yuandang Lake; to improve and expand public recreation sites (e.g., parks and beaches); and to establish nature reserves for endangered species, such as the lancelet (*Branchiostoma belcheri*), egret (*Egretta spp.*), and Chinese white dolphin (*Sousa chinensis*). With the implementation of ICM, environmental quality in Xiamen has improved considerably. The rising trend of water pollution has been halted, and good air quality has been maintained.

To measure the economic benefit associated with improvements in environmental conditions and resource protection, a Contingent Valuation (CV) study[13] was conducted in 1998. CV is the most well developed of the stated preference methods. CV surveys involve posing a hypothetical market to a sample of respondents and asking for an opinion about the value of a good under specified contingencies (Hanemann, 1991; Mitchell & Carson, 1989; Freeman, 1993; Carson, 2000; and Kopp, et al., 1997). If respondents answer a CV question as assumed by economic theory, the elicited value corresponds to the economic value of the good (resource) as measured by the Hicksian compensating surplus (Mitchell and Carson, 1989). The estimated value for a natural resource can then be used as an input to a cost–benefit analysis.

Estimation of the Willingness-to-Pay

The planning and designing of the survey questionnaire began in April 1998, involving four pretests to improve the questionnaire and train the enumerators, mostly students from Xiamen University and Jimei University. The actual survey was administered in July of the same year covering six coastal and five interior areas in Xiamen. Respondents have been selected through stratified random sampling. A total of 2,030 questionnaires were given out through random interviews.

[13] CV is a stated preference method. CV surveys involve posing a hypothetical market to a sample of respondents and asking for an opinion about the value of a good (e.g., willingness to pay, WTP, for a change in the supply of an environmental resource) under specified contingencies (Freeman, 1993). There is, however, substantial controversy about what exactly is being measured by CV responses (e.g., Hausman 1993).

Among those, 1,496 completed questionnaires were included in statistical analysis. The characteristics of respondents generally correspond to the demographic features described in the *Coastal Environmental Profile of Xiamen* (ITTXDP, 1996). Most of the respondents were males (63.7 percent) and married (67.2 percent). The dominant age group was 25-34 years and 35.6 percent have college degrees. Initially, 2,030 questionnaires were given out, with 1,860 questionnaires returned. After the questionnaires were evaluated for completeness and consistency in responses, only 1,496 were chosen as valid samples.

The reported WTP estimates are actually the result of a 5 percent trimmed mean to cut down the variability of the data obtained. A trimmed mean is calculated by discarding a certain percentage of the lowest and the highest values and then computing the mean of the remaining figures. It is therefore less susceptible to the effects of extreme figures and sampling fluctuations.