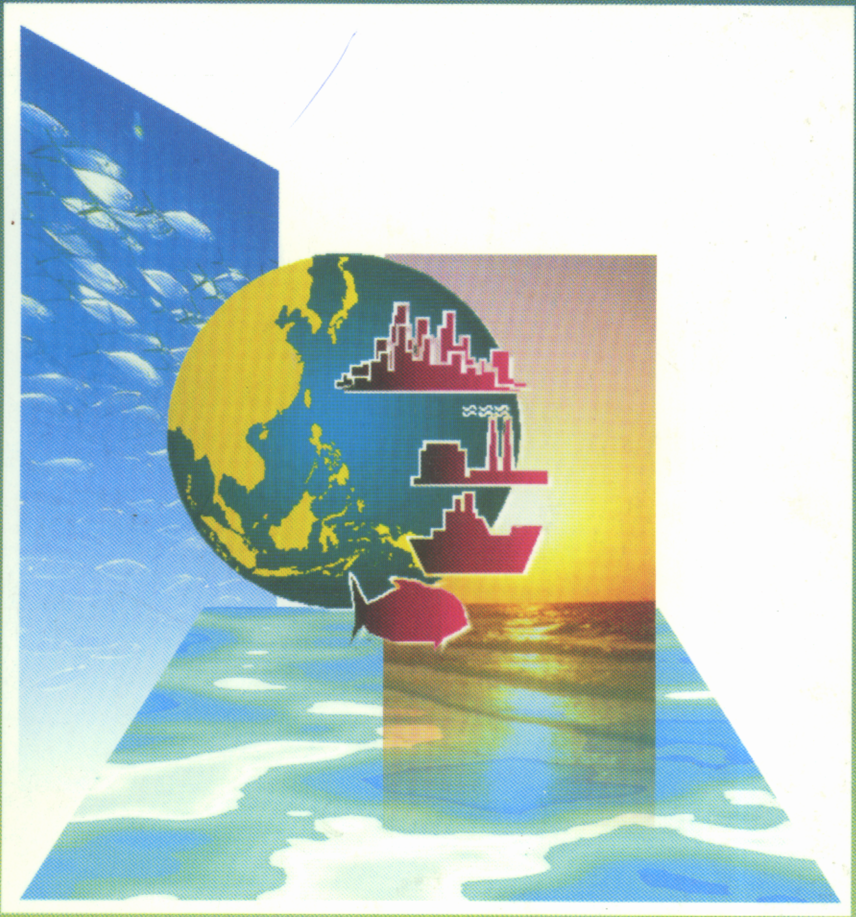
Challenges and Opportunities in Managing Pollution in the East Asian Seas

Edited by

Chua Thia-Eng and Nancy Bermas



Sida UWEP

CHALLENGES AND OPPORTUNITIES IN MANAGING POLLUTION IN THE EAST ASIAN SEAS

Proceedings of the International Conference

Metro Manila, Philippines • 22-24 March 1999

Edited by:

Chua Thia-Eng
Nancy Bermas

Organized by:

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

Co-organized by:

Urban Waste Expertise Programme-WASTE
United Nations Environment Programme/Coordinating Body
on the Seas of East Asia
Department of Environment and Natural Resources

Sponsored by:

GEF
UNDP
IMO
Canada-ASEAN Centre
Swedish International Development Cooperation
Agency Marine Science Programme
Coastal Management Center

Hosted by:

Government of the Republic of the Philippines

Challenges and Opportunities in Managing Pollution in the East Asian Seas

Proceedings of the International Conference

Metro Manila, Philippines • 22-24 March 1999

Published by the GEF/UNDP/IMO Regional Programme for the
Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS)/
Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)

Printed in Quezon City, Philippines

Editorial Supervision: Leticia B. Dizon
Editorial Assistance: Florisa Norina L. Carada and Maricel F. Bigal
Layout: Florisa Norina L. Carada
Cover Design: Jonel P. Dulay
Text set in CG Omega

CHUA THIA-ENG and NANCY BERMAS, Editors. 1999. Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS)/Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), Quezon City, Philippines.

A GEF Project Implemented by UNDP

The contents of this publication do not imply, on the part of the Global Environment Facility, the United Nations Development Programme, the International Maritime Organization and its Programme Development and Management Office (PDMO) for Marine Pollution Prevention and Management in the East Asian Seas/ Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), the expression of any position or opinion on the legal status of any country or territory, or its authority, or concerning the delimitation of its boundaries.

ISBN 971-812-003-3

MISSION STATEMENT

The primary objective of the Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas is to support the efforts of the eleven (11) participating governments in the East Asian Region to prevent and manage marine pollution at the national and subregional levels on a long-term and self-reliant basis. The 11 participating countries are: Brunei Darussalam, Cambodia, Democratic People's Republic of Korea, Indonesia, Malaysia, People's Republic of China, Republic of the Philippines, Republic of Korea, Singapore, Thailand and Vietnam. It is the Programme's vision that, through the concerted efforts of stakeholders to collectively address marine pollution arising from both land- and sea-based sources, adverse impacts of marine pollution can be prevented or minimized without compromising desired economic development.

The Programme framework is built upon innovative and effective schemes for marine pollution management, technical assistance in strategic maritime sectors of the region, and the identification and promotion of capability-building and investment opportunities for public agencies and the private sector. Specific Programme strategies are:

- Develop and demonstrate workable models on marine pollution reduction/prevention and risk management;
- Assist countries in developing the necessary legislation and technical capability to implement international conventions related to marine pollution;
- Strengthen institutional capacity to manage marine and coastal areas;
- Develop a regional network of stations for marine pollution monitoring;
- Promote public awareness on and participation in the prevention and abatement of marine pollution;
- Facilitate standardization and intercalibration of sampling and analytical techniques and environment impact assessment procedures; and
- Promote sustainable financing mechanisms for activities requiring long-term commitments.

The implementation of these strategies and activities will result in appropriate and effective policy, management and technological interventions at local, national and regional levels, contributing to the ultimate goal of reducing marine pollution in both coastal and international waters, over the longer term.

Dr. Chua Thia-Eng
Regional Programme Manager
GEF/UNDP/IMO Regional Programme
for the Prevention and Management
of Marine Pollution in the East Asian Seas

Contents

List of Abbreviations and Acronyms

ADB	Asian Development Bank
AFD	Agriculture and Fisheries Department
AFEJ	Asia Pacific Forum of Environmental Journalists
ARCO	Atlantic Richfield Company
ASEAN	Association of Southeast Asian Nations
BACI	Before-After-Control-Impact
BAPEDAL	Badan Pengendalian Dampak Lingkungan-Environmental Impact Control Agency
BAPEDAL-DA	BAPEDAL-Daerah or Provincial BAPEDAL
BBDP	Batangas Bay Demonstration Project
BBR	Batangas Bay Region
BCRMF	Batangas Coastal Resources Management Foundation, Inc.
BIMAS	Agricultural mass extension guidance program, Indonesia
BOD	Biological oxygen demand
BOO	Build-operate-own
BOT	Build-operate-transfer
BPD	Barrels per day
BTU	British Thermal Unit
CAC	Command-and-control
CAM	Coastal area management
CBCs	Capacity building centers
CBCRM	Community-based coastal resources management
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CENRO	Community Environment and Natural Resources Office
CFEJ	China Forum of Environmental Journalists
CH_4	Methane
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLC	Civil Liability Convention
CO_2	Carbon dioxide
COD	Chemical oxygen demand
CPR	Continuous plankton recorder
CPU	Central processing unit
CRM	Coastal resources management
CRMP	Coastal Resource Management Project
CSD	Commission for Sustainable Development
CV	Contingent valuation
CWDNRMD	Chinese White Dolphin Nature Reserve Management Division
CZM	Coastal zone management
DENR	Department of Environment and Natural Resources

DGPS	Differential global positioning system
DGSC	Directorate General of Sea Communications
DH	Department of Health
DKI	Daerah Khusus Ibukota
DOH	Department of Health
DWT	Dead weight tonnes
EAS	East Asian Seas
EC	European Community
ECC	Environmental compliance certificate
ECDIS	Electronic chart display and information systems
ECMWF	European Center for Mid-range Weather Forecast
EEZ	Exclusive economic zone
EGF	Environmental guarantee fund
EIA	Environmental impact assessment
EIP	Eco-industrial park
EIs	Economic instruments
EMF	Environmental monitoring fund
ENC	Electronic navigational chart
EPD	Environmental Protection Department
FAO	Food and Agriculture Organization
FCZs	Fish culture zones
FP	Friends Provident
FTICM-LME	Fast Track ICM-LME
G6PDH	Glucose phosphate dehydrogenase
GDP	Gross domestic product
GEF	Global Environment Facility
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GIS	Geographic information system
GLAs	General Lighthouse Authorities
GNP	Gross national product
GOI	Government of Indonesia
GOOS	Global Ocean Observing System
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
GPS	Global Positioning System
GTS	Global Telecommunication System
GUI	Graphical user interface
HEED	Health Ecological and Economic Dimensions of Global Change Program
HEMP	Hazards and effects management process
ICAM	Integrated coastal area management
ICES	International Council for the Exploration of the Sea
ICM	Integrated coastal management
ICS	International Chamber of Shipping

ICZM	Integrated coastal zone management
IFEC	Indonesian Forum of Environmental Communicators
IHO	International Hydrographic Organization
IIAPCO	Independent Indonesia-American Petroleum Company
IIMS	Integrated Information Management System
IMCO	Intergovernmental Maritime Consultative Organization
IMO	International Maritime Organization
IMTGT	Indonesia-Malaysia-Thailand Growth Triangle
INMAS	Agricultural mass intensification program, Indonesia
IOC	Intergovernmental Oceanographic Commission
IOPC	International Oil Pollution Compensation
IPCC	International Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
IRR	Internal rate of return
ITTXDP	Integrated Task Team of the Xiamen Demonstration Project
ITOPF	International Tanker Owners Pollution Federation
ITZ	Inshore traffic zone
IUCN	The World Conservation Union
IW	International Waters
IWICM	The International Workshop on Integrated Coastal Management in Tropical Developing Countries
IWMAP	Integrated Waste Management Action Plan
JABOTABEK	Jakarta-Bogor-Tangerang-Bekasi
JCP	Baltic Sea Joint Comprehensive Environmental Action Programme
JFEI	Japan Forum of Environmental Journalists
JICA	Japan International Cooperation Agency
KORDI	Korea Ocean Research and Development Institute
KORECE	Korea Reporters' Club on the Environment
KPPL-DKI	Kantor Pengkajian Perkotaan Lingkungan (Office of Urban and Environment Study of the Jakarta Metropolitan Area)
LDH	Lactate dehydrogenase
LIMCOMA	Lipa Multipurpose Cooperative and Marketing Association
LIPI	Indonesian Institute of Sciences
LGUs	Local government units
LMEs	Large marine ecosystems
LMIS	Lloyd's Maritime Information Services Ltd.
MARPOL	International Convention for the Prevention of Pollution from Ships
MASSMA	Malacca and Singapore Straits Management Authority
MBIs	Market-based incentives
MEH	Marine Electronic Highway
MENAS	Middle East Navigation Aids Service
MIMA	Maritime Institute of Malaysia
MOC	Ministry of Communications

MOMAF	Ministry of Marine Affairs and Fisheries
MTE	Multidisciplinary Team of Experts
NCP	National Contingency Plan
NIPAS	National Integrated Protected Areas
NEAR-GOOS	North-East Asian Regional Global Ocean Observing System
NGOs	Nongovernment organizations
NO_2	Nitrite
NO_3	Nitrate
NOAA	National Oceanic and Atmospheric Administration
NOEC	No observable effect concentration
NPI	National Provident Institution
NSQSR	North Sea Quality Status Report
NZODA	New Zealand Official Development Assistance
OCIMF	Oil Companies International Marine Forum
OECD	Organization for Economic Cooperation and Development
O&M	Operation and maintenance
OPRC	Oil Preparedness, Response and Cooperation
OSC/XMPA	Office of the Standing Committee for Xiamen Municipal People's Assembly
OXMPG	Office of Xiamen Municipal Government
PAHs	Polycyclic aromatic hydrocarbons
PAMB	Protected Area Management Board
PAR	Photosynthetically active radiation
PCB	Polychlorinated biphenyl
PEIP	Ports Environmental Improvement Project
PEJI	Philippine Environmental Journalists Inc.
PG-ENRO	Provincial Government of Batangas-Environment and Natural Resources Office
PhilBIO	Philippine Bio-Sciences and Engineering Co., Inc.
PMA	Pollution Management Appraisal
PNEC	Predicted no effect concentration
POPs	Persistent Organic Pollutants
PPA	Participatory policy approach
PPP	Public-Private Partnerships
PPPUE	Public-Private Partnerships for the Urban Environment
PSP	Paralytic shellfish poisoning
P & I Club	Protection and Indemnity Club
PSC	Port State Control
REDB	Relational environmental database
ROOS	Regional Ocean Observing System
RSD	Regional Services Department
SAR	Search and rescue
SASTRAT	Slop and Sludge Reception and Treatment Center
SCUBA	Self-Contained Underwater Breathing Apparatus

SEAPOL	Southeast Asian Program in Ocean Law, Policy and Management
SFEC	Singapore Forum of Science and Environmental Communicators
SIJORI	Singapore, Malaysian State of Johor and Riau Province of Indonesia
SMEs	Small and medium enterprises
SMEIS	Straits of Malacca Environmental Information System
SOA	State Oceanic Administration
SOPs	Standard operating procedures
SPA	Singapore Port Authority
SPM	Sustainable Project Management
SST	Sea surface temperature
STAP	Scientific and Technical Advisory Panel
STCW 78	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978
SWAN	Simulating waves nearshore
TA	Technical assistance
TAC	Total allowable catches
TCF	Trillion cubic feet
TEU	Ten-foot equivalent unit
TEV	Total economic value
TFSEC	Thailand Forum of Science and Environmental Communicators
TSS	Traffic separation scheme
TTEG	Tripartite Technical Expert Group
TURMEPA	Turkish Marine Environment Protection Association
UKC	Under-keel clearance
ULCCs	Ultra large crude carriers
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Education, Scientific and Cultural Organization
USAID	United States Agency for International Development
USD	Urban Services Department
UWEP	Urban Waste Expertise Programme
VLCCs	Very large crude carriers
VTIS	Vessel traffic information system
VTS	Vessel traffic system
WB	World Bank
WBCSD	World Business Council for Sustainable Development
WHO	World Health Organization
WTP	Willingness to pay
WWF	World Wide Fund for Nature

Preface

As we approach the new millennium, it is perhaps timely to review the state of pollution in our seas and oceans and how well we have addressed the problem especially in the seas of East Asia, a region inhabited by more than one-fourth of the world's population. It is timely, too, to prepare ourselves for the new challenges requiring reorientation in policy, management and technological application for resolving increasing transboundary marine pollution problems in a region characterized by a very complex socioeconomic, political and cultural setting. On the other hand, there are also emerging opportunities especially investment opportunities in marine pollution prevention, control, mitigation and other management measures that require a paradigm shift in our concept, approaches and conventionally used methodologies in order to maximize the benefits.

One-fourth to one-third of the gross domestic product of many coastal countries is produced in coastal and marine areas through utilization of living and non-living marine resources for their goods and services especially fish and energy production, transportation, recreation, medicines and other industrial development. The ever-increasing demand for food and better standard of living triggers a corresponding change in the production and consumption patterns in a world of growing population, which now stands at six billion. Unfortunately, policy and management inadequacies to timely remove or reduce the environmental stress on the resource systems have resulted in severe impairment of their functional integrity and reduced their ability to continue to provide the goods and services that we enjoy.

In addressing marine pollution problems, one cannot ignore the fact that at least 70-80% of pollutants is attributed to human activities on land. For the East Asian Seas Region, as in any other regions of the world, most contaminants to the marine environment originate from land-based activities. However, with the ever-increasing volume of shipping traffic into and within the region coupled with numerous exploration and exploitation activities for oil and gas in the continental shelves, sea-based pollution is certainly a source of concern especially along heavily congested shipping routes such as the Straits of Malacca and Singapore and the Lombok-Makassar Straits.

A significant number of national and international initiatives to curb the increasing environmental degradation come in diverse ways and forms. In East Asia, regional and national collaborative efforts are making headway towards mitigating and managing the marine pollution problems in the region. International conventions, agreements and protocols are already in place, their implementation will greatly and certainly help to prevent further deterioration of our seas and oceans. Increasing countries in the region have already ratified or acceded to relevant environment related conventions. Some of the pertinent international conventions and programs are the United Nations Convention on the Law of the Sea (UNCLOS), Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, London Convention, International Convention for the Prevention of Pollution from Ships (MARPOL) and Agenda 21.

This Conference was convened as part of the effort to consolidate and accelerate innovative approaches in marine pollution prevention and management especially in the East Asian Seas Region. The Conference was participated by experts, policy-makers, coastal managers and representatives from the government, nongovernment organizations, the private sector, regional and international organizations, embassies, the youth and womenfolk. The conference brought together diverse experiences, lessons learned and achievements in regional and national collaborative initiatives in the abatement and management of marine pollution in the East Asian Seas and other regions.

This publication presents the summary of the proceedings of the conference and the key papers presented during the three-day event focusing on the following five relevant themes:

- **Integrated management of marine pollution**. Covers management techniques and approaches for coastal areas and large marine ecosystems including area-specific initiatives in the Malacca Straits, China, Indonesia and the Republic of Korea.

- **Environmental investments**. Discusses the opportunities and developments in environmental enterprises such as waste management, innovative financing mechanisms, public-private sector partnerships, contingent valuation and economic instruments.

- **International conventions**. Presents the ratification and implementation of marine pollution-related international conventions, policy development, formulation of model ordinances and the establishment of institutional infrastructure and legal frameworks.

- **Application of science and technology**. Introduces techniques and technologies in the abatement and management of marine pollution, techniques in environmental and resource assessment, management, monitoring and rehabilitation including GIS, remote sensing, zoning, risk and damage assessment, information management, modelling and decision support systems among others.

- **Stakeholders' participation**. Demonstrates the participation of active stakeholders in integrated management of marine pollution, defining the role of donor agencies, media, the youth, womenfolk, nongovernment organizations, people's organizations and the communities in the protection, management and conservation of coastal and marine resources and environments.

The essential linkages of the above themes have broadened the agenda on marine pollution to include identifying and testing new paradigms in marine pollution management. A general consensus at the conference is the shared responsibility and partnership of all stakeholders of which we are one, to face the enormous challenges together.

Chua Thia-Eng
Nancy Bermas

ACKNOWLEDGMENTS

The Conference on the Challenges and Opportunities in Managing Pollution in the East Asian Seas owes its success to the collective effort and strong support of various individuals, agencies and organizations. Their valuable contribution is acknowledged with deep appreciation.

Sincere appreciation is extended to the Canada-ASEAN Centre; the Swedish International Development Cooperation Agency Marine Science Programme (Sida) and the Coastal Management Center (CMC) for their financial support without which the conference would not have taken place. The assistance and support of the Urban Waste Expertise Programme - WASTE and the United Nations Environment Programme/Coordinating Body on the Seas of East Asia (UNEP/COBSEA) in promoting and in co-organizing the conference is also acknowledged. The Government of the Philippines through the Department of Environment and Natural Resources (DENR) hosted and co-organized the conference. The support and enthusiasm shown by the DENR Secretary Honorable Antonio Cerilles; the National Coordinator of the Coastal Environment Program, Ms. Beatriz Dar; and Undersecretary Ramon J.P. Paje in promoting the conference, for bringing in participants from the different regions of the Philippines to attend and for their time in participating in the event are highly appreciated.

The conference sessions were efficiently guided and facilitated by excellent chairpersons and to them we owe our sincere gratitude. Sincere thanks go to Ms. Sarah Timpson, United Nations Development Programme, Manila; Dr. Olof Linden, Swedish International Development Cooperation Agency Marine Science Programme, Sweden; Dr. John S. Gray, University of Oslo, Norway; Prof. Raphael P.M. Lotilla, National Economic and Development Authority, Philippines; Mr. John Cowan, Sustainable Project Management, USA; Mr. Ian Robertson, Canada-ASEAN Centre, Singapore; Ambassador Hasjim Djalal, Department of Foreign Affairs, Indonesia; Dr. Hugh Kirkman, United Nations Environment Programme/ Coordinating Body on the Seas of East Asia, Thailand; Prof. Chou Loke Ming, National University of Singapore; Dr. Angel Alcala, Commission on Higher Education, Philippines; Hajah Rosnani Ibarahim, Department of Environment, Malaysia; Prof. Edgardo Gomez, University of the Philippines; Dr. Aprilani Soegiarto, Indonesian Institute of Sciences; Dr. Mark Valencia, East-West Center, USA; and Mr. Lex Hemelaar, WASTE, The Netherlands.

The papers included in this publication are of high quality and this is attributed to the tireless efforts of some able reviewers. Special thanks go to Mr. S. Adrian Ross, Dr. Gil Jacinto, Ms. Stella Regina Bernad and other reviewers for their time and effort in reviewing the manuscripts.

Finally, the staff of the Regional Programme who worked hard behind the scenes to ensure that every detail of the conference organization is in order are also recognized. The dedication, support and guidance of the senior staff particularly Mr. S. Adrian Ross, Dr. Huming Yu and Ms. Socorro Guerrero and the rest of the staff who efficiently performed a hundred and one tasks and still maintained their enthusiasm are gratefully acknowledged.

Chua Thia-Eng
Nancy Bermas

SUMMARY

INTRODUCTION

The International Conference on Challenges and Opportunities in Managing Pollution in the East Asian Seas was held at the Manila Diamond Hotel, Manila, Philippines, on 22-24 March 1999. The Conference was hosted by the Department of Environment and Natural Resources (DENR) of the Republic of the Philippines and was jointly organized and sponsored by the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (GEF/UNDP/IMO Regional Programme), the Coastal Management Center (CMC), the DENR, the Swedish International Development Cooperation Agency Marine Science Programme (Sida), the Canada-ASEAN Centre, the United Nations Environment Programme/Coordinating Body on the Seas of East Asia (UNEP/COBSEA) and the Urban Waste Expertise Programme-WASTE. Representatives from the government, nongovernment organizations, universities, private sector, regional and international organizations and several embassies attended the conference (Annex 1).

During the opening ceremonies, Mr. Ramon J.P. Paje (Undersecretary of the Environment and Programs Development, DENR), Dr. Chua Thia-Eng (Regional Programme Manager, GEF/UNDP/IMO Regional Programme), Ms. Sarah Timpson (Resident Representative, United Nations Development Programme), the Honorable Antonio Cerilles (Secretary, DENR) and the Honorable Felipe M. Medalla (Secretary of Socioeconomic Planning and Director-General of the National Economic and Development Authority and Chair of the Philippine Council for Sustainable Development) delivered the welcome and keynote addresses. The following are the highlights:

- The main objective of the Conference was to discuss the challenges and opportunities in managing marine pollution with special reference to the East Asian Seas Region. The conference deliberation focused on five relevant areas related to pollution management, *viz*: integrated management, environmental investments, international conventions, science and technology and stakeholders' participation.

- There are needs to reform the world's fishing industry, to encourage responsible fisheries management and to safeguard critical ocean habitats by creating an effective global network of marine parks and reserves. There is also a need for international cooperation, determination and action to address these issues.

- The Philippine Government through the DENR has developed plans to manage the marine environment including the prevention, control and mitigation of marine pollution. It has established a special program to address coastal environment problems including efforts in cleaning up the Pasig River and the formulation of the national marine policy.

- Regional collaboration in environmental management is necessary as a step towards sustainable use of regional seas. The key developments at the international (i.e., UNCLOS; Agenda 21) and national levels (Philippine Agenda 21) involving the oceans and its resources were enumerated by the Keynote Speaker. The relevance of the conference theme to the objectives of the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities was specially highlighted. The activities, strategies and outputs of the GEF/UNDP/IMO Regional Programme were cited as example of regional efforts in the implementation of the GPA. However, it was stressed that the Regional Programme should provide countries, intergovernmental and international bodies, donor agencies and other organizations its working models for replication throughout the region. It was suggested that the output of the conference be presented to the Seventh Session of the United Nations Commission on Sustainable Development in April 1999, where oceans and seas comprise one of the major themes.

At the closing ceremonies, Mr. Jean Claude Sainlos, Mr. Ian Robertson and Prof. Gao Zhigou rendered their closing remarks on behalf of the International Maritime Organization, the Canada-ASEAN Centre and the participants, respectively.

Integrated Management of Marine Pollution

The key lectures and papers covered a wide range of topics from management techniques and approaches for coastal areas and large marine ecosystems (LMEs) to area-specific initiatives in the Malacca Straits, China, Indonesia and the Republic of Korea.

ICM Application at the Regional and Ecosystem Levels and Performance Evaluation of Integrated Coastal Management (ICM) Projects

Dr. Chua Thia-Eng reviewed the rationale, process and benefits of ICM application, in relation to projects that had been undertaken in the region. Dr. Chua explained how the local application of the ICM process actually contributes to the achievement of obligations and objectives of international conventions and agreements, including MARPOL 73/78, London Convention 1972, Agenda 21 and the GPA. A system of indicators for evaluating the performance of ICM projects was identified, consisting of: a) process indicators; b) stress reducing indicators; c) sustainability indicators; and d) environmental status indicators. Dr. Chua illustrated the use of performance indicators by reviewing the results of an evaluation completed on ICM projects in Batangas Bay (Philippines) and Xiamen (China).

In responding to a question on criteria for site selection, Dr. Chua highlighted the importance of: (a) the willingness of local government units to commit to the integrated management approach and the provision of counterpart staff to undertake the activities; (b) political will; and (c) the nature of the environment management issues. Such commitment is reflected in political interest and will to undertake the project, the provision of human resources to be trained in ICM implementation and in-kind contributions to the work program. In order to sustain ICM activities over the longer term, local government units need to assume ownership of the program from the start of the process.

On the issue of involving different stakeholders, Dr. Chua clarified the various approaches for stakeholders' participation being used in coastal management. He stressed the need for better dialogue between special interest groups, scientists and politicians. Information exchange mechanisms should be strengthened in order to ensure "informed" multi-stakeholder inputs to decision-making processes.

In relation to the benefits of the integrated approach illustrated by Dr. Chua, Dr. Kenneth Sherman discussed the ecosystem management principles, which represent a paradigm shift from sectoral management approach to the broader ecosystem approach that moves spatially from smaller to larger scales and from short-term to long-term management practice. The new paradigm has relevance to the management of 50 large marine ecosystems (LMEs) established globally. The importance of the LMEs was highlighted and the presenter described the modular strategy developed for linking science-based management of the changing states of the LMEs to the socioeconomic benefits expected from the long-term sustainability of their resources. The five modules, *viz.* 1) productivity; 2) fish and fisheries; 3) pollution and ecosystem health; 4) socioeconomic conditions; and 5) governance priorities were presented.

Marine Pollution Risk Assessment

In his lecture on marine pollution risk assessment and management as key elements in integrated coastal management, Prof. Peter Calow reviewed the different policies that have been adopted by governments regarding environmental management. Prof. Calow stressed that some of these policies may create excessive economic burden, and ultimately deny society benefits in terms of human health and food consumption arising from industrial development. The risk assessment/risk management approach was identified as one method of balancing the responsibility to protect human health and the environment with economic reality. The work completed in the Malacca Straits, as part of the GEF/UNDP/IMO Regional Programme, was cited as an example of how risk assessment/risk management can provide governments with a rational strategy for identifying priority concerns and appropriate management interventions in an area containing multiple sources of pollutants, risk pathways and targets, including transboundary marine pollution. Prof. Calow reminded the conference participants that the risk assessment process should also provide decision-makers with an indication of levels of uncertainty and limitations. Overall, risk assessment/ risk management provides a practical analysis of environmental issues/impacts for consideration by decision-makers.

Assessing the Malacca Straits

The Straits of Malacca is an important sea route for local and international trade. It physically links the Indian Ocean with the South China Sea LME to the Pacific Ocean. As such, it is very vulnerable to pollution risks. Dr. Mark Valencia emphasized that the Malacca Straits are dirty, and are likely to get worse in the future because of increasing populations, economic growth, industrialization and shipping within and along the coastal and marine areas of the sub-region. Examples of land- and sea-based sources of marine pollution were identified, and the gaps and constraints in addressing these sources within existing administrative, regulatory and financing mechanisms were reviewed. Dr. Valencia suggested three possible approaches for the littoral States to consider in developing a comprehensive pollution prevention and management strategy for the Straits, namely: a) sea-use planning, focused on key issues that are of major individual interest, but where these interests are likely to be more effectively promoted by collective and harmonized action; b) a fund for enhancing navigational safety and pollution prevention measures, supported by voluntary contributions from those who benefit from the oil cycle, a new international convention, or maritime dues; and c) an intergovernmental Malacca/Singapore Straits Management Authority.

In support of Dr. Valencia's recommendation, Dr. B.A. Hamzah also spoke on the need for alternative funding for the services provided in the Malacca Straits, specifically, the need for users to contribute to the costs of maintenance for navigation in the Straits.

Although roughly 70% of contaminants entering the Straits of Malacca and Singapore are derived from land-based sources, the relative importance of pollutants and their sources need to be considered within the context of likely effects on human health and the coastal and marine resources of the Straits. Dr. Rokhmin Dahuri pointed out complexities in hazard assessment in the Malacca Straits, being an economically important resource because of its biological productivity and as a transport route. The difficulties in using toxicological testing as well as analyses of environmental samples and the importance of laboratory assay in confirming phenomena and processes that are observed in the field were emphasized. The speaker presented results (risk quotients or RQs) of the study.

Being significant for its resources and for the economic growth of the three littoral States, valuation of the coastal resources of the Straits of Malacca was also done. Dr. A. Sasekumar presented the breakdown of the total value derived on categories of use and non-use values per country. The total value of the coastal resources derived is US$6.83 billion consisting of US$3.17 billion market resources and US$3.66 billion non-market resources. On the non-market value, it was clarified that aesthetic value rather than tourism revenue was considered. Discussion was focused on how the values were derived particularly the value on biodiversity and carbon sequestration. In deriving the value per hectare, the coastal area was divided into districts and the values considered were expressed in value per hectare per annum.

Finally, Prof. Low Kum Sang presented the software package, Straits of Malacca Environmental Information System (SMEIS) for use in illustrating the risks for ecological and socioeconomic impacts under different scenarios, particularly relating to oil spill and fate of pollution from rivers draining into the Malacca Straits. The SMEIS is a useful tool to describe the resources that are present in the Malacca Straits and the issues confronting these resources, e.g., oil spill, pollution from land, etc.

Integrated Management of Pollution at the National Level

China

Prof. Xu Kuncan described some of the pollution monitoring problems encountered in Xiamen before the setting up of the Integrated Marine Pollution Monitoring Program. He presented the composition of local institutions participating in the program and the approach on how the monitoring program was executed. He described how the eight members of the pollution network operate based on a common sampling program, standardized analytical techniques, sharing of technical data and mutual technical assistance. An interlaboratory calibration for quality assurance was also undertaken. Through the monitoring program, a better relationship between the different monitoring units was fostered, and the quality, comparability and value of monitoring data were enhanced.

Mr. Xue Xiongzhi, on the other hand, highlighted the need to consider cumulative impacts in considering environmental impacts of economic development in Xiamen. Mr. Xue defined cumulative impacts as the combined environmental impacts that accrue from a number of individual development projects. To assess such impacts, complex environmental studies need to be made which include analysis of the state and capacity of the recipient environment, evaluation of the individual impacts of major projects and their interrelations as well as their total effects on the environment and resources. Mr. Xue examined the Xiamen West Sea as a case to show the cumulative impacts.

Indonesia

In another setting, Dr. Aprilani Soegiarto reviewed the national and international efforts towards management of marine pollution in Jakarta Bay in Indonesia. Dr. Soegiarto presented information on the physical attributes of Jakarta Bay and subsequently enumerated the multiple but conflicting uses of the Bay. He also cited the increasing loads of land- and sea-based pollution in the bay which include sediments, solid wastes, sewage, hydrocarbon and its derivatives, chlorinated hydrocarbons, heavy metals and industrial wastes. He briefly described various pollution management efforts including enactment of legal instruments, institutional arrangement and other mitigating measures. He also highlighted the research and monitoring programs undertaken by Indonesian institutions. So far, data showed little improvement in the water quality of the three major river systems that drain into the bay.

Republic of Korea

In his paper on marine environmental monitoring and prediction, Dr. Dong-Young Lee stressed that understanding the coastal processes is essential for accurate prediction of the consequences of coastal development. He pointed out that existing monitoring and prediction modelling efforts in the East Asian Seas are unorganized, duplicative, not integrated and were undertaken in an *ad hoc* manner. The Republic of Korea had developed a coastal environment information system that could integrate field monitoring, remote sensing and satellite information for numerical modelling. The various field stations established were able to generate the required data through automated instruments. As a result, the country had developed an extensive database comprising, *inter alia*, wind data from 1979, wave database for 20 years from all regions in the Northeast Asian Seas, tidal harmonic currents, and information on sediment transport. Based on these databases, the Korea Ocean Research and Development Institute (KORDI) was able, among other things, to make tidal current predictions, and oil spill modelling.

Environmental Investments

This session placed special emphasis on the approach and environmental investment opportunities in the East Asian Seas. Attention was drawn to the business opportunities in the coastal and marine environment through an innovative public-private partnerships (PPP) mechanism. The lectures provided a background of the PPP process and structure and a sound illustration on its implementation.

Public-Private Partnerships

Mr. Hugh Faulkner introduced the concept and major features of the public-private partnerships (PPP) mechanism. The partnerships combined the private sector advantages, e.g., access to finance, knowledge of technology and management efficiency, with public sector concerns in social responsibilities, environmental awareness, job generation, etc. The PPP process would reduce the project development costs and optimize its financing package. In support of Mr. Faulkner's presentation, Mr. John Cowan further explained the PPP approaches. In his definition, partnership meant joint ownership. He stressed that time, cost-effectiveness and a visible and quantifiable engagement of all parties are essential to the PPP process.

During the ensuing discussion, the following points were raised:

1) The role of local and central governments in the PPP process is essential. Their attitude and participation would greatly influence the policy environment upon which the PPP mechanism could operate. Private sector commitment and investment opportunities could be secured only within a stable and predictable government policy and regulatory framework. Integrated coastal management framework and process could make available necessary policy and regulatory conditions for investment activities;

2) PPP is a "marriage" of both sectors. It shortens the long process needed to bring an investment of this nature into the operational stage. What the GEF/UNDP/IMO Regional Programme had done in Batangas was close to that "marriage";

3) PPP is not only a transfer of technology, but also a process to build up local capacity to absorb and sustain the transferred technology, and use it effectively;

4) Major constraints to the PPP process could include corruption, nepotism and "crony" capitalism. The transparency of the process, the involvement of all the stakeholders, and the level playing field are the tools to make the PPP process a success, and also to prevent and mitigate those constraints; and

5) Using innovative technology deserved more attention in the development of the PPP as it provided the added values. Innovative technology should be drawn from local, national and international pools. However, the type of technology used would also be dependent on the types and scale of the problem, the cost-effectiveness of the technology and the local capacity to use the technology.

Case Studies on Public-Private Partnerships

Mr. S. Adrian Ross reported an initiative undertaken jointly by the GEF/UNDP/IMO Regional Programme and the Sustainable Project Management (SPM) directed towards creating a mixed (public and private sectors) ownership company for developing a province-wide integrated waste management service for Batangas, Philippines. Although the project process and its benefits and constraints were still unfolding, both sectors built up consensus on a formal agreement to proceed with developing the needed facilities and services within the framework of the partnerships.

Mr. Frederick Contreras shared his experiences on the voluntary agreement in waste reduction being undertaken by the private sector in Batangas Bay. The private sector framework to address serious environmental challenges was considered feasible, particularly in the management and reduction of waste through voluntary agreement. It is a process that takes time but makes economic sense. He pointed out that the application of pollution management appraisals (PMAs) in industrial waste minimization and management had generated positive synergy among the industrial firms located along Batangas Bay as a result of the active participation of the major industries. Some of the wastes generated are being used in waste exchange programs with other industries and enterprises. The voluntary agreement was forged with the major industries in Batangas Bay which are willing to comply with its provisions. Other industries were hesitant partly due to the regulatory aspect of the mechanism. With information campaign and participation of the large companies, other industrial firms have indicated their willingness to participate in the program.

Mr. West Stewart further highlighted the benefits of PPP in the treatment and management of animal waste streams in Batangas. Mr. Stewart described the partnership already forged between the Batangas Provincial Government, Lipa Multipurpose Cooperative and Marketing Association (LIMCOMA) livestock cooperative and the Philippine Bio-Sciences & Engineering Co., Inc. The GEF/UNDP/IMO Regional Programme facilitated the proposed establishment of a viable animal waste treatment system and distribution of by-products. It is foreseen that the partnership will assure the bankability of the project and expansion of the market for the technology throughout the province and possibly into other provinces as well.

Mr. Martin O'Neill provided a close look at the complexity of the challenges involving investment and management of soil and industrial hazardous waste. Private sector involvement in a public-private sector partnership framework calls for full, imaginative marketing and not just selling goods and services and that includes analysis of client/partner relationship.

Mr. Lex Hemelaar, on the other hand, discussed the challenges and opportunities in small and medium enterprises (SMEs) in ship and port waste management. He introduced UWEP's efforts in establishing SMEs in three case study areas in Batangas Bay Region: 1) collecting waste oil and oily bilge water; 2) collecting recyclable solid waste fractions; and 3) collecting solid wastes. Mr. Hemelaar expressed concern that the trend towards contracting large enterprises as private partners could make SMEs the forgotten partners. He opined that the main contribution of SMEs stems from the fact that they are well-established in the market for recycled products.

Environmental Investments at the National Level

Indonesia

Mr. Mattheus Sturm presented the Ports Environmental Improvement Project being undertaken in Indonesia. The project addressed maritime activities, particularly wastes generated by ships and coastal engineering works in relation to the protection and conservation of the marine environment. It resulted in the formulation of a master plan and generated information for a maritime policy. Dr. Aprilani Soegiarto commented that the action plan should specifically address marine pollution associated with shipping and must be implemented in order to have positive impacts on the marine environment. Ambassador Hasjim Djalal also commented that public awareness about the project must be enhanced including setting up sustainable financing programs with the shipping industry within the public-private sector partnership framework.

Malaysia

Dr. Tong Soo Loong reviewed the privatization of pollution management in Malaysia. He pointed out that the monitoring function of the Department of Environment has been privatized since 1995. Other privatized pollution management projects were sewerage (1993), the integrated waste management center (1996) and solid waste management (1997). The private sector, thus, handles the financing operation and maintenance of monitoring air and water quality and uses human resources with greater flexibility to ensure speedy delivery of outputs. The scheme resulted to a savings of up to 85% for the Government. Thus, the Government could focus on its regulatory functions and policy matters. Dr. Tong cited the following advantages in creating a comprehensive network of environmental monitoring programs in line with the privatization of pollution management in the country: cost-effectiveness, efficiency, optimum utilization of technology, more effective enforcement of environmental regulations and wider utilization of data.

Environmental Funds

Mr. Magnus Pettersson outlined the trends in the financial sector with respect to funding sustainable development. The need for stability in the East Asian Seas Region following the recent financial crisis and appropriate framework that will take environmental issues into account are important factors in enhancing environmental investment. Several mechanisms were discussed such as those using green policies, environmental tax and insurance. Environmental fund mechanisms are effective and efficient for environmental protection. It was suggested that the administration of such funds could be best given to NGOs and the private sector.

Economic Instruments and the Role of Industry in ICM

Dr. Corazon Abansi presented the results of the case studies on the contingent valuation survey on willingness to pay in Batangas, Philippines and Xiamen, China. Dr. Abansi stated that people expressed willingness to pay (WTP) more than what they are paying now for environment protection services. Selection of priorities related to environmental management programs could serve as the most basic building blocks to measure public support and general willingness to pay. Priority areas covered fishery resources, garbage, coral reefs and sewage for the Batangas Bay Region while sewage, solid waste, endangered species, fish resources and beaches were selected for Xiamen Municipality. Age, educational attainment and income significantly affected ranking of priorities among the respondents. In responding for clarification on how the concept of WTP was explained to the respondents in Batangas and Xiamen, Dr. Abansi stated that respondents in Batangas were made to understand WTP through the use of survey forms that contain graphics and texts to visualize the market benefit being offered. She said that respondents from Xiamen have high awareness in environmental protection. Their priority concerns were given to waste management and endangered species such as the dolphin and egret, among others.

While highlighting the effectiveness of economic instruments (EIs) and market-based incentives (MBIs) in achieving specific environmental management objectives, Ms. Ma. Corazon Ebarvia emphasized that EIs/MBIs should work through market signals, which can motivate decision-makers towards more environment-friendly activities. Both instruments can correct market and policy failures, which are the two broad types of inefficiency in modern economies, by accounting for externalities, correcting prices and by making taxes and incentives compatible with environmental objectives.

A speaker from the oil industry, Mr. John Lemlin, expounded on the evolution of the industry's position and involvement in environmental management. He pointed out that despite the recent high regard for the environment in terms of operation and development, the industry was still perceived negatively and often excluded to participate in environmental studies and/or projects. The concept of partnership in coastal management programs could be seen as a means for a more harmonious relationship between all stakeholder groups. Towards this end, Mr. Lemlin suggested that the industry perhaps could convene and sponsor a stakeholders' workshop for various stakeholders to meet in a non-confrontational situation; and to enable them to understand the needs, aspirations, concerns and values of the various community groups. A process of confidence building and of breaking down the barriers that exist between industry and the community at large could begin through the implementation of coastal management projects.

International Conventions

International conventions play a key role in promoting cooperation and collaboration in the use of the oceans and seas and their resources. In particular, international conventions that relate to safe navigation and marine environmental protection are key instruments in the control of marine pollution. This session examined the legal aspects of ocean-related legislation and regulations for addressing marine pollution issues and the existing regimes for compensation of marine pollution damages.

Funding for the Malacca Straits

Dr. B.A. Hamzah underscored the need for alternative funding for the services provided in the Malacca Straits, specifically the need for users to contribute to the costs for the maintenance of the safety of navigation in the Straits. He pointed out that the States bordering the Straits are shouldering all the costs for providing navigation facilities in the Straits. This has led to a situation where the Straits States subsidize the developed States using the Straits. Japan is the only user State that contributes to the costs for providing the services, which it provides through a Revolving Fund. Dr. Hamzah argued that: (1) under international law, States bordering Straits used for international navigation are not obliged to pay for all costs of providing navigation services in the Straits; (2) the Straits States are not obliged to provide services beyond their financial ability and payment for services is allowed under article 26(2) of the Convention on the Law of the Sea; (3) under the polluter pays principle, the shipping community should begin shouldering costs to protect the environment; and lastly, (4) the Straits States have the right to demand payment for services they provide in the Straits for international navigation. He warned that unless the stakeholders pay for services, some very critical facilities and services may not be available in the future.

It was pointed out during the discussion that it would be more practical to include as stakeholders all those who use the Straits and not just the ship and cargo owners only. There was a suggestion that the Tripartite Technical Expert Group (TTEG) comprising of representatives from the three littoral States should take up the issues mentioned above. It was also proposed that a conference be organized to raise the issue of funding and the establishment of high-level institutional arrangement to move the suggested options forward.

Regional Conventions

Mr. Marc Richir introduced the regional mechanism adopted for environmental management in Europe. He pointed out that marine pollution problems are being addressed under two regional frameworks, *viz*: the European Community and the three regional conventions covering the following regions: the Baltic Sea, the Mediterranean Sea and the North Sea. The European Community, as a contracting party to all three regional conventions, ensures that measures taken under the regional conventions are congruous, and that standards adopted under each are at least as high as the Community's. The regional conventions provide an interface between the international requirements and specific circumstances in the regions. The three European regional conventions are different from each other, and have different emphases, because they deal with different areas and different parties. In common, they were initiated in the early 1970s, were reviewed in the early 1990s, have permanent secretariats, and deal with the same or related environmental issues.

According to Mr. Richir, the conventions standardized methodologies for compilation and reporting of data and provided legal instruments in the form of decisions, recommendations and action programs. The regional conventions helped in building confidence, influencing national legislation and integrating environmental policies with development policies. There were direct or indirect evidences that a large number of concrete actions taken by the concerned countries were the results of the conventions, thus influencing the environmental policies and practices of the European countries. They also created public awareness resulting in a marked change of attitude and a sense of solidarity in the importance of collective action. However, Mr. Richir cautioned that a convention is only a tool and its usefulness depends very much on the continued political will of the contracting parties.

In contrast to the European experience, it was mentioned during the discussion that the biggest obstacles in the East Asian Seas Region are the territorial and jurisdictional disputes prevalent in the South China Sea. This region could learn from the experience of Europe, where an effective approach was to deal with technical issues and avoid the political or sensitive issues. With regard to public-private partnerships, the European conventions have tried to create a policy environment for private investment. Private companies in Europe participated in projects particularly in civil contracts.

Regimes of Compensation for Marine Pollution Damages

Dr. Michel Girin reviewed the existing regimes of compensation for marine pollution damages. Despite progress in developing a system to compensate for pollution damages, Dr. Girin pointed out that there were difficulties to get satisfactory compensation for such damage claims. Although the polluter pays principle gained wider acceptance, the national laws were not uniform in the definition of the "polluter". Dr. Girin described three types of pollution situations: (1) no identified polluter (or "orphan pollution"); (2) identified polluter, evidently responsible; and (3) an identified polluter, not evidently guilty. For a situation where no polluter was identified, experience showed that governments accept no liability for failing to find the polluter. In the second type of situation, the two sources of compensation are the polluter and his insurer. The extent to which they will pay depends on the laws of the country. Typically in such a situation, the polluter's insurer will pay within its contractual limits. In the third type of situation, where there is an identified polluter who is not necessarily guilty (such as in the case of a collision), the probability of getting compensated depends on whether the polluting substance is persistent oil or not. Pollution involving persistent oil in tankers is covered by the CLC and Fund Conventions. However, many countries are not members of CLC, and even less are members of Fund. For all pollutants other than persistent oil, fault has to be demonstrated and a guilty party found, unless national laws provide otherwise. The IOPC Fund has many rules that exclude many items that victims typically claim as compensable. Several of its rules are unknown to outsiders who are then surprised when they are applied. Dr. Girin gave examples of cases showing the evolution of claims vis-à-vis the actual compensation paid. These showed that the actual payments made are far below the amounts of the claims. In disputes regarding compensation for pollution damage, the polluters have the advantage over the victims. Polluters employ experts with plenty of experience with oil spills, who closely communicate with each other, apply established rules, and are in no hurry to pay. In contrast, the claimants are amateurs with little or no spill experience, have diverse backgrounds and interests, are unaware of the rules, and are eager to be paid.

It was stressed during the discussion that a payment of 30% to 50% of claims made is considered reasonable. Very high claims usually lead to very high expectations but very low compensation. Regarding the special rules of pollution damage compensation in the USA and Canada, Dr. Girin remarked that the USA law is excessive in many ways. On the other hand, for the rest of the world, the CLC/Fund system is still far from ideal for fair compensation. A balance between the two systems is needed. However, it was suggested that for the time being, countries in the East Asian Seas Region should be well-prepared with better information (e.g., through resource valuation) and more professionals trained for the claims process.

On the East Asian Seas setting, Mr. Zafrul Alam discussed how the region implements MARPOL and international regimes on liability and compensation for oil pollution damage. In general, ratification and accession to these conventions and other IMO conventions are slow because of a number of reasons grouped as follows: 1) lack of human and financial resources, including technical expertise and incentives (e.g., low government priority, lack of capacity to build reception facilities, lack of understanding of the conventions); 2) administration issues (e.g., gaps or overlaps in agency functions, lack of coordination); 3) legislation and enforcement (e.g., lack of or inadequate laws, inadequate penalties, lack of coherence, lack of enforcement measures, lack of capacity); 4) lack of awareness (e.g., no active participation in the formulation of the international conventions); and 5) lack of political will. Mr. Alam cited the experience of Singapore in overcoming such obstacles. It took Singapore many years of preparation for accession to and implementation of MARPOL, CLC 69, CLC 92, and Fund 92. The preparatory actions included designating one responsible agency (e.g., Maritime and Port Authority of Singapore), preparing background information such as capacity to comply, consultations with the private sector and convincing them of the conventions' benefits, preparation of facilities and preparation of legislation. Singapore, thus, enjoys the social, economic and environmental benefits of acceding to these conventions.

During the discussion, it was clarified that under the law, the Singapore reception facilities are required to service every ship making a request. MPA has not yet received any complaints about the facility operator refusing to service a ship making a request, although the agency would promptly act on such a complaint, or complaints involving the unreasonableness of the service charges. MPA also implements port state control very strictly, but due to the volume of ships it has to prioritize inspections. While everything is not perfect in Singapore, MPA's efforts are fairly effective in ensuring compliance with MARPOL. Regarding the discharge of garbage from ships, currently, Singapore laws only prohibit the discharge of garbage into Singapore waters. However, Singapore is scheduled in April 1999 to accede to Annex V of MARPOL. When the Annex takes effect, all ships will be prohibited from discharging garbage anywhere.

Legal Framework for Transboundary Marine Pollution from Offshore Oil and Exploration Activities

Prof. Gao Zhigou outlined the legal framework for transboundary pollution management in relation to offshore oil exploration and development. Prof. Gao initially dealt with the global conventions (e.g., UN Convention on the Law of the Sea, the 1972 London Convention, and MARPOL 1973/78) and regional conventions (e.g., the 1972 Oslo Convention, the 1992 OSPAR Convention, the 1994 Energy Charter Treaty, the 1994 Mediterranean Protocol and the 1989 Kuwait Protocol) which govern offshore oil exploration and development. Prof. Gao noted that most of these conventions only had reference to activities affecting the marine environment but did not have any specific reference to pollution from oil exploration activities. He noted that the 1994 Protocol to the Convention for the Protection of the Mediterranean Sea Against Pollution is the only convention which specifically deals with transboundary marine pollution resulting from offshore oil exploration activities. The legal framework for offshore oil exploration also includes soft law principles, an example of which is UNEP Guidelines which have been recommended by the UN General Assembly for adoption by the States. At the national level, pollution from offshore oil exploration and development is governed either by national regulatory laws and rules on marine pollution or by stipulations of specific development contracts or joint venture agreements for oil exploration entered into with the national government. Prof. Gao commented on the absence of concerted legal development in regulating pollution from offshore oil exploration and development activities as well as the absence of a general framework to deal with the issue resulting in a confusion of jurisdictional arrangements. Existing conventions such as the London Dumping Convention and MARPOL cannot bridge these regulatory lacunae because these conventions cannot be implemented in the absence of national laws. Prof. Gao recommended the adoption of a regional approach in lieu of the global approach as a better strategy in the development of regulations and the harmonization of rules and standards. The process towards regional regulations is long and hard but it is a step to ensure that the petroleum resources are explored and developed in a safe and sustainable manner.

The Need for Guidelines on the Implementation of Marine Pollution Treaties

Ms. Juita Ramli emphasized the need for guidelines on the implementation of marine pollution treaties as municipal law in East Asian countries. Since the 1972 Stockholm Conference, more than 50 treaties for the protection of the marine environment have been developed. Many words and phrases that recur in these treaties are left undefined or ill-defined, leading to a situation where terminology accepted as standards are not interpreted in a universally uniform manner. Examples of these phrases are "dumping", "marine environment", "prevent, reduce and control pollution", "environmental damage", "integrated", "precautionary" and "anticipatory". This results in a low level of implementation due to the failure of implementing agencies to fully grasp the obligations, responsibilities and rights created by the treaties, or a tendency to interpret the clauses to suit specific purposes, leading to ineffective and inefficient implementation of the treaties. Furthermore, disparate interpretations among States in a region hamper efforts to harmonize environment policies, as required by several of the treaties. East Asia is the only region, which has yet to develop a regional marine environment protection treaty. There is a need for collaboration of the States within the region to identify the common ground for interpretation of vague treaty provisions and principles, to agree to develop guidelines towards harmonizing policies and to identify significant principles for shared interpretation.

It was brought up during the discussion that things are not perfect in Europe either, and the meaning of the "precautionary principle", and such phrases as "toxic persistent bioaccumulable" are constantly under debate. Other problems in Europe involve cooperation among ports. In East Asia, several offshore structures are ready for abandonment, and need a consensus in the region for action on their proper disposal.

Harmonization of Local Legislation

Mr. Li Haiqing described a case in Xiamen, China towards harmonization of national legislation. Mr. Li provided some basic facts about Xiamen and discussed certain laws on marine resources and on marine environmental protection. He particularly cited the example of the Regulations on Dumping of Wastes at Sea and mentioned that there are also national laws on navigation and shipping, as well as laws on scientific survey and research. Mr. Li enumerated the deficiencies in the laws mentioned which include: (1) sectoral in approach; (2) absence of integrated ocean policy-making and coordination mechanism among government department; (3) absence of national laws on coastal zone management; (4) absence of an implementing agency for laws on the territorial sea and the contiguous zone, or for the EEZ and the continental shelf; and (5) absence of a unified law enforcement system. Mr. Li emphasized the need for marine legislation, since the laws are: (1) outpaced by the rapid development of the economy; (2) national laws are too general; and (3) law enforcement organs are not clearly spelled out in some local legislation. What is needed then is a set of new laws to address the emerging problems in coastal management. The existing legislation also has to be harmonized with the local legislation. Taking advantage of the legislation right granted to Xiamen by the National People's Congress in March 1994, the city has been promulgating a set of laws and regulations covering nearly all fields of marine resources development and environmental protection.

An experience gained in sea-use planning which helped resolve several multiple use conflicts in Xiamen was presented by Dr. Huming Yu. He focused on the marine zoning scheme and its integration into the integrated coastal management program. The rationale, principles and classification of the zoning scheme were discussed. Based on the functional characteristics of each sea area, traditional practices and their best uses, the sea areas of Xiamen were first broadly classified into four zones and the prime activities determined. Within each zone, subsidiary activities could be accommodated. Dr. Yu also discussed the zoning process as well as the political and conceptual difficulties in the preparation and adoption of the zoning scheme. Resolution of multiple resource use conflicts in the West Sea was cited to demonstrate the effectiveness of the zoning scheme.

Environmental Guarantee Funds and Environmental Monitoring Funds

Atty. Brenda Jay Angeles reviewed the effectiveness of environmental impact assessment and the use of environmental guarantee funds (EGF) and environmental monitoring funds (EMF). She described the evolution of the EIA system in the Philippines where it has moved from a command-and-control approach to a community-based and market-based approach, and from use as a regulatory tool to use as a planning and management tool. She attributed these shifts to a number of factors, including: (1) shifts in perception of the value of the process; (2) the adequacy or inadequacy of enforcement measures; (3) the need for public access to information and public participation in the process; and (4) the need for monitoring responsibility. The incorporation of the two types of funds, namely the EMF and the EGF to the EIA system was discussed. The EGF and EMF provide advantages to the government, project proponents and the stakeholders, especially the host communities. For the government, the funds allow better performance of its mandate despite limited resources and capacities, and allow opportunities for partnerships with the private sector. For project proponents, the funds ensure caution in project implementation, an increased role in environmental management, and the availability of funds for contingencies. For the stakeholders, the funds provide a venue for increased citizens' participation, greater access to information and security and assurance of protection in contingencies.

The Philippine experience has shown that the following should be considered when establishing EMFs and EGFs: fund security and administration; the form and amount of the fund; the procedures involved (such as assessment, claim and payment); and the legal and operational issues. To fix the amount of the fund, the following factors must be taken into consideration: 1) commitments that have been made under the EIA process; 2) the degree of environmental risk involved; 3) the valuation of resources that would most likely be affected, and 4) the proponent's ability to provide the funds. Application of the funds is valuable to prevention and management of marine pollution because it promotes the positive collaboration and partnerships among various sectors, it has applicability in current efforts, and it may be replicated in other East Asian countries.

Devolution of Coastal Management to Local Governments

Atty. James Kho traced the devolution of coastal management to local governments in the Philippines. The Philippine legal framework on local autonomy is enshrined in the Philippine Constitution and is implemented in the Local Government Code of 1992, granting vast powers and functions to local governments that include the duty to protect and manage the coastal and marine environments. The devolution of powers through the Local Government Code of 1992 has empowered local governments to devise creative programs to address the multifaceted problems confronting them. The Fisheries Code of 1998 also granted the local governments the jurisdiction over municipal waters for its management, conservation and utilization. Atty. Kho discussed the experiences of two local governments that are active in coastal and marine resources management: 1) Batangas Provincial Government in Batangas Bay; and 2) El Nido Municipal Government on the El Nido Marine Protected Area, Palawan. Atty. Kho particularly expounded on the achievements and outputs of these local initiatives in relation to the devolution of some of the functions to the provincial government and municipality, respectively. Atty. Kho concluded that the main limiting factor in the attainment of integrated coastal management is the absence of a clear policy for devolution. He pointed out the need for harmonization of the Local Government Code with other national laws such as the National Integrated Protected Areas (NIPAS) Law and the necessity for continued capacity building of local governments. Local governments need national support in funding, technical expertise and integration with national planning development strategies. A phased approach to devolution may provide the key to solving the problem.

Discussion regarding national and local government conflicts in relation to the identification of protected areas and the jurisdiction over these areas followed. It was pointed out that there are mechanisms to avoid conflicts under the NIPAS Law of the Philippines. For example, the law requires consultation of stakeholders, including local governments in the identification of protected areas. Furthermore, various stakeholders, including the local governments are mandatory members of the Protected Area Management Board (PAMB), which is the body tasked to manage the protected area. Hence, while the protected area is still under the jurisdiction of the national government, the local government is ensured that it is represented in all levels of decision-making.

Application of Science and Technology

Science and technology have helped unravel features and processes occurring in the marine environment and coastal areas, showing the vulnerability of the ecosystems to human activities. They provide reliable information and data that form the basis for sound management interventions. Today, useful technologies, methodologies and analytical tools are indispensable to our deeper understanding of the marine realm. This session focused on the status of marine environmental management, some interventions that have been found effective, as well as other technical issues (e.g., environmental impact assessments), and uncertainties in science that environmental managers have to contend with.

Application of Science and Technology in Environmental Management

In her paper on the application of science and technology for environmental management, Dr. Helen Yap pointed out the inability of many scientists to communicate effectively with managers. This is one of the main reasons for the lack of good application of science and technology in many coastal management initiatives. Her paper focused on the role of natural sciences (e.g., physical oceanography, marine chemistry, biology and ecology) and technology (e.g., remote sensing, autonomous instruments, analytical techniques, biological indicators, prognostic modelling, data assimilation, geographic information systems, expert systems and information highways) in marine environmental management. Citing her own experience, Dr. Yap asserted that scientists are perceived as arrogant and that many stakeholders believe that scientists tend to put their own agenda above everything else even in matters that concern resource conservation. She recommended that scientists and managers should talk *to* each other and not *at* each other to resolve the issues she presented.

A comment was made stating that scientists often look at a problem from an ivory tower and prescribe theoretical solutions accordingly. They should come down to the ground and try to understand the problem and suggest solutions, which are relevant and practical.

Environmental Impact Assessment

Dr. John Gray reviewed the effectiveness of environmental impact assessments (EIAs). He emphasized that many EIAs are poorly designed and do not predict the effects. More often than not, after the EIA process was completed, no followup work was undertaken to determine whether the predictions of environmental effects were accurate. He pointed out that standard EIA practices undertake only limited and short-term surveys before the project is implemented. He stressed the need to undertake continuous assessment during and after the project was completed. His paper also emphasized the importance of statistical tests, power analysis in particular, to determine if predicted changes in fact occur.

Marine Biodiversity

Prof. Edgardo Gomez highlighted the need to determine the value of natural resources so that this can be considered in management decision-making. He pointed out that while East Asia is reputedly the epicenter of marine biodiversity of a large number of taxa inhabiting shallow waters, current management efforts have not been adequate to prevent the continued degradation of the ecosystems especially coral reefs.

Prof. Makoto Omori, on the other hand, reviewed the scientific advances in coral reef restoration or rehabilitation being done in Okinawa, Japan. In an attempt to develop coral reef restoration technology, scientists at the Akajima Marine Science Laboratory in Okinawa conducted reproductive (i.e., mass spawning) and recruitment studies of corals. In addition to developing the appropriate technology for rehabilitation purposes, several actions that were identified to support this initiative include education and public awareness, government action/legislation, scientific research and technological development for restoration.

Red Tide Management

Prof. Rudolf Wu described the status of red tide management in Hong Kong. It was highlighted that problems remain in predicting the occurrence of red tide in Hong Kong, as is the case in majority of other countries. Given existing technology, it is better to utilize practical approaches focusing on monitoring and mitigatory measures for minimizing loss. Among the components of the program in Hong Kong are the establishment of 'mobile squads' for monitoring red tide incidents and for timely relocation of fish cages in the event of red tide episodes.

Use of Information Technologies

Dr. Donald Hodgins presented a software system called Integrated Information Management System (IIMS) which is being developed and implemented by the GEF/UNDP/IMO Regional Programme. The objectives of the IIMS include: (1) standardization of multidiscipline data collection and recording; (2) improving the quality and uniformity of the data collected; and (3) integrating data into a common software system for time- and cost-effective analysis. Dr. Hodgins described the concept and components of IIMS and provided an example of its application, particularly for pollution policy and management analysis. It was mentioned that the prototype IIMS is reaching the first stage of development and will be tested at the end of March 1999 with a limited dataset from Batangas Bay.

Dr. Hodgins made clear during the discussion that the database is reliable but has certain limitations.

Mr. James Paw described the preparation and applications of a management atlas. The prerequisites, design, contents and presentation were discussed in detail including a comparison of the features of both printed and electronic atlases. Mr. Paw stressed the linkage with geographic information system (GIS) as the major source of spatial data and cited the advantages. It was pointed out that since the atlas is a self-contained system, the contents particularly spatial information, can be easily outdated. Suggestions were made to address this issue to enable the atlas to maintain its viability over a longer time period. Finally, the existing and potential applications of the management atlas were presented which range from integrated coastal management (ICM) to risk assessments and EIAs including specialized applications such as facility site selection and critical area/special area management.

Mr. Christer Colliander emphasized how remote sensing can assist in coordinating oil spill response planning and improve oil spill management. Mr. Colliander discussed the possible applications of remote sensing in combination with GPS positioning and GIS in the different phases of an oil spill incident. He emphasized that this combination is an effective tool for qualified contingency planning and in the implementation of coastal management programs. The speaker outlined the planning process, the spill surveillance mechanisms and the management of the spill response using this technology. Mr. Colliander concluded that through this technology, improvement in the control and overview of oil spill incidents at sea could be facilitated.

Dr. Cesar Villanoy presented the hydrodynamic modelling in Batangas Bay. He reviewed the development of a 3-D numerical circulation model for the bay to obtain advective velocity fields for pollutant dispersal modelling. An oil spill trajectory model was also applied to simulate hypothetical oil spills from the location of oil refineries in Batangas Bay. Results show that tidal currents are not strong enough to flush the waters in the northern part of the bay. With respect to the simulations of pollutant releases, there is limited flushing from the southwest when winds are absent. Releases in the northernmost part of the bay results to the entrapment within the area regardless of wind direction. It was recommended that additional data are required to refine the models further, although they can serve as diagnostic tool for monitoring purposes.

Based on the above and several related studies, a water use zoning scheme was developed for the Batangas Bay. In presenting the scheme, Prof. Ernesto Serote emphasized that this initiative is the first attempt in this country and cited the importance of such undertaking in an archipelagic country such as the Philippines. The Batangas Bay area is characterized in terms of its biophysical features and the existing patterns of utilization both of the bay water and of the landward part of the coastal zone. The water use zoning scheme is intended to resolve the existing and potential resource use conflicts. The proposed scheme designates three categories of use zones: (1) restricted use zone; (2) exclusive use zone; and (3) multiple use zone. The activities allowed on each of these zones were delineated. A fourth zone, waterfront land use zone, was added to attain rational and efficient utilization of the area of interface between land and water. Prof. Serote also discussed the institutional arrangements for implementing the scheme. The involvement and consultation of the different stakeholders in the decision-making process have helped minimize or resolve the conflicts of interest between the different users of the bay. He concluded that the success of implementing the scheme would rely on the role of the Batangas Bay Environmental Protection Council.

Water Quality and Related Issues

The scientific basis for deriving water quality standards for coastal management was presented by Dr. Paul Lam. He stressed the importance of ecological risk assessment, which is a set of procedures that can be used to assist decision-making in order to minimize potential harm to the ecosystems arising from anthropogenic activities. Review of the approaches and methodologies in setting water quality standards was discussed, in particular, that of North America and Europe. It was argued that there is a need to establish similar water quality standards for the East Asian coasts. The experience of Hong Kong in establishing fisheries and marine ecological criteria was used as an example why water quality standards have to be system specific and how they were derived using toxicological information gathered from local species. The benefits and drawbacks of toxicity testing using local species to be used for water quality standard were discussed. The need for a cooperative regional approach for coastal management was recommended considering the transboundary nature of pollutants.

Clarification was made on how to relate the extrapolates/endpoints to costs and benefits since risk assessment is site specific and RQs are based on endpoints. In order to maximize the costs or benefits from risk assessment, it is important to identify the target or objective and relate the RQ as a measure of impacts on the targets.

In a closely related subject, Prof. Rudolf Wu expounded on the pressing problem and scientific challenges of marine hypoxia. He outlined the causes of marine hypoxia and the ensuing problems associated with it. The speaker pointed out that increasing anthropogenic input of nutrients and organic wastes into the coastal environment has caused large-scale hypoxia causing major changes in the structure and function of marine communities as well as the trophic relationship of marine food chains. Prof. Wu presented the global situation and trend as well as the biological and ecological responses to hypoxia. The challenges consist of developing cost-effective pollution control technologies and cost-effective monitoring techniques to reduce the ecological risk of hypoxia. In addition, relating biochemical and physiological responses to ecological effects was also put forward. Although there is information available on biochemical and biological responses of organisms to hypoxia, very few attempts have been made to relate this sub-organismal responses to Darwinian fitness traits. This makes it difficult to predict ecological risk from laboratory data.

On her discussion on the role of mangrove swamps as pollutant sink and wastewater treatment facility, Dr. Nora Tam presented data collected from 18 mangrove swamps in Hong Kong with elevated concentrations of several pollutants. Based on this, an ongoing field study has been conducted at the Futian National Nature Reserve, China where municipal sewage was discharged into the landward region of the mangrove forest. Results showed the ability of mangroves to effectively treat municipal wastewater. It was stressed, however, that accumulation of excess pollutants in soils would affect the microbial communities therein. Careful consideration must be exercised in utilizing mangroves as wastewater sink particularly the long-term effects of strong wastewater such as industrial effluents as the efficiency depends on the type of mangroves and the waste being discharged. Basically, the plants trap excess nutrients and metals before they are discharged into the water.

In presenting the regional scientific efforts in improving efficiency of marine pollution monitoring approaches and techniques, Dr. Gil Jacinto introduced the ASEAN-Canada Cooperative Programme in Marine Science-Phase II: water quality standards and marine pollution monitoring. Dr. Jacinto presented the strengths and challenges during the course of the seven-year project involving seven participating countries from the ASEAN to establish marine environmental criteria for the development and management of living marine resources and human health protection. Criteria documents for 15 water quality parameters were prepared. It was stressed that while the programme was able to arrive at relevant criteria for the region, arriving at a common standard was difficult and may not even be necessary as each country may establish its own based on the criteria developed. The speaker emphasized that among the major improvements the programme has done were interlaboratory comparisons, addressing the issues on quality assurance/control, access to certified reference materials in doing analysis and some changes such as improved capacity of the region in marine pollution monitoring.

Stakeholders' Participation

Almost every sector of a maritime nation has a strong stake in the coast and the ocean, in particular, the economic sector whose activities may directly or indirectly impact the marine environment. This session discussed how various stakeholders addressed the issues of environmental protection and management from different perspectives. Each case highlights in varying manner, the need for a participatory approach and the involvement of the local community including women, the youth and media in environmental management.

Womenfolk and Youth

Senator Helena Benitez spoke on the women stakeholders' position in environmental management. According to the senator, women constitute the largest sector in the coastal communities in most countries. Women's role in managing pollution of the seas is integral and consistent with their role as nurturers of home and children. She emphasized that women in Asia are considered as "work addicts", citing a recent survey by a woman's magazine, where 78% of Asian women relate accomplishment and fulfilment with the amount of work done. In relation to this, Senator Benitez mentioned that the National Council of Women of the Philippines, an umbrella organization of more than 200 women's organizations, has a membership base of more than 10 million Filipino women who can be harnessed in environment-related endeavors. Combining the energies, commitment and capabilities of women plus providing ways and means of their participation would translate to effective response to the challenges for managing pollution in the East Asian Seas.

A comment was made that the role of the youth is equally important and should be included in any environmental protection efforts. The youth's involvement, however, should be directed and supervised by people with experience and background to allow them to set up their priorities in a systematic manner.

A public awareness program, known as Batangas Bay Watch, involving the youth in the Batangas Bay Region was reported by Engr. Evelyn Estigoy. The program involved the youth as active partners in the protection of the bay. A particularly attractive feature of this effort is the involvement of students from different educational institutions in Batangas. Bay Watchers, as the members of the program are called, aim to become role models by not committing to the polluters, to influence their peers and family (advocacy), become aware of environmental laws, rules and regulations and help disseminate these objectives and thus, influence compliance. Some of the activities of the Batangas Bay Watch include holding of seminars on ecological waste management, campus cleanup, and community outreach programs (adopt-a-*barangay*). The enhancement of environmental awareness in the younger generation is worthy of replication elsewhere.

Role of Media

Atty. Manuel Satorre reflected on the role of media in marine environmental protection and management. He argues that the support of community and the people in sustainable development projects can be generated by harnessing the mass media through reportage not only of the projects but also of vital environmental issues, which directly affect their lives and the environment. According to Atty. Satorre, the media today is preoccupied with the coverage of other issues ranging from politics, economics, culture, arts, entertainment and others. These issues get immediate media attention because they impact directly on the lives of the media audience. Environmental issues, however, are sometimes seen as very complicated and remote that unless there is immediate impact on the community, they are not usually covered. Such impacts usually come in the form of tragic situations such as people poisoned by eating polluted shellfish or fish, people suffering from floods or people getting sick from chemical poisoning from factories. In certain situations, media simply ignores environmental issues probably because they do not have a clear understanding of what is happening. In our society, if one does not understand an issue, it is oftentimes ignored. It was argued that environmental programs should make a special effort to train journalists to report on environmental issues, including the marine environment. There should be a continuing training program for members of the media to understand pressing issues and be able to form partnerships with program managers. Such training and partnership would enhance responsible reporting on the environment.

An issue was raised regarding overblown coverage by the media. Atty. Satorre cited an example during a fishkill, wherein blame was immediately pinned by the media on a certain company. Subsequent investigation showed that the company was not to blame, since they had a wastewater treatment plant. According to the Department of Environment and Natural Resources, the fishkill was caused by cyanide used by fishermen. Unfortunately, the NGOs and local legislators picked up such news stories. Journalists must check the facts and observe accuracy and objectivity in news reporting to uphold their credibility. It was further discussed that the environmental situation is usually complicated. Thus, the scientific community has the responsibility to put their findings in language that people can understand, with the help of media. To this end, a well-written article must be understandable even to a five year-old. The Asia-Pacific Forum of Environmental Journalists, in the conduct of its training to young environmental journalists, stresses this element.

Public Opinion

Mr. Joost H.M. De Ruig focused on the Dutch experience on the interactive approach with stakeholders in coastal zone management. The first attempt towards an interactive or participatory policy approach (PPA) in The Netherlands was the Delta project in the 1970s. Public opinion resulted in important changes in the original design of the project. In the late 1980s, lessons learned were used in the establishment of a long-term policy regarding the erosion of the Dutch coast in which stages in public opinion and phases of the policy life cycle have been linked. Mr. De Ruig mentioned that at present, the "dynamic preservation" policy offers opportunities for a more integrated approach in the coastal zone. Essential elements include a multisectoral and multidisciplinary approach and input from a number of (non-) government stakeholders. Likewise for large-scale land reclamation plans like the construction of the Amsterdam Airport in the sea, all relevant partners in the coastal zone should be involved in the early stages, which is a real communication challenge for a custom-made interactive strategy with stakeholders.

Local Community Involvement

Dr. Angel Alcala discussed the role of the community in environmental management. Dr. Alcala highlighted the importance of community-based approaches in coastal resources management. However, he stressed the need to organize communities to make them effective, i.e., a working, empowered community organization with capabilities of performing the different tasks of resource management. He also suggested that for communities to be most effective, they should be able to manage simple projects such as putting up of marine reserves, constructing artificial shelters for fish and producing salt from seawater. Certain issues were raised regarding the effectiveness of community participation. Dr. Alcala assured the participants that community-based approach is generally effective for ecosystem management.

Community-based approach is also adopted by the ongoing Coastal Resource Management Project (CRMP) in the Philippines. In introducing the CRMP efforts, Dr. Alan White presented an analysis of the situation of marine resources in relation to the approaches for coastal management. The project put emphasis on integrated approaches to management focusing on fisheries management and habitat protection. A framework was developed for measuring successes in implementing best practices. According to Dr. White, results from selected sites were satisfactory especially in satisfying the following requirements: (1) budget allocation; (2) formation of organization; and (3) adoption of best CRM practices. Examples of economically-driven alternatives were also presented as well as the information campaign and linkages developed. Community participation was generated by initially training people at the municipal level and the process is replicated in the barangays (villages).

In relation to the above initiatives on community participation on environmental issues, the pilot project setting on waste recycling in Batangas Bay by the Urban Waste Expertise Program (UWEP) was presented. Mr. Palmares described the four pilot projects being carried out by UWEP, all of which are focused on developing local expertise and generating participation of community residents. Various forms of participation were described. Problems encountered in the initiation and implementation of the different pilot projects were identified.

Donor and International Agencies

Dr. Tim Boyle highlighted the diversity of stakeholders that are normally involved in pollution management. They include the central and local governments, local communities, NGOs, academic communities and the private sector. He emphasized the importance of stakeholders' consultation in the design, implementation and participation in project development and its implementation. He called for the promotion of institutional network of NGOs, which will complement regulatory mechanisms in reducing pollution risks.

On the role of donor and international agencies, Dr. Boyle informed the participants the availability of financial resources through the GEF/UNDP to support projects in any of the four focal areas of GEF: a) international waters; b) biodiversity; c) climate change; and d) ozone depletion. He encouraged participants to take advantage of the opportunity to strengthen their efforts in contributing to the global improvement of the Planet Earth.

S e s s i o n I

Integrated Management of Marine Pollution

Integrated Coastal Management: An Effective Mechanism for Local Implementation of Coastal and Marine Environment Related International Conventions

Chua Thia-Eng

GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas
P.O. Box 2502, Diliman, Quezon City 1165, Philippines

CHUA THIA-ENG. 1999. Integrated coastal management: An effective mechanism for local implementation of coastal and marine environment related international conventions, p. 3-23. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The paper discusses the coastal and marine environmental management difficulties, compounded by changing production and consumption patterns. The operational modality of integrated coastal management (ICM) is described, supported with case studies to illustrate its effectiveness as a mechanism to resolve complex environmental and management issues in the coastal areas. The generic framework of ICM and its planning and implementation processes are presented as the two main pillars of an ICM program. The effectiveness of ICM in implementing marine environment conventions is also discussed with appropriate examples. The paper discusses the application of ICM in addressing major global environmental concerns through operationalizing the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities and Agenda 21. ICM can be a blueprint for achieving the goal of sustainable development in the coastal areas.

INTRODUCTION

Multiple use conflicts and environmental degradation are two major interrelated social and environmental consequences that threaten sustainable development of the coastal areas where a large part of the world population lives and substantial national economic development occurs. The situation is aggravated by the changing production and consumption patterns in the last few decades brought about by an increase in living standards and national policies of most nations to accelerate economic growth after the Second World War. This is especially so in many developing nations in Asia.

The management of marine natural resources in Asia was rather relaxed in the early 1950s. The marine resources were abundant and the fishery supply adequate. However, with increasing population and immense economic growth after the 1970s, the natural resource base was rapidly eroded. Single sector management has gradually become ineffective to regulate open access to natural resource exploitation and to reduce the increasing use conflicts between sectors. The rise of civil consciousness of the adverse effects on the health of the ecosystems and the public, of the increasing loss of ocean heritage and of the realization of the threats to sustainable development has led to global efforts in searching for better management options and methodologies.

The need for a more comprehensive, coordinated and integrated approach in addressing the above problems resulted in the development of a new environment and natural resources management mechanism three decades ago. Since the 1970s, this new mechanism has been operational in various forms such as coastal resources management (CRM), coastal zone management (CZM), integrated coastal zone management (ICZM), coastal area management (CAM), integrated coastal area management (ICAM) and recently, integrated coastal management (ICM) (Cicin-Sain and Knecht, 1998).

Initially, ICM was conceptualized to address obvious multiple resource use issues as a result of increasing competition for the limited coastal and marine resources. It began with a conservation focus (Clark, 1992, 1996) aiming at conserving the ecosystem and the marine flora and fauna. In recent years, ecosystem management and community-based management became an integral part of the ICM program (see case studies in Clark, 1996). The operational modality, however, underwent various transformations and improvement as more resource management and environmental projects were being implemented. Sorensen (1997) identified about 180 ICM related projects in 90 nations during the last three decades. The scope of operation covered by an ICM program has greatly widened as the resource management and environmental issues have become more complicated.

Over three decades of trial and error, appropriate operational modality has now been developed to address various environmental and resource management issues of the coastal and marine areas. ICM is effective because it provides a local management framework, facilitates policy and functional integration, establishes institutional arrangements (including organizational and legal arrangement), formulates strategic and action plans for management interventions, creates policy and partnership environment for environmental financing, provides scientific support and monitors environmental changes. It promotes stakeholders' participation and mobilizes community support in protecting the integrity of the ecosystems (Cicin-Sain and Knecht, 1998; Chua et al., 1999).

ICM Working Models: East Asian Initiatives

In East Asia, ICM is a relatively new management concept although it has gained increasing recognition by coastal managers as a viable management tool. In Southeast Asia, ICM initiatives were launched as early as the 1980s. There are different levels of successes despite investment of large amount of financial and human resources. In 1994, the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas established two ICM demonstration sites in Xiamen, China and Batangas Bay, Philippines. Both sites successfully completed the first ICM cycle (Chua, 1998; Chua et al., 1999).

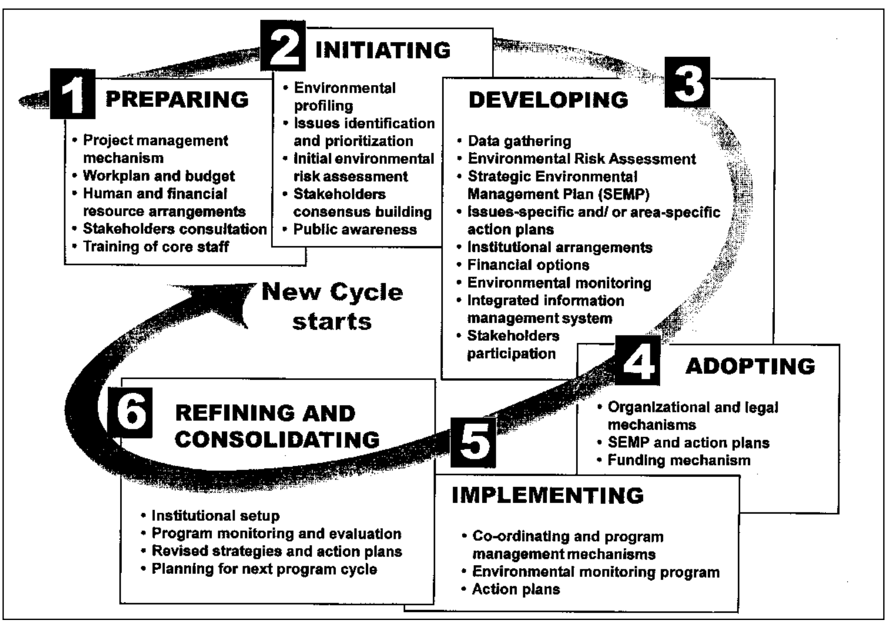
Xiamen is a coastal municipality with more than 1.2 million people. It is situated close to the island of Taiwan and is considered as one of the rapid economic growth areas of China. Xiamen has a coastline of 234 km and a sea area of 334 km^2 while the total land area is 1,516 km^2. The major environmental challenges are the fouling of the Yuandang Lagoon with sewage and industrial effluents, conflicts between competing users for sea space and natural resources, contamination of coastal waters, coastal erosion, frequent occurrence of red tides, destruction of habitats such as mangroves and threats to endangered species (ITTXDP, 1996).

The Batangas Bay Region, on the other hand, is situated in Luzon, the northern island of the Philippines. It is made up of five coastal municipalities and has a total population close to 600,000. Batangas Bay has a total sea area of 220 km^2 and a coastline of 470 km. The total land area is 1,460.7 km^2. The environmental challenges of the Batangas Bay Region are the waste problems arising from inadequate control and treatment of all types of wastes ranging from toxic wastes from hospitals and industrial plants along the bay to solid wastes, sewage and oily wastes from ships. Batangas Province is one of the key meat-producing centers in the country. Organic wastes from pigs and poultry are also a major concern. The country's second largest port is located on the coastline of the bay and navigational traffic is expected to be high with concomitant increase of chronic and accidental oil spills. Fishery production in the bay is declining and certainly the livelihood of the fishermen has become a social issue (MTE, 1996).

Although the causative factors of environmental degradation and unsustainable use may vary between the two sites, the socioeconomic and ecological consequences are basically similar. Despite differences in social, economic and political structures, management measures to resolve multiple use conflicts and environmental degradation are essentially the same. Policy and management interventions were administered and the results were very encouraging.

Based on the experience and lessons from the two demonstration sites as well as those from other national and international initiatives, the essential elements needed to operationalize an ICM program had been refined, tested, incorporated and packaged into working models that could be applied elsewhere in other coastal areas. These elements were presented as a sequential part of the ICM program development and implementation cycle (Figure 1). The operational details are given in an earlier paper (Chua, 1998).

Figure 1. The ICM Program Development and Implementation Cycle.



The execution of an ICM program using the sequential steps indicated in the cycle would enable the practitioner to assess the progress made. A set of performance indicators were developed (Chua, 1998). These indicators measure the level of achievements with respect to planning and implementing processes (process indicators), the ecological improvements that take place after management interventions (status indicators), the removal of ecological stresses (stress removal indicators) and the social impacts (social indicators) and program sustainability (sustainability indicators). While all ICM initiatives will add value to the environmental protection efforts, the use of performance indicators will certainly enable one to measure its cost-effectiveness.

Local Implementation of International Agenda

The management framework of ICM facilitates the local implementation of a number of environment and sustainable development related international agenda. These include the local implementation of Agenda 21, the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, London Convention, International Convention for the Prevention of Pollution from Ships (MARPOL), Framework Convention on Climate Change, Convention on Biological Diversity and Code of Conduct for Responsible Fisheries and others.

Agenda 21

Chapter 17 of Agenda 21 calls for effective application of integrated environmental planning and management of coastal and marine areas to address multiple use conflicts and the protection of the marine ecosystem. Agenda 21 requests governments to develop integrated coastal policy, apply preventive and precautionary principles and the involvement of stakeholders and communities.

The ICM framework and processes provide a stepwise approach in achieving the provisions of Agenda 21. A good ICM program normally incorporates the seven principles of ICM good practices as discussed and agreed upon at the international conference on "Integrated Coastal Management in Tropical Developing Countries: Lessons Learned from Successes and Failures" (Chua, 1996). The seven principles of ICM good practices are (IWICM, 1996):

1. Adopt a systematic, incremental approach;

2. Involve the public;

3. Integrate environmental, economic and social information;

4. Establish mechanisms for integration and coordination;

5. Institute sustainable financing mechanisms;

6. Develop ICM capacity at all levels; and

7. Monitor the effectiveness.

Agenda 21 was adopted during the United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro in 1992. While the noble goal of Agenda 21 is to achieve sustainable development, specific programs in achieving these goals depend on the understanding of the concept and the ability to adopt appropriate policies and management approaches and methodologies. ICM is one such approach for local implementation of Agenda 21.

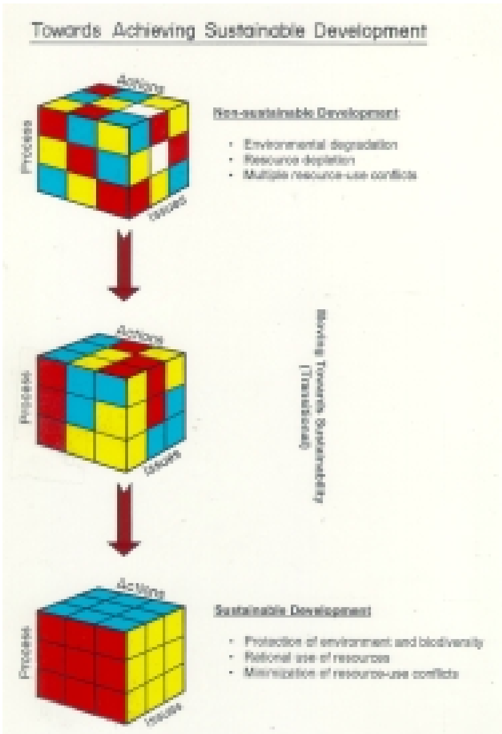
Sustainable development is a long process requiring a combination of policy, management and technological interventions in addressing use conflicts and protecting the functional integrity of the environment. It requires a good mix of central and local government policy, local capacity to plan and manage the coastal resources, availability of financial resources, adequate regulatory controls and law enforcement as well as a good system to monitor environmental changes. Such mix of efforts can only be achieved over time, with patience and collaboration among the various concerned agencies and sectors. It requires adequately coordinated efforts to do things in the right way at the right time. The effectiveness of ICM follows an evolutionary process, and is highly related to how the various steps in the development and implementing cycle are executed. The operation of ICM is compared to a "rubic cube" (Figure 2) which requires skill, patience and effort to place the same color in the same dimension of the cube (Chua et al., 1999).

The unique features of ICM are:

- Integrates sea-use planning into coastal land-use plans;

- Strengthens local government capacity to undertake environmental management;

Figure 2. The Operation of ICM as Compared to a Rubic Cube.



- Creates an institutional arrangement for interagency and multistakeholders consultation;

- Harmonizes legislative requirements and their enforcement; and

- Applies scientific knowledge and appropriate technologies for management interventions.

The two ICM programs in Xiamen and Batangas Bay have fully demonstrated these features. In Xiamen, the implementation of the sea use zoning (Figure 3) effectively reduced the competing use of sea space between fishing and navigation (Chua et al., 1997) in the West Sea and between tourism and industrial development in the Gulangyu Island after the latter has been zoned for tourism development. In Batangas Bay (Figure 4), the traffic separation scheme enables the streamlining of incoming and outgoing shipping traffic at the Batangas Port, the second largest in the country. Scientific studies enable the local government to determine the siting of industries along the coastline in relation to the physical structure, environmental impacts of operation and the pollutant transport in the bay. Appropriate local legislation was adopted to harmonize legislative conflicts. In Xiamen, an integrated law enforcement team was established to enforce the legislation enacted by the provincial and municipal people's congresses. The implementation of the first ICM cycle in Xiamen and Batangas is the first step towards achieving sustainable development at the local level.

Socioeconomic and ecological benefits could be detected before or after completing the implementation of the first ICM cycle. As seen in the cleaning up of the Yuandang Lagoon, the socioeconomic benefits have eventually outweighed the cost (Chua et al., 1999). This strengthened political commitment and support from the stakeholders. The two local governments are now developing the second

Figure 3. Xiamen Marine Functional Zonation Scheme.

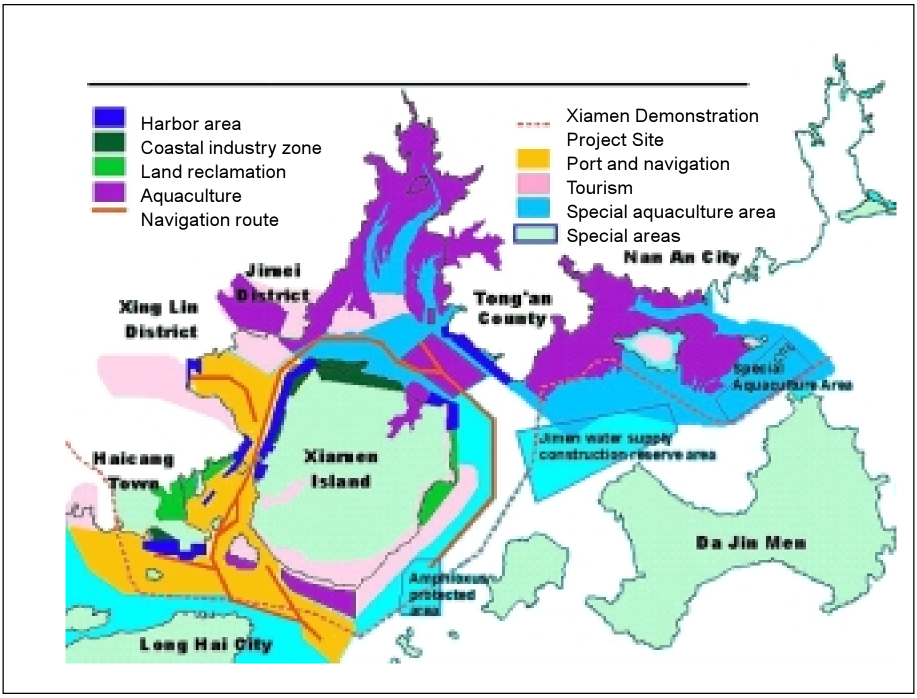
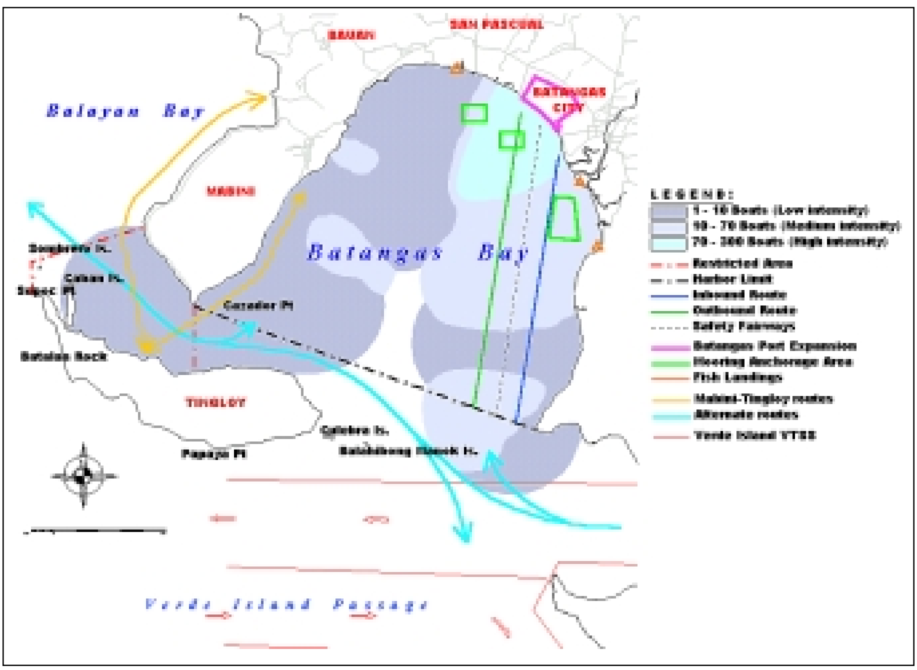


Figure 4. Marine Zoning Scheme in Batangas Bay.



cycle of ICM using its own financial resources. This is an encouraging sign of sustainability. If such ICM efforts can be continued and sustained by the local governments, achieving the goals of sustainable development will not be very far away.

CODE OF CONDUCT FOR RESPONSIBLE FISHERIES

Article 10 of the above Code highlights the integration of fisheries into coastal area management. The Code recognizes the significant impacts of other external activities on the management of fisheries resources and aquaculture practices. Therefore fisheries and aquaculture development at the local level should be considered and managed within the ICM framework so as the impacts of externalities could be more effectively mitigated.

The Code also provides guidance on institutional framework, policy measures, regional cooperation and implementation (FAO, 1995; Caddy,1996).

Although the two ICM programs in Batangas Bay and Xiamen Municipality focused on pollution prevention and management, the problems of fisheries and aquaculture development encountered in Batangas Bay and Xiamen were also addressed. The Fisheries Agency is represented in the interagency committee of the Xiamen Municipality. It thus plays a very significant role in policy and management interventions that may affect fisheries and aquaculture. In Xiamen, the main fisheries and aquaculture related problems were: (a) conflicts between fishing and shipping arising from the harvest of eel fry in the navigational route of the West Sea; (b) conflicts between fish farming and shipbuilding; (c) inadequately regulated fish farming practices leading to overcrowded fish farms; and (d) degraded water quality affecting fish growth and public health.

The establishment of a zoning scheme in the municipal waters of Xiamen helps in resolving the above-mentioned issues. The Code emphasizes that "zoning is a common approach in the resolution of intersectoral difference involving fisheries especially using time and area restrictions". As the primary function of the West Sea has been designated for navigation, eel fry gathering within the main navigational route is, therefore, not encouraged. Similarly, coastal areas designated for shipbuilding under the scheme must also be protected from the encroachment of cage culture practices. The zoning scheme was established with the consensus of concerned stakeholders and government agencies and has been effective in mitigating and lessening the long-standing use conflicts. On the other hand, overcrowded fish cages and oyster rafts in the various bays around the island of Xiamen have resulted in self-pollution and poor fish growth. Carrying capacity assessment undertaken through the ICM program suggested that the environmental absorption capacity has been overstretched and that there is a need to cut down annual production from 11,000 to 8,000 tons*/yr in order to ensure optimum production. At the same time, new culture areas have been zoned which allowed the displaced fish farmers to continue with their livelihood.

A multiagency, collaborative water quality monitoring program was installed. The monitoring program constantly provides the local government information on the condition of the water quality as well as the occurrence of red tides. This information is essential not only for the management of fisheries and aquaculture in the coastal waters but also for marine recreational activities and tourism as well.

Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (1995)

UNEP's Global Programme of Action (GPA) (1995) recommends the application of ICM framework for the protection of the marine environment from land-based sources of pollution. The recommended strategies and activities (see Box 1) are already integral components of an ICM program. Indeed, ICM strengthens the effectiveness of local governments in pollution prevention, control and mitigation. The two working models in Xiamen and Batangas Bay fully illustrate the operational modality of GPA at the local level.

It is only through the collective efforts of local governments that total pollution load can be effectively reduced. GPA recognizes the need for a long-term strategic and programmatic approach in addressing marine pollution caused by land-based activities. However, central government policy and support are absolutely necessary for providing

Box 1. Strategies and Activities of the GPA.

- Issues identification and assessment
- Priorities and management objectives
- Strategies and approaches
- Criteria for evaluation of strategies and measures
- Program support elements
  - Institutional arrangement
  - Financial mechanism
  - Research and monitoring
  - Contingency planning
  - Human resource development

* *1 ton = 0.907 tonnes*

the general policy guidance and for enabling local governments to secure the necessary financial and human resources to develop and implement the ICM programs. Financial incentives to adopt integrated planning and management, either through the support of central government or donor agencies, will certainly accelerate attainment of the GPA objectives.

The two marine pollution prevention and management programs for Batangas Bay and Xiamen have been in operation since 1994 before the GPA was formally endorsed. The essential activities recommended by GPA as shown in Box 1 are in fact incorporated in the ICM program framework. In Batangas and Xiamen, environmental and natural resource management issues were identified and prioritized. A long-term strategic plan was established to serve as framework for management intervention while specific issue-oriented action plans were formulated and implemented during the course of the ICM cycle. During the process, the cumulative impacts of coastal development were also assessed in relation to the carrying capacity of the area. The various program support elements in terms of organizational and legal arrangements, sustainable financing mechanism, environmental monitoring, scientific support and capacity building were incorporated as integral part of the ICM program.

FRAMEWORK CONVENTION ON CLIMATE CHANGE

The main impacts of climate change are changes in rainfall pattern, change in storm frequency and intensity and sea level rise. The consequences are inundation and flooding of low-lying areas, erosion and saltwater intrusion. The socioeconomic consequences are very serious. Many sectors will be affected, especially tourism, fisheries, aquaculture, agriculture and transportation. Climate change affects the supply of freshwater, contaminates water quality, disrupts human settlements, impairs human health and affects the normal operation of supporting and financial services.

The problems of climate change and the extent of likely socioeconomic impacts have been a subject of international debate. The issues summarized in the assessment report of the International Panel on Climate Change (IPCC) in 1995 are as follows:

1. Human-induced climate change is almost certainly now being felt and almost certainly will become increasingly apparent in decades ahead.

2. While the "cost" of dealing with climate change will be large, it can be reduced through the prudent use of the ICM approach.

3. Though mathematical models appear likely to produce a reasonable approximation of the global situation, they will not be able to produce scenarios at the regional and local scales. Hence, uncertainties must be taken into account in regional and local planning.

4. Unless feasible adoption of adaptive or retreat strategies are developed within the framework of ICM, unsustainable development could take place in coastal areas.

Guidelines for integrating coastal management programs and national climate change action plans have been developed (Cicin-Sain et al., 1997). The guidelines highlight the operational modality to include:

- Better understanding of the concept and principles of ICM;
- Improving the scientific and information base of ICM;
- Improving institutional capabilities at national and subnational levels among NGOs and communities and enhancing capabilities for enforcement and voluntary compliance;
- Building consensus among stakeholders;
- Organizing education, training and outreach programs; and
- Financing and implementing management strategies.

The above guidelines are similar in approach and content with those highlighted in the ICM program development and implementation cycle and the seven principles of ICM good practices briefly described in this paper. In view of the fact that most coastal areas have yet to experience the impacts of sea level rise, its severity is not fully recognized nor considered to be of government priority. On the other hand, most countries have now realized the usefulness of ICM and its application will enable local governments to include sea level rise problems in their strategic action plans. This will enable local governments to adopt adaptive or retreat strategies in areas where impacts of sea level rise are predicted.

CONVENTION ON BIOLOGICAL DIVERSITY (1992)

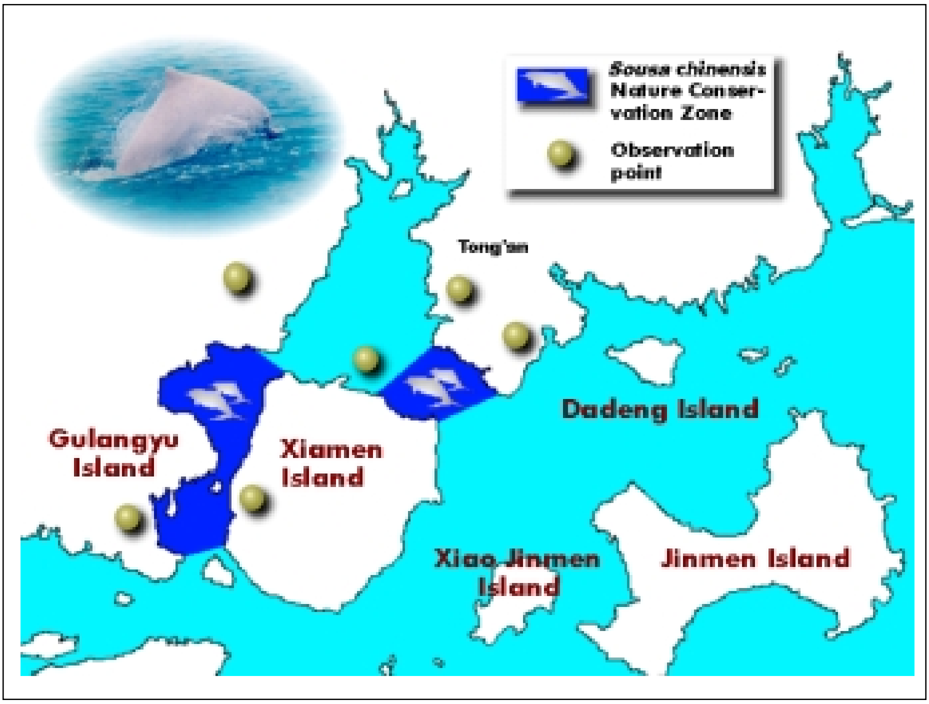
One of the major outcomes of the Second Meeting of the Conference of Parties to the Convention on Biological Diversity (CBD) (1992) in Jakarta, 1995 was Decision II/10 on the "Conservation and Sustainable Use of the Marine and Coastal Biological Diversity" which is also known as the "Jakarta Mandate". An important recommendation with reference to ICM is quoted herewith:

> *"encourages the use of integrated marine and coastal area management as the most suitable framework for addressing human impacts on marine and coastal biological diversity and for promoting conservation and sustainable use of this biodiversity [and] encourages Parties to establish and/or strengthen, where appropriate, institutional, administrative, and legislative arrangements for the development of integrated management of marine and coastal ecosystems, plans and strategies for marine and coastal areas, and their integration within national development plans"* (UNEP, 1995).

Cicin-Sain and Knecht (1998) noted that as the Conference of Parties and the Subsidiary Bodies of the CBD continue their implementation of the convention, ICM is being seen as an important tool in protecting coastal and marine biodiversity. This observation is fully demonstrated by the experience in the ICM initiative in Xiamen (Chua et al., 1999).

The zoning scheme for the marine areas within the administrative jurisdiction of Xiamen Municipality Government is able to designate priority use of the sea space based on their primary, secondary or accessory functions (see Ruan and Yu, this vol.). Protected areas for endangered species were set up within the zoning framework. The Chinese white dolphin *(Sousa chinensis)*, the egret *(Egretta eulophotes)* and the lancelet *(Branchiostoma belcheri)*, a rare living fossil are now being protected through the zoning scheme within the overall ICM framework of Xiamen (Figure 3). The West Sea of Xiamen is an important habitat for the Chinese white dolphin, a species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The area is designated as a Nature Reserve (Figure 5). This area, however, is also a navigational route. In order to reduce the potential use and legal conflicts, the local authority of Xiamen issued a special administrative ordinance to protect the dolphin and also allow navigation. The salient points of the administrative ordinance as quoted in Chua et al. (1999) are:

Figure 5. Nature Conservation Zones for Chinese White Dolphin *(Sousa chinensis)* in Xiamen, China.



- No bottom trawling or gill netting;
- No high speed recreational boating and surfing;
- No effluent discharges, unless under permit and in keeping with relevant standards;
- Special permits required for reclamation; and
- No underwater explosions and other activities that would disturb the habitat or increase suspended sediment loads in the water column.

The Fisheries Agency established a division to manage the conservation of the white dolphin especially the full enforcement of the administrative ordinance. Observation points were set up along the coast. A Special Fund for White Dolphin Protection was also established in 1997 with contribution from 19 public institutions and 900 individuals. As a result of the enforcement of the ordinance, no dolphin catching or killing has been reported since then.

An island in the West Sea known as the Dayu Island was also declared as a bird sanctuary. The egret, which is the mascot of Xiamen, was abundant a few decades ago. Its number declined considerably due to habitat destruction. The conservation of the Dayu Island provides protection for its habitats. The egrets have now returned and bred. There is no human settlement on the island. However, bird watching for tourists and local residents is allowed within vessels cruising around the island.

The Tong'an Bay in Xiamen is one area where the *Amphioxus*, commonly known as lancelet, is found. A few decades ago, this living fossil had been fished for human consumption. Production, however, had declined from as high as 286 tons four decades ago to less than a ton in 1970. The remaining habitat near Liuwudian in Tong'an Bay has now been declared as a protected area.

The incorporation of protected areas within the framework of ICM not only enables the best use of public resources in the management of these protected areas at the local level but also ensures cost-effective management and results. The significance of the Xiamen experience is that conservation of biodiversity is manifested through the ICM process when the needs and values of conservation are fully identified and recognized by the local stakeholders. Integrating conservation into ICM is a paradigm shift from the conventional approach. Dutton and Saenger (1994) suggested that a broader vision is required in which marine conservation is integrated at a range of scales and across a range of resource management systems.

The integrated management approach has now been widely adopted in the management of marine reserves (see Brunckhorst, 1994).

Marine Pollution Related Conventions

A number of marine pollution related conventions developed through the International Maritime Organization (IMO) such as the London Convention (1972), the MARPOL Convention (1973/78) and through the United Nations Environment Programme (UNEP) such as the Basel Convention (1989) require local implementation. The ICM program in Xiamen and Batangas Bay demonstrated how some of these conventions were implemented at the local level.

London Convention 1972

Table 1 shows how the provisions under the 1996 Protocol of the London Convention 1972 are addressed through the ICM framework. Many of the articles such as Articles 2, 3(1), 3(2), 3(3), 4 and 6 can be effectively addressed under the ICM mechanism.

Table 1. ICM as Framework for Implementation of 1996 Protocol to London Convention 1972.

1996 Protocol	ICM Framework
(a) Contracting parties shall individually or collectively protect and preserve the marine environment. (Article 2)	(a) Planning and management framework (b) Integrated waste management including dumping
(b) Apply precautionary approach to environmental protection from dumping of wastes or other matters. [Article 3(1)]	(a) Risk assessment/EIA
(b) Promote practices whereby those it has authorized to engage in dumping and incineration at sea bear the cost of meeting the pollution prevention and control requirements for the authorized activities. [Article 3(2)]	(a) Damage assessment (b) Polluter pays principle (c) Determination of dump site at sea
(c) Not to transfer, directly or indirectly, damage or likelihood of damage from one part of the environment to another, or transport one type of pollution to another. [Article 3(3)]	(a) Intersectoral and interagency cooperation and integration (b) Harmonization of procedures and compliance
(d) Avoid dumping in favor of environmentally preferable alternatives. (Article 4)	(a) Integration of waste management practice (b) Development of waste treatment facilities on land
(e) Procedures and measures to determine and monitor pathways of contaminants entering the environment. (Article 6)	(a) Pollution monitoring

Ocean dumping of organic wastes generated from the manufacturing of monosodium glutamate in Xiamen has become an issue with the Chinese Government's accession to the 1972 London Convention and its 1996 Protocol. Under Annex I of the convention, ocean dumping of uncontaminated organic materials of natural origin needs to meet the appropriate criteria for the disposal sites (in terms of depth, dilution, distance from shore, etc.). The existing ocean dumping site (Tazio dump site) is too close to the coast and may not meet the requirements of the convention because past dumping of wastes contributed to the increased sedimentation of the navigational channel in the West Sea. After a comprehensive evaluation of the existing site, the local government prohibited the dumping of wastes in the area in October 1990. From 1990 to 1994, an alternative site, much further away from the shore located at Zhenghaijiao near Wuyu islet, was identified. The site is a high-energy environment with a water depth of 13-30 m and 16 km away from the shore of Xiamen. Field tests and environmental impact assessments were undertaken with respect to the dumping of waste from the manufacturing of monosodium glutamate. The proposed site was found to be suitable based on the criteria in Annexes I, II and III of the convention.

However, in view of the distance, the manufacturer found that it is too expensive to dump the wastes at sea. As a result, ocean dumping in Xiamen coastal water was completely stopped in 1995.

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)

The primary objective of MARPOL 73/78 is to prevent the pollution of the marine environment by discharge of harmful substances or effluents from ships. MARPOL 73/78 consists of 6 annexes, i.e., Oil (Annex I), Noxious Liquid Substances in Bulk (Annex II), Harmful Substances Carried by Sea in Packaged Form (Annex III), Sewage (Annex IV), Garbage (Annex V) and Air Pollution (Annex VI). While a large majority of the countries in the world have already acceded to all or some of the annexes of the convention, many countries especially those in the developing world, have difficulties in effectively implementing the provision.

The administration of MARPOL requires on-ship inspection, monitoring and detection of violations and their follow-on investigation and prosecution. This requires local technical and enforcement capability in addition to adequacy of national legislation. A primary requirement of MARPOL is that contracting parties must ensure adequate port reception facilities. They are also expected to report any discharge or probable discharge of oil or noxious liquid substance carried in bulk or in packaged form.

In coastal areas where port management is included within the general management framework of ICM, the implementation of MARPOL Convention can be included. In Batangas Bay, where the second largest port of the Philippines will be sited, the establishment of port reception facilities has been included in the Integrated Waste Management Action Plan for Batangas Bay Region (MPP-EAS, 1996). In Xiamen, port reception facilities were established with funding support from the World Bank.

Conclusion

Over the last three decades, the number of countries practicing ICM has increased. Despite the limited success, the experiences and lessons learned have driven the process forward. Although the ecological and socioeconomic benefits of ICM need to be fully documented, they are increasingly being recognized by policy-makers and coastal managers. The cost- effectiveness of ICM is well demonstrated in the two working models described in this paper. However, ICM is only a tool and an approach. If properly adopted and its program adequately implemented, the process itself can lead to the attainment of sustainable development goals. In fact, ICM can be considered as a blueprint for sustainable development at the local level. Indeed, it is an appropriate tool for local implementation of national Agenda 21 for the coastal areas.

However, ICM is not a magical tool. Its effectiveness depends on a number of important factors: policy, local capacity, financial resources and stakeholders' participation. It is the combined effects of the above elements that make ICM work.

The success of local implementation of ICM can also influence national policy. The successful story of Xiamen was highlighted in the recently published Chinese Government White Paper on Marine Development (Information Office, China, 1998). Central Government directives to propagate the experience of the ICM program in Xiamen have resulted in increased interest in ICM and their adoption in a number of coastal areas in the country.

The appropriateness and effectiveness of ICM for local implementation of a number of environment related international conventions illustrated an added value to the usefulness of the integrated management approach. ICM opens up a new environment management horizon and opportunities that were not fully understood in the past. The cost-effectiveness demonstrated in Batangas and Xiamen shall enhance their wider applications.

References

Brunckhorst, D.J. 1994. Marine protected areas and biosphere reserves: Towards a new paradigm. Proceedings of a Workshop. Australian Nature Conservation Agency.

Caddy, J.F. 1996. A checklist for fisheries resources management issue seen from the perspective of the FAO code of conduct for responsible fisheries. FAO Fisheries Circular 917. Food and Agriculture Organization of the United Nations, Rome.

Chua, T.E., Editor. 1996. Lessons learned from successes and failures of integrated coastal management initiatives. MPP-EAS Technical Report No. 4, 90 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Chua, T.E., H. Yu and G. Chen. 1997. From sectoral to integrated coastal management: A case in Xiamen, China. Ocean Coastal Manage. 37(2): 233-251.

Chua, T.E. 1998. Lessons learned from practicing integrated coastal management in Southeast Asia. Ambio 27(8): 599-610.

Chua, T.E., S.A. Ross, H. Yu, G. Jacinto and S.R. Bernad. 1999. Sharing lessons and experiences in marine pollution management. MPP-EAS Technical Report No. 20, 94 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Cicin-Sain, B., C.N. Ehler, R. Knecht, R. South and R. Weicher. 1997. Guidelines for integrating coastal management programs and national climate change action plans. Developed at the International Workshop: Planning for Climate Change Through Integrated Coastal Management, 24-28 February 1997, Taipei. 31 p.

Cicin-Sain, B. and R.W. Knecht. 1998. Integrated coastal and ocean management: Concepts and practices. Island Press, Washington, D.C. 517 p.

Clark, J.R. 1992. Integrated management of coastal zones. FAO Fish. Tech. Pap. No. 327. Food and Agriculture Organization of the United Nations, Rome. 167 p.

Clark, J.R. 1996. Coastal zone management handbook. Lewis Publishers, New York. 694 p.

Dutton, I. and P. Saenger. 1994. Expanding the horizons of marine conservation: The challenge of integrated coastal management. *In* D.J. Brunckhorst (ed.) Proceedings of the Workshop on Marine Protected Areas and Biosphere Reserves: Towards a New Paradigm. Australian Nature Conservation Agency.

FAO (Food and Agriculture Organization of the United Nations). 1995. Code of conduct for responsible fisheries. FAO, Rome. 41 p.

Information Office, China. 1998. The development of China's marine affairs. Information Office, State Council, Beijing, People's Republic of China.

ITTXDP (Integrated Task Team of the Xiamen Demonstration Project). 1996. Strategic management plan for marine pollution prevention and management in Xiamen. MPP-EAS Technical Report No. 7, 60 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

IWICM (The International Workshop on Integrated Coastal Management in Tropical Developing Countries: Lessons Learned from Successes and Failures). 1996. Enhancing the success of integrated coastal management: Good practices in the formulation, design, and implementation of integrated coastal management initiatives. MPP-EAS Technical Report No. 2, 32 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

MPP-EAS. 1996. Integrated waste management action plan for the Batangas Bay Region. MPP-EAS Technical Report No. 9, 76 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

MTE (Multidisciplinary Team of Experts). 1996. The coastal environmental profile of the Batangas Bay Region. MPP-EAS Technical Report No. 5, 148 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Sorensen, J. 1997. National and international efforts at integrated coastal management: Definitions, achievements and lessons. Coastal Manage. J. 25.

UNEP (United Nations Environment Programme). 1995. Report of the Second Meeting of the Conference of the Parties to the Convention on Biological Diversity. UNEP/CBD/COP/2/19. 70 p. + annexes.

A "Clean" and "Safe" Malacca/Singapore Straits: The Reality and the Dream

Mark J. Valencia

East-West Center
1601 East-West Road, Honolulu
Hawaii, 96848-1601, USA

VALENCIA, MARK J. 1999. A "clean" and "safe" Malacca/Singapore Straits: The reality and the dream, p. 24-57. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The reality is that the Malacca/Singapore Straits are a nexus of the coastal use conflicts in the region. The Straits are already "dirty" and are likely to get "dirtier" because pollution loads from sewage, agriculture and industry are unlikely to abate. Shipping traffic, including tankers, will increase due to growth triangles, increased oil imports from the Middle East and proliferation of refineries along the Straits. Although the Straits States have made considerable progress in addressing sea-based pollution, gaps in, and problems with the safety regime remain.

The dream is that the Straits States will cooperate to institute comprehensive sea-use planning for the Straits, including harmonized ship regulation, new routing patterns, management of hazardous cargoes, environmental impact statements, and enhanced monitoring and regulation of land-based inputs. The state of the environment of the Straits should be assessed, and a dynamic atlas for marine policy prepared. Institutional responses could include enhanced compensation funds and a Straits Management Authority. The Straits can be made considerably "cleaner" and "safer" than they are now.

Introduction

The Malacca/Singapore Straits are neither "clean" nor "safe". Nor will they ever be completely "clean" and completely "safe"! However, the Straits are hopefully "safer" now than they have ever been. And they can be considerably "cleaner" and "safer" than they are now. This paper addresses the reality of the present and the probable future of the Straits, and suggests *how* they can be made "cleaner" and "safer".

The Present Situation

The Malacca/Singapore Straits are a nexus of the coastal activities and use conflicts in the region (Jaafar and Valencia, 1985). The Straits are a major transport route for oil tankers. But they are shallow, hazardous to navigation, and characterized by narrow channels and shifting bottom topography. The nearest substitute for most through navigation is the Sunda Strait between Sumatra and Java but it is too shallow for very large crude carriers (VLCCs). The Lombok Strait off Bali is deep and wide enough to reduce the risk of accidents but adds considerable mileage. The Malaysian ports of Penang, Port Klang and Port Dickson; the Indonesian port of Dumai; and the world class port of Singapore are situated on the Straits. Refineries are located in Port Dickson, Sungei Pakning, Dumai, Singapore and Batam. The outputs of the region are clearly competitive in some areas (Table 1). For example, logging and agro-industrial waste disposal damage fisheries and tourism while cross-traffic and fishing vessels may create hazards for tankers in transit and vice versa.

Much of Malaysia's population and industrial/agricultural processing activity is concentrated on the west coast of Peninsular Malaysia, discharging wastes directly or indirectly into the Straits.

The Straits are already "dirty". Land-based sources are thought to contribute as much as 70% of the pollution in the Straits (Chua et al., 1997). The wastes include organic materials, suspended solids, heavy metals, petroleum hydrocarbons, synthetic organic compounds—including pesticides and herbicides—and sewage. Major causes of concern are heavy metal contamination, nutrient loading leading to harmful algal blooms, fecal coliform contamination, tributyltin contamination, oil and chemical spills, and sedimentation. The level of contamination and the impact of these pollutants on human and ecosystem health need to be examined. As a concrete example, in 1993, samples collected off Kedah, Malacca and Negeri Sembilan all exceeded the zero tolerance limit for oil and

Table 1. Activity/Issue Matrix for the Malacca/Singapore Straits.

Activity	Shipping	Fishing	Mining	Environmental Protection	Security
Shipping	Cross-channel vs. transit traffic	Traffic in fishing areas		Oil spills Other pollution from vessels Regional contingency plan Regional SASRAT*	Smuggling Piracy Illegal traffic/dis-charges Regional traffic surveillance
Fishing	Fishing in traffic lanes	Traditional rights Access to surplus stocks Trawling vs. traditional fishing Regional fish marketing		Resource depletion	Poaching
Mining	Interference or obstruction	Displacement of fisheries	Uncoordinated development	Regional contingency plan for blowouts Pollution	
Environmental protection				Pollution from land-based sources	
Security					Regional surveillance and enforcement
Boundary resolution	Port development	Undefined property rights	Undefined property rights	Unregulated vessel discharges	Boundary/lo-cation area gained

* Slop and Sludge Reception and Treatment Center.
Source: Jaafar and Valencia (1985).

Table 1. Activity/Issue Matrix for the Malacca/Singapore Straits.

Activity	Shipping	Fishing	Mining	Environmental Protection	Security
Shipping	Cross-channel vs. transit traffic	Traffic in fishing areas		Oil spills Other pollution from vessels Regional contingency plan Regional SASRAT*	Smuggling Piracy Illegal traffic/dis-charges Regional traffic surveillance
Fishing	Fishing in traffic lanes	Traditional rights Access to surplus stocks Trawling vs. traditional fishing Regional fish marketing		Resource depletion	Poaching
Mining	Interference or obstruction	Displacement of fisheries	Uncoordinated development	Regional contingency plan for blowouts Pollution	
Environmental protection				Pollution from land-based sources	
Security					Regional surveillance and enforcement
Boundary resolution	Port development	Undefined property rights	Undefined property rights	Unregulated vessel discharges	Boundary/lo-cation area gained

* Slop and Sludge Reception and Treatment Center.
Source: Jaafar and Valencia (1985).

grease, and near the Riau archipelago, hydrocarbon levels were as high as 1,000-11,500 µg/l. Sublethal effects on mussels (*Mytilus edulis*) can be observed at 20 µg/l (Chua et al., 1997). Fish kills, algal blooms, paralytic shellfish poisoning, and pollution hot spots of heavy metals and hydrocarbons already indicate serious degradation of the marine environment of the Straits.

And the Straits are likely to continue to be "dirty" or even get "dirtier". In 1989, the estimated biological oxygen demand (BOD) loading from domestic sewage discharged in the coastal areas of Indonesia, Malaysia and Singapore was 5,014 tonnes*/day. The BOD loadings are expected to increase to over 6,000 tonnes/day by the year 2000 (Table 2).

Table 2. Estimated BOD Loadings from Sewage Discharges in Coastal Areas of the Littoral States Bordering the Malacca Straits.

Year	Parameter	Indonesia	Malaysia	Singapore
1989	National population (million)	184.6	20.14	2.7
	Total BOD load (tonne)	9,230	870	324
	Coastal population (million)	110.76	12.8	2.7
	% national population	65	60	100
	Daily BOD load in coastal area			
	Generated (tonne)	5,538	565	324
	Primary treatment (%)	60	70	10
	Secondary treatment (%)	0	5	90
	Daily BOD removal (tonne)	997	144	272
	Residual daily BOD disposal (tonne)	4,541	421	52
2000	National population (million)	222	20.9	2.9
	Total BOD load (tonne)	11,100	1,045	348
	Coastal population (million)	133.2	13.58	2.9
	% national population	60	65	100
	Daily BOD load in coastal area			
	Generated (tonne)	6,600	679	348
	Daily BOD removal (tonne)	1,199	173	313
	Residual daily BOD disposal (tonne)	5,461	506	35

Source: Koe and Aziz (1995), cited in Chua et al. (1997).

Tin mines are scattered throughout the Thai isthmus and the Malay Peninsula, and logging activity is significant on Sumatra, all generating much sediment and contributing to coastal accretion. Petroleum is being produced along the coasts of north and central Sumatra and petroleum exploration is ongoing off southwest Thailand and the west coast of Peninsular Malaysia. Bottom tin mining is ongoing from Phuket northwards, and exploration has been undertaken off Johor, Malacca, Negeri Sembilan and Penang.

* *1 tonne   1 metric ton*

Pollution loads from industry are significant and destructive and are unlikely to abate (Table 3). Industrial waste is mostly generated from agro-based and manufacturing industries including food beverage processing, palm oil and rubber processing, tapioca starch processing and other manufacturing industries for fertilizers, textiles, pulp and paper, tanneries and sugar. Industrial sources of hazardous waste are the mining, energy production, oil refining and pharmaceutical sectors, as well as hospital and health-care facilities and research laboratories. Heavy metals, such as lead, mercury, cadmium and silver from the manufacturing sector are discharged into rivers and coastal waters, mostly untreated. These agricultural and manufacturing industries form the backbone of the economies of the Straits States.

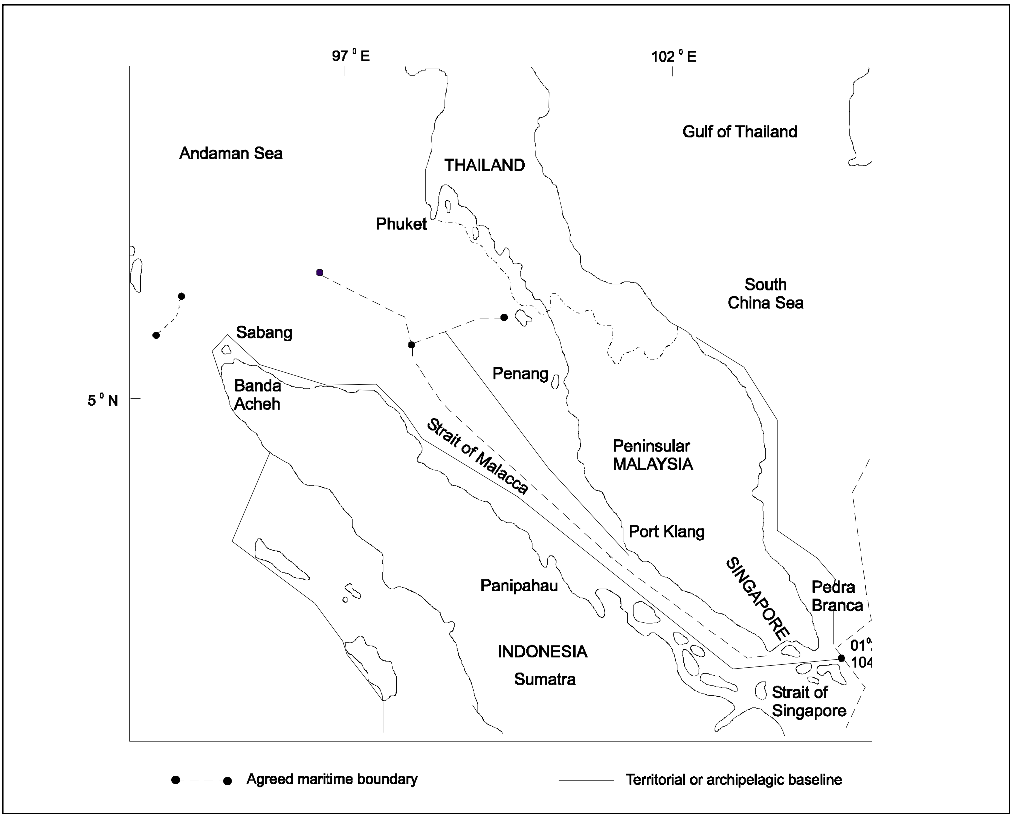
Table 3. Origin and Characteristics of Major Marine Pollutants from Land-based Sources.

Type of Pollutant	Origin	Main Characteristics
Domestic Sewage	River discharges or direct outfall.	High bacterial count, high BOD; high nutrient concentrations with eutrophication potential.
Municipal Solid Waste	Direct dumping or river discharge.	Interference with fishing operations, causes damage to marine life, is unsightly and causes beach pollution.
Industrial Wastes		
• Organic industrial waste (sulfite, phenols, polycyclic, aromatics, benzene, alpha-naphthylamine, oil products, etc.).	River discharges, coastal pipelines, marine dumping by chemical factories, refineries, pulp and paper mills and atmospheric fallout of gaseous emissions.	Many are toxic to marine life and cause oxygen depletion; affect higher forms of marine flora and fauna.
• Inorganic industrial waste (acids and alkalis, nitrates and phosphates, mercury, lead, zinc, chromium, cadmium, arsenic, bismuth, antimony, selenium, etc.).	River discharges, coastal pipelines, marine dumping by chemical factories, refineries, metal finishing and atmospheric fallout of gaseous emissions.	Most metals are toxic to marine life. Some heavy metals (e.g., mercury, lead and arsenic) are toxic to human beings. Nitrates and phosphates are nutrients with eutrophication potential.
• Pesticides (herbicides, organochlorine compounds, carbamate compounds, insecticides, fungicides, germicides, rodenticides, etc.). Most common forms are DDT, BHC, Dieldrin, Endrin, Aldrin and Endosulfan.	Agriculture and forestry, marine absorption of atmospheric sprays, runoff from agricultural uses, floods, dumping, burning and drainage.	Some are toxic to marine life, especially in upper level of the food chain, causing chronic mammalian toxicity and adverse effects on sea birds. High concentrations may result in damage to fish.
Mining, Dredging and Quarrying	Dredging operations, disposal of mining and quarrying spoils into the marine environment.	Heavy concentrations of suspended materials cause serious changes in marine life and danger to fish population in spawning and nursery grounds. Can kill marine plant and animal life; often interfere with spawning.

Source: Koe and Aziz (1995), cited in Chua et al. (1997).

The Straits are also not completely safe for shipping nor do all operators behave responsibly, thus increasing the risk of additional oil pollution in the Straits. The Europe and Middle East-Far East shipping route that traverses the Malacca and Singapore Straits and the South China Sea is one of the busiest in the world (Figure 1). Some 90% of Japan's oil imports move through this region as do most of the oil imports of the Republic of Korea and Taiwan. Oil moving to China and Hong Kong along this route is also increasing. Eastbound tankers proceeding along the Malacca/Singapore Straits through the South China Sea are generally loaded with crude oil from the Middle East and bound for East Asia. They also carry crude oil from Nigeria and Algeria (IPE, 1993).

Figure 1. The Malacca and Singapore Straits.



The alternative route for VLCCs (200,000-300,000 gross registered tonnes [grt]) and ultra large crude carriers (ULCCs) (greater than 300,000 grt) is through the deep Lombok/Makassar Straits and the Celebes Sea south of Mindanao through the Surigao Strait and northward through eastern Philippine waters. VLCCs save about 1,000 miles or three days by using the Straits and ULCCs coming from the direction of South Africa save 200 miles. The Straits route is used by 72% of eastbound loaded tankers, while the Lombok/Makassar Straits route is used by the rest. In terms of deadweight tonnage as well as the volume of oil carried, however, the share is about even. All tankers, including ULCCs in ballast, can use the westbound route through the Straits (Fairplay International, 1993).

During the past two decades, shipping traffic in the Malacca Straits rose from an average of 119 vessels transiting the Straits daily in 1982 to around 274 vessels daily in 1993. During the past decade, the average annual rate of increase in shipping traffic through the Straits was 8%. Shipping traffic in the Straits is projected to increase further to around 598 vessels daily by the year 2000. A ship either enters or leaves Singapore harbor on an average of every two minutes. In 1996, 117,723 vessels called at Singapore for an average of 9,000 vessels per month. Traversing Singapore Strait to enter or leave the port is like crossing a busy intersection without traffic lights.

In 1994, 1995 and 1996, the number of vessels passing the One Fathom Bank Lighthouse was 34,446, 30,251 and 31,672, respectively, excluding vessels stopping at Port Klang, and fishing vessels (Dow, 1993). About 35% of these were oil tankers, i.e., 11,069, 8,915 and 9,815, respectively (Table 4). Thus, an average of 30.3, 24.4 and 26.9 oil tankers per day passed through this section of the Straits in 1994-1996. More than 60% of these tankers were larger than 200,000 grt (Hamzah and Basiron, 1996). Another source puts the percentage of supertankers at 33% and petroleum product carriers at more than 50% (Noer and Gregory, 1994).

Table 4. Shipping Traffic in the Strait of Malacca by Type of Vessel (percentage).

Type of Vessel	Year										
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Tanker	35.5	40.0	37.3	35.6	35.3	34.3	32.9	32.1	28.5	31.0	31.2
Container	8.2	10.3	14.5	14.2	15.3	16.4	16.4	16.7	17.0	18.3	18.1
Tug	3.9	4.4	4.0	4.1	4.8	4.2	4.1	4.6	5.8	6.1	5.5
Fishing	5.0	6.9	5.8	5.6	4.2	4.5	4.5	4.7	5.8	5.1	4.2
Ro-ro	1.7	1.8	2.5	2.3	2.8	3.4	3.8	3.2	4.0	.4	3.5
Passenger	0.8	0.7	0.6	0.8	0.7	1.0	0.8	1.3	2.2	1.8	1.5
Naval Craft	1.2	0.9	1.0	1.3	1.5	1.1	1.0	1.4	1.4	1.0	0.9
Cargo Carriers	43.6	36.8	34.3	36.3	35.1	35.1	36.1	35.8	34.3	3.9	35.1
Others	0.2	0.0	0.0	0.1	0.2	0.1	0.2	0.2	----	---	---

Source: From data on the number of ships passing off One Fathom Bank in the Strait of Malacca furnished by the Marine Department, Peninsular Malaysia.

Control is made difficult by the fact that as much as 90% of the Strait of Malacca shipping traffic is purely foreign flagged transit traffic. Japanese interests owned 27.6% of the tonnage passing through the Malacca Strait in 1993, four times more than any other nation. Greece was second with 6.5%, and the United States was third with 6.2% of tonnage. The rest of the top ten owning nations are divided between maritime nations such as the United Kingdom and Norway, and Asian nations, such as Singapore and the Republic of Korea. The majority of owners in large states, e.g., Japan, Greece and the United States, fly flags of convenience. Norway, Taiwan and Malaysia are exceptions.

The current common concern of the States bordering the Malacca and Singapore Straits regarding shipping is oil discharged during routine passage of ships and accidental oil spills from mishaps involving ships, particularly oil tankers. Although accidents are the most dramatic sources of oil pollution, routine discharge of bilge water, cleansing of ballast and oil tanks, and leaks are also important sources of oil pollution.

Between 1977 and 1992, there were 71 shipping casualties in the Straits (Table 5) with 60% occurring since 1987.[1] Collisions and groundings were the most common types of marine casualties. Although general cargo vessels accounted for the largest percentage of casualties (Table 6), it is the number of tanker casualties (17%) that is of greatest concern to the littoral States because they possess the potential to cause serious pollution damage to the environment. There have been 54 such oil spill incidents in the Strait of Malacca since 1975 (Table 7). The major incidents resulting in large oil spills included the *Showa Maru*, the *Diego Silang* and the *Nagasaki Spirit* (Table 8). The combined spill from these three incidents alone was more than 26,000 metric tons of oil.

Table 5. Types of Shipping Casualties in the Malacca/Singapore Straits, 1977–1993.

Type	Number
Collision	25
Grounding/Stranding	13
Explosion/Fire	5
Foundering	7
Others	21
Total	**71**

Source: Lee (1994), cited in Chua et al. (1997).

[1] *Lloyd's Maritime Information Services (1994), as reported in Hamzah and Basiron (1996) records 476 casualties averaging 30 per year.*

Table 6. Breakdown of Shipping Casualties in the Strait of Malacca, 1977-1993.

Ship Type	Number of Incidents	Percentage
Container	3	4
Fishing	11	15
General Cargo	23	32
Government Craft	4	6
Passenger	6	8
Tanker	12	17
Tug	5	7
Others	7	10
Total	**71**	**100**

Source: Lee (1994), cited in Chua et al. (1997).

Table 7. Number of Oil Spill Incidents in the Strait of Malacca, 1975-1996.

Year	Total
1975	1
1976	1
1977	1
1978	1
1979	0
1980	1
1981	2
1982	2
1983	0
1984	1
1985	0
1986	7
1987	4
1988	8
1989	5
1990	2
1991	3
1992	5
1993	10
1994	5
1995	26
1996	31
Total	**116**

Source: Modified from DOE, Malaysia, cited in Muhammad Razif bin Ahmad (1997).

Table 8. Major Oil Spills (over 1,500 metric tonnes) from Tankers in the Malacca Straits, 1975-1997.

Year	Tanker Name	Cause
1975	*Heiwa Maru*	Grounding
1975	*Showa Maru*	Grounding
1976	*Mysella*	Grounding
1976	*Diego Silang*	Collision
1976	*Sealift Pacific*	Grounding
1978	*Sealift Meditterranean*	Grounding
1978	*Kountouriotis*	Fire/Explosion
1979	*Fortune*	Collision
1980	*Lima*	Collision
1983	*Monemvasia*	Grounding
1987	*El Hani*	Grounding
1988	*Century Dawn*	Collision
1992	*Nagasaki Spirit*	Collision
1993	*Maersk Navigator*	Collision
1997	*Evoikos*	Collision

Source: Modified from White (1994).

Then in mid-October 1997, the Malacca/Singapore Straits suffered from their largest oil spill to date—about 28,500 metric tons of heavy marine fuel oil—from the loaded eastbound tanker *Evoikos* which collided with the empty westbound tanker *Orapin Global*.[2] The 20.5 mile long slick drifted into Malaysian and Indonesian waters. Some 16 agencies, 60 vessels and a team of Japanese experts were engaged in the round-the-clock battle to fight the oil spill.[3] At the time of the accident, visibility at 8 km was good, the shipping lane was not congested and the port's navigation equipment was functioning perfectly. The vessel traffic system (VTS) had warned the westbound empty tanker *Orapin Global* that it was in the wrong lane and both ships three times that they were on a collision course. However, the managers of the Thai-registered *Orapin Global* claimed that the eastbound *Evoikos* cut across the lane for westbound traffic at a narrow angle, rather than at a right angle as required by the traffic separation scheme (TSS). On 20 October 1997 the captains of the two tankers were arrested by Singapore authorities and charged with reckless navigation and endangering, i.e., failure to take appropriate action to avoid the collision, and failure to reduce speed to prevent serious damage.[4]

---

2 *Reuters. Singapore oil spill threatens Malaysia. 22 October 1997; AFP. Singapore charges oil spill skippers as pollution spreads. 22 October 1997.*

3 *AFP. Singapore authorities end clean-up operation of oil spill. 6 November 1997.*

4 *AFP. Tanker captains arrested over Singapore oil spill. 20 October 1997.*

The fact is that the total number of shipping accidents is high and some of the pollution incidences have had serious environmental and economic consequences. Increasing numbers of transiting ships carrying large amounts of potential pollutants in this ever-increasingly congested waterway should raise concern.

Fishing and Fishing Boats

Fish production in the Strait of Malacca was about 865,000 tons* in 1990 and 884,000 tons in 1993. Indonesia and Malaysia each took about half of the total fish catch. There are 139 fishing villages along the west coast of Peninsular Malaysia supporting 70% of the fishing population. The Malaysian fishing industry has about 21% of the total number of fishing boats, but almost all of the 16,000 registered boats. Malaysian fishing vessels are powered and highly mechanized. The cumulative effect of oil discharge from these vessels is not insignificant. In 1994, nearly 60% of all Malaysian landings came from the Strait while Indonesia's fisheries catch from the Strait ranked second only to that from the Java Sea (Hamzah and Basiron, 1996).

Responses

Land-based Pollutants

Although the Straits States share genuine concern about the threat of marine pollution, the level of concern and the capacity to respond to pollution vary widely among the Straits States. In managing the Straits, Malaysia and Indonesia have much more area and many more internal and external concerns to resolve than Singapore. Although all have environmental laws and regulations, their more intense efforts to tackle pollution are rather recent. Moreover, the countries have chosen different strategies to combat pollution making coordination more difficult.

Because of the expected high cost of administering the strategy of effluent variable standards, Singapore has adopted uniform standards. With its manageable size, Singapore has been able to introduce an additional option in which polluters are encouraged to utilize the state-run wastewater treatment plants. By utilizing these services, polluters do not have to treat their wastewaters fully before submission to these plants; thus, they save some costs.

* *1 ton = 0.907 tonnes*

Malaysia has introduced a mixed strategy issuing two sets of uniform standards for treated sewage and industrial effluents, and regulating its agriculture-based industries—palm oil and rubber. To regulate these industries, the Department of Environment has the power to exercise many options, such as controlling production or factory operations and specifying the conditions of discharge into watercourses or onto land. Other industries or sources of pollution have to comply with either Standard A or B, depending upon their locations: Standard A is applicable to discharges within drinking water catchments, and Standard B is applicable to those discharges outside such areas.

Indonesia has contemplated adopting a multiple-uniform-standards strategy by issuing four sets of uniform standards for discharges into four types of water bodies designated or used for drinking water and domestic water supplies, fisheries, agriculture and industry, and urban drainage for waste transport.

Sea-based Pollutants

The Straits States have made considerable progress in addressing sea-based oil pollution. Because modern construction methods had rendered tonnage measurements less relevant than size for purposes of regulation, an under-keel clearance (UKC) was adopted as an alternative criterion for size limitation on tankers using the Straits. Limitations based on size or deadweight tonnage would also have been unfair to westbound tankers and tankers which were not fully loaded. In 1975, the Straits States agreed on an UKC of 3.5 m and the establishment of a TSS in three critical areas in the Straits for vessels with a draft of more than 15 m, e.g., at (1) One Fathom Bank, (2) in the Philip Channel in Singapore Strait and (3) at the Horsburgh Light area. Both the Tripartite Agreement and the TSS and its details were adopted by IMO on 13 November 1977. The TSS came into effect in May 1980 and was supplemented by a Revolving Fund for the payment of compensation and damages arising out of pollution of the marine environment caused by accidents related to oil spills.

On 1 December 1998, with IMO approval, the Straits States implemented mandatory ship reporting (Straitrep) to enforce an extended TSS which stretches about half the length of the Straits (Hand, 1998). There is also a new inshore traffic zone (ITZ) which extends along the Malaysian coast between Port Klang and Tanjong Piai and is designed to keep power-driven vessels of 20 m and above from the coast. For vessels eastbound of over 15 m draught there is a new deepwater routing off Tanjong Menang. Unlike the existing deepwater route in the Singapore Strait, vessels will be permitted to overtake in the new deepwater route and to navigate at a "safe speed" where the maximum speed of 12 knots overground does not apply.

All vessels over 300 grt entering the operational area of Straitrep will be required to report to shore-based authorities. Ships violating the TSS will be dealt with either by the flag-state, if the vessel is transiting, or the coastal state concerned if it is calling at a port. A Malaysian vessel traffic information system (VTIS) also came on stream on 1 December 1998, allowing the entire TSS to be monitored by either Singapore or Malaysian authorities. Vessels which maneuver in an erratic or unsafe manner could also be liable to Port State Control (PSC) inspections under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW 78). PSC officers would board the vessel concerned and question seafarers to determine if they are compliant with Coregs. There is also a new rule on operational safety introduced under Rule 4—any vessel with defects affecting operational safety should have these fixed before entering the Straits of Malacca and Singapore.

When the marine electronic highway (MEH) is implemented for the Straits, safety should improve dramatically. The MEH is an important new concept which, when implemented, will revolutionize maritime traffic management, greatly improve safety of navigation and, in the long-term, may save money (McDonald and Anderson, 1997). The MEH is a network of national electronic navigational chart (ENC) databases which enables ship board guidance and computer systems to fully benefit from the worldwide advances in positional information generated by global positioning systems (GPS). The highway is a result of several emerging technologies including geographic information systems (GIS), digital hydrography and ocean mapping, as well as timely transmission of water level and current information to underpin the navigational decision-making of mariners. The underlying network of ENC databases is based upon approved international standards developed by the International Hydrographic Organization (IHO). The ENCs support and enable the use of precise navigation technologies—the Electronic Chart Display and Information Systems (ECDIS) and the Differential Global Positioning System (DGPS)—for precise continuous navigation. It represents the integration and networking of ENC databases with telecommunication technologies, as well as real-time water level and current information. The ENCs permit the user to make current, tide, wind, siltation and water level data interactive and three dimensional by using ECDIS. Mobile data communications will be required on vessels using the MEH to receive ENC update information, as well as real-time water level and current information. Vessels that add to the small incremental cost of transponders will be able to transmit position information to shore-based highway facilities, as well as receive position information of other vessels in the area and display the information on ECDIS, supplementing radar information.

Although this is a large task, the financial paybacks for the shipping community could prove quite attractive. Results of tests show increased safety; increased profits through incident free operations; longer hours of work in adverse conditions;

ability to operate when the traditional aids to navigation were removed or had malfunctioned; and decreased costs of insurance (through increasing the deductible portion of ship insurance). The combination of precise ENCs and timely water level information could enhance the margins of safety in the Straits, enabling carriage of larger loads well within safe limits. If this possibility can be developed into reality then significant increases in revenues to shippers and cargo owners can result, giving rise to a potential revenue source, part of which could offset the costs of production of the infrastructure.

Because most MEHs traverse the waters of many nations, as well as international waters, infrastructure building and financing are an international challenge that will require the participation and cooperation of several nations, as well as ship and cargo owners. The hope is that when the MEH is built, the transportation community will use it.

The Reality

Control of Land-based Pollutants

The Straits of Malacca and Singapore are not likely to be "clean" in the foreseeable future, especially if that requires harmonization of environmental policies and regulations among the Straits States. The fundamental problem with cooperation in the control of land-based pollutants is that there is no internationally agreed, unifying principle, or framework like UNCLOS to foster and guide such cooperation. Regulation of land-based pollutants remains a national responsibility and right. The Straits States have similar wastes and a similar level of technology for disposing of the wastes. Theoretically, they might adopt uniform standards (Valencia and Jaafar, 1985a). The fact is that they do not reflect real differences in national priorities for environmental protection in general and for specific pollutants and pollutant sources in particular. These policy differences are consistent with the Law of the Sea Treaty which provides that states "shall use the best practicable means at their disposal and within their capabilities to prevent, reduce and control pollution" (Article 194, par. 2). Yet, a mosaic of different pollution regulations inhibits coordinated management of land-based pollutants.

Moreover, scientific knowledge of pollutant types, sources, distribution and effects is inadequate for remedial action. There remains a need for more baseline studies of the components, processes and functions of tropical marine ecosystems; for studies of the physical processes that distribute pollutants in coastal waters; and for research on the physical and chemical characteristics of coastal marine environments to better understand the processes by which pollutants are accumulated. There is also an urgent need to standardize the analytical methods used within the region in marine pollution research and monitoring.

Preventive and remedial legislation and enforcement of existing legislation are inadequate. Programs are needed to upgrade awareness and skills of the personnel in the region and to train more people to conduct research, monitoring and policy formulation to control marine pollution (Valencia and Jaafar, 1985a).

There is interest in multilateral cooperation for marine pollution prevention and control, but more analysis and articulation of the benefits and costs to each country concerned are necessary before cooperative approaches to transnational issues will be fully supported. Although the UNEP Regional Action Plan is a first regional step toward responding to pollution in each country's coastal waters, formidable policy obstacles must still be overcome to move toward a truly cooperative approach to marine environmental protection in the Straits.

Control of Sea-based Sources

Despite all the improvements, the Straits are unlikely to be completely safe for navigation or free from sea-based inputs of oil in the foreseeable future because of economic growth, increasing tanker traffic, more refineries, indigenous hydrocarbon development, and gaps in, and problems with the safe navigation scheme.

Growth Triangles

Growth triangles being promoted at the southern and northern entrances to the Straits will surely increase shipping traffic and the likelihood of accidents. Singapore and Malaysia are relatively advanced in finance, communication, and marketing infrastructure and expertise, while Indonesia and Thailand have abundant labor with lower wage rates, ample land areas and rich natural resources. A combination of these factors would offer a unique mix of resources, infrastructure, labor, skills and product marketing opportunities. The growth triangles are designed to harness these complementary factors.

The growth triangle in the southeastern entrance of the Strait of Malacca links Singapore, the Malaysian State of Johor and the Riau Province of Indonesia (SIJORI). Originally, activities within this growth triangle were concentrated on Batam Island in Riau Province, a group of islands 20 km southeast of Singapore, which is being developed by Indonesia as an industrial estate. A side effect of the Batam development is rapid population growth—from about 6,000 in the 1970s, to

198,000 in 1995 or a 19% increase per year. The actual number is nearly double the official count due to illegal job-seeking migrants from other parts of Indonesia. The official projected population is 700,000 by the year 2006. The Batam Island Development Authority has various multi-million dollar projects underway such as a second runway and new terminal at the Hang Nadin Airport; a new cargo terminal; a 16,000 ten-foot equivalent unit (TEU)-capacity container port terminal at Kabil; additional water supply dams; and six BARELANG bridges, connecting Batam Island with its neighboring islands of Setokoh, Rempang, Galang and Galang Baru.

A second growth triangle is being developed in the northern entrance of the Malacca Straits, linking Aceh and North Sumatra provinces of Indonesia with the five southernmost provinces of Thailand and four northern states of Malaysia—the Indonesia-Malaysia-Thailand Growth Triangle (IMTGT). The combined population of the area exceeds 20 million, with economic output in 1988 of US$12.4 billion (Chua et al., 1997). This growth triangle was originally planned to link the tourist resort areas in southwest Thailand (Phuket and Suratani), the northwest coast of Malaysia (Penang and Langkawi) and North Sumatra (Toba Lake and surroundings). However, the latest development plan envisions expanding the cooperation to include agro-industries, industrial estates, tourist resorts, upgraded port facilities for cargo and fisheries.

The development of growth triangles at both ends of the Malacca Straits will generate heavier shipping traffic, both for cargo and trade, as well as passengers, among the ports of the cooperating coastal states. This will create more congestion and collisions and thus increase the sea-based pollution risk. The industrial and agricultural development will also add to the land-based pollution load entering the Strait.

There are also several industrial projects slated to come on stream along the east coast of Sumatra (Kusuma-Atmadja, 1994). Some of these projects are huge such as the Asahan aluminum project and the pulp mill project in Aceh province. There are also several important down-steam oil and gas projects underway such as the Arun LNG plant in Aceh province, the Caltex operations at Dumai and near Pekanbaru in Riau Province, and the Pertamina refinery near Palembang. Not all of these projects will have direct impact on the marine environment of the Strait of Malacca, but their contribution to economic growth and development all along the east coast of Sumatra will result in more traffic in the Straits.

Increasing Tanker Traffic

The unfortunate fact is that oil imports from the Middle East to East Asia will continue to increase above 1997 levels after the year 2000 for all major importing countries except Japan (Table 9). And these figures do not include product imports. This means that tanker traffic in the Straits will also increase.

Table 9. Forecasts for Imports of Crude from the Middle East* (million barrels of oil per day).

	1997	2000	2002	2005
Japan	3.86	3.68	3.64	3.77
Korea	1.76	1.81	1.92	2.13
Singapore	0.98	0.79	0.97	1.01
Taiwan	0.38	0.68	0.89	0.91
China	0.34	0.47	0.59	1.22

1996-1997 figures are actual; those thereafter are forecast.
* Courtesy of Resources Program, East-West Center.

Refineries on the Straits

The total oil refining capacity by the refineries located along the Malacca Straits as of 1 January 1995 was estimated to be around 1.54 million barrels per day (bpd). Among the three littoral States, Singapore has the highest refining capacity which constitutes about 72.43% of the total; Malaysia, 16.72%; and Indonesia, 11.30%. The demand for refined petroleum products in the Asia-Pacific Region is expected to increase by around 14.25% in 1993-1997 and the supply from the region's refineries is predicted to increase by around 15.07% over the same period. There are numerous plans for increasing the refining capacity in the region and if these plans were to materialize, it would add another 6 million bpd to Asia's refining capacity by the year 2000.

Indigenous Hydrocarbon Development

Potential recoverable reserves of oil and gas from three major basins in the region are believed to be on the order of 8 billion barrels. The major offshore regions include the Arun fields in Aceh and the basins around the Riau islands. A major natural gas field (Arun field) is located northeast of Sumatra, near the northwest entrance of the Malacca Straits. Arun gas field contributes around 47% of Indonesia's total gas production, with an output of around 12 trillion cubic feet (tcf) annually. The oil and gas fields support a number of refineries in the region.

No oil has been produced along the Malaysian section of the Malacca Straits but contract areas have been assigned for exploration purposes. Some of the other minerals that may be exploited in the Straits include tin, bauxite, granite, kaolin and sand.

Gaps and Problems with the Safety Regime

Although the new regime is a great improvement, significant gaps and problems remain.

1. The existence of "no man's lands" creates a problem in enforcement. One particular problem area is located between the TSS lanes near the Nipa Islands where ships wait in Indonesian waters to enter Singapore harbor. There are activities going on here which require greater surveillance and cooperation between Singapore and Indonesia.

2. Under the International Maritime Organization (IMO) VTIS regulations, mandatory reporting includes specification of cargo, but shippers and governments of maritime powers oppose this provision.

3. The present system relies on radar and there is little or no overlap or interaction between the Singapore and Malaysian systems. Indeed, radar is part of the national security system of the Straits States and they are unlikely to fully share their system output with neighbors.

4. There is a need to clarify the responsibility of the country in whose waters a spill occurs, as well as the liability of a country that pushes or diverts a spill into another country's waters.

5. The competition between Malaysia and Singapore for providing port services may adversely impact cooperation between them on Straits matters. Thus, all Straits States may not uniformly and steadfastly enforce the rules regarding safety of navigation. If they do not do so, substandard vessels and/or crews may be attracted to the region and to the more 'friendly' ports, thereby eroding the competitive advantage of the stricter ports. For example, a problem can arise when port authorities turn a blind eye to obvious discrepancies in sludge loads when a ship puts in for repair. In other words, in order to get its business, a port may ignore evidence that the ship dumped some of its sludge in a neighbor's waters.

6. The obstacles for an MEH for the Malacca/Singapore Straits are that:

   (a) The sale of the charts does not cover the costs of data gathering and production, so it is unclear who will pay for the initial system startup as well as its operation and maintenance;

   (b) The charts will only be as good as the data, and some data are old and unreliable;

   (c) New competing systems are becoming available, e.g., RASTA, thus making the choice of technology an issue;

   (d) There are insufficient electronic charts available and thus their use is limited; indeed, slowness in their production has impeded the global use of the system;[5]

   (e) There are important unresolved questions that need to be addressed regarding the liability of the chart suppliers;

   (f) There is no agreement yet between the three Straits States as to where the command center(s) will be and who will maintain and update the charts, as well as who will distribute, charge and collect for their use;

   (g) All vessels using the Straits—no matter how small—would need to carry a computer to be part of the system; however, different versions will be made available and the lowest cost-version will be a simple position locator;

   (h) Not all Straits States have the requisite trained manpower to implement an MEH;

   (i) To implement an MEH for the Malacca Straits, cooperation across-the-board is absolutely essential and this may not be as forthcoming as it should be;

   (j) Exemptions from the system for military vessels could eventually impede the system's effectiveness;

---

[5] *AFP. International shippers, maritime safety agencies meet in Singapore. 26 October 1998.*

(k) The system could possibly be used for nefarious purposes by, e.g., pirates, terrorists, or computer hackers, or for military purposes in the event of hostilities; and

(l) To make it work, linkages must be formed with other coastal states and regions, but IHO copyright prevents copying of digital maps.

The financing of an MEH still needs to be evaluated in light of a business plan that credibly addresses issues, such as capital and operating costs along with well thought out revenue projections. The support of national authorities responsible for international cooperation will also need to be gained with assurances that the databases will remain as national property and with royalty revenues paid to the contributing nation for data usage, after operating costs and debt service are factored in. The most important element of the business plan is the probability of revenue generation sufficient to maintain operations and, after a startup period, retire debt or pay dividends.

7. The process of establishing a new regime for safety of navigation needs to be broadened, in number of countries, and in scope. But some User States are not interested and those that are do not appear to be particularly supportive of expanding the participation of User States.

8. Many marine casualties are not due to a flaw in the TSS or its obsolescence. Over 90% of the marine casualties in the Straits were caused by collisions—not grounding. The underlying reasons for the marine casualties were therefore not hazards to navigation but poor seamanship. Apparently, most accidents were caused by ignorance of the basic rules of road such as “the right of way” of ships passing in opposite directions. Some collisions were also due to the inability of the crew member at the wheel to understand English. The practice of hiring substandard crews by “flag of convenience” vessels has now penetrated the tanker fleets. This cost savings measure is employed because of continuing low World Scale shipping rates and the increased costs of operating oil tanker fleets produced by the strict construction and other standards set by the IMO.

9. Increasing safety will do nothing to stop the intentional polluter.

10. Although a united front would be in their collective interest, the major impediment to forging a new regime for the Straits is differences among the Straits States themselves. Indonesia and Malaysia continue to have more interests in common than either do with Singapore. Malaysia and to a lesser

extent, Indonesia, have always been more concerned with the control of navigation and the prevention of pollution in the Straits. Singapore, being surrounded by a Malay sea, is more concerned with its security. It believes that navigational freedom for all maritime powers effectively neutralizes its potential bullying by any regional state. Moreover, the oil refining industry in Singapore was built on the assumption of free transit through the Straits for the most modern tankers of any size. And Singapore has minimal sensitive coastline and marine resources that could be damaged by spilled oil.

Singapore strongly supports the concept of the Malacca and Singapore Straits as 'straits used for international navigation' as defined in the Law of the Sea Treaty and wishes to have IMO take the lead and govern the establishment of a management regime for the Straits. While having ratified the Law of the Sea Treaty and thereby recognizing the right of transit passage through the Malacca Straits, Indonesia and Malaysia insist that first and foremost, the Malacca Straits is part of their waters and that they must initiate, authorize and lead the establishment of a management regime there.

But Can't Some Traffic be Diverted To Other Routes?

Malaysia and Indonesia have advocated the use of the alternate route east of Bali and Borneo via the Straits of Lombok and Makassar for laden supertankers. However, while ship owners are quite discreet about this issue, very few, if any, follow this advice (Noer and Gregory, 1994).

Indeed, almost all supertankers on the main oil route from the Arab Gulf to Northeast Asia use the Strait of Malacca because it is the shortest route available for supertankers. Further, vessels plying the Malacca Straits can use the facilities of Singapore, a significant logistical and operational advantage. Although westbound tankers in ballast have plenty of room under their keel, at least three fully laden eastbound supertankers per day enter the Strait from the west.

The two largest sizes of supertankers operating in the region are affected by the Strait of Malacca draft constraint. Larger vessels within the range of 160,000 to 250,000 DWT are definitely testing the "officially" recommended limit of 18.5 m when fully laden, although many squeeze in under 20 m. Most tankers of the largest size observed in the region, over a quarter million DWT, operate well in excess of any official guideline when laden, although some light load, i.e., take cargoes of less than maximum size, to reduce their draft when they sail through the Straits (Tables 10 and 11).

Table 10. Supertanker Design Drafts (m).

	VLCC Size	
	160,000-250,000 DWT	Greater than 250,000 DWT[a]
Average Draft	19.4	21.2
Standard Deviation	1.01	1.36
Maximum	21.4	28.6
Minimum	15.5	18.4

[a] Excludes ULCCs > 320,000 DWT.
Source: Noer and Gregory (1994).

The operators of the fully laden tankers face a close judgment call about draft restrictions. Loading too deep may ultimately contribute to an accident; loading too light reduces profits. This tradeoff decision between operating cost efficiency and safety is made for many supertanker voyages. Further, a supertanker finding itself on a collision course with another ship may face a difficult choice. The watch officer may be forced to choose between the risk of a collision in the channel and the risk of running aground by leaving the channel. Supertankers may take as much as 10 miles to stop, and they have little control at very slow speeds due to loss of steerage way. This is one good reason why accidents happen.

Table 11. Supertankers Transiting the Strait of Malacca, 1993.

Supertanker Size	Vessel Capacity (DWT) (in million)	Vessel Transits[a]
160,000-250,000 DWT:		
Westbound (ballast)	105.6	452
Eastbound (laden)	105.9	453
Over 250,000 DWT:		
Westbound (ballast)	179.8	669
Eastbound (laden)	182.7	684
Total supertankers	**574.0**	**2,258**

[a] Includes only interregional voyages, excludes lightering.
Source: Noer and Gregory (1994).

The short answer to the diversion question is: some have been—loaded supertankers over 250,000 DWT; some others can, and some cannot. Over 20% of the crude oil from the Gulf passing through the Straits of Malacca and Singapore is bound for Southeast Asia, arriving at Singapore in large supertankers (Noer and Gregory, 1994). Singapore is a major refining center, importing crude in large tankers and exporting product all over the region in smaller product tankers. Any policy or set of events that inhibited the use of supertankers in the Malacca Straits could increase voyage distances up to 49.7% if the alternative was Lombok. But it is highly unlikely that Singapore would easily accept such a constraint to one of its most important industries. Singapore thus has more economic reasons than any other nation to insist upon commercial freedom of navigation in the Strait of Malacca. The Northeast Asian nations can always ship by Lombok, but Singapore has no realistic alternative to the Malacca Straits. And Singapore profits from facilitating Malacca Straits traffic to other nations.

An added attraction of the Malacca Straits route over others for through-bound supertankers is operational convenience. The Port of Singapore offers a full range of facilities. And its low taxes, competitive prices, cheap bunker fuel, fast turnaround, and a minimum of regulations and restrictions, are attractive to many large vessels. Indeed, there is no other comparable port situated right next to the main route of the region.

THE DREAM

The heavy and increasing multiple use of the Straits requires sea-use planning. Sea-use planning tries to provide a directed balance between and among the various uses of ocean space and resources, and between sea uses and the marine environment (Huang, 1993). Sea-use planning as a scientific concept was derived from the concept of land-use planning and first implemented in the early 1970s by scientists and planners of countries bordering the North Sea[6], especially those of Norway and the Netherlands.

The purpose of sea-use planning is to maximize benefits while minimizing the costs and risks, through an integrated policy for sea-use activities. There are five basic goals for sea-use planning: safety, efficiency, health, sustainability and harmony. Thus, the objectives of sea-use planning are to guarantee security and safety for each type of sea-use; to protect the marine environment from land-based or sea-based pollution; to develop a sustainable and efficient marine economy for marine resources and energy; and to produce positive social impacts on human society. These objectives interact and sometimes conflict. Sea-use planning balances these objectives. Indeed, a major focus of sea-use planning is the resolution of inter-use conflicts at the national and international levels.

---

[6] *For background, analysis and proposals for cooperation in the North Sea, see Young and Fricke (1975); Carison (1978); Smith et al. (1984); Smith and Lalwani (1984); Peet (1986); Andersen and Flostad (1988); Andersen (1989, 1995); and Second Chamber of the State General, The Netherlands (1989-1992).*

In general, sea-use conflicts can be divided into two categories: spatial conflicts and functional conflicts. There are usually several options for sea-use planning, each of which would have different results in terms of economic and social benefits, costs, and marine environmental risks. When choosing options for sea areas, it is necessary to make an advantage-disadvantage comparison, and it may be necessary to apply cost-benefit analysis.

Sea-use planning has perhaps reached its pinnacle in the North Sea where comprehensive sea-use planning has been ongoing since the early 1970s (Jaafar and Valencia, 1985). The international goal is the development of a balanced and effective battery of instruments for both national and international administration and management. The general economic objective is the safe and efficient use of the various opportunities offered by the sea, now and in future. A comprehensive sea-use plan consists of individual plans. In the North Sea case, there are five specific plans: for offshore oil and gas development; for fisheries management; for water quality; for shipping routes; and for special sea uses. The plan also combines infrastructure facilities and furthers multiple or shared use of particular areas. An important feature of the North Sea regime is its small but efficient joint secretariat which facilitates coordination between two different conventions. The Commissions established to implement the conventions are supported by technical working groups, and a joint monitoring group.

Some zoning has already taken place in the Malacca/Singapore Straits in the form of different jurisdictional regimes and the TSS. Indonesia and Malaysia have declared 12 nautical mile (nm) territorial seas and 200 nm exclusive economic zones (EEZs). Indonesia has also declared archipelagic waters (Kusuma-Atmadja, 1994). Where the breadth of the Straits is more than 24 nm, the jurisdictional regime of the Straits is divided between territorial waters and EEZs (Figure 1). This zoning could be the beginning of an international sea-use plan for the Malacca/Singapore Straits.

Some Possible Elements of a Sea-use Plan

A joint approach by the Straits States would ideally focus on several areas where the States have major individual interests but where these interests are likely to be more effectively promoted by collective and harmonized action. Such areas include the following.

1. The employment, establishment and operation of enhanced vessel traffic systems (VTS). The increasing level of maritime transport in the region means that each of the States needs to establish a working system for the regulation

of shipping entering its ports and other installations. In view of the proximity of these ports and the likelihood that they will be used by the same vessels, it makes sense for the systems which are adopted for the various ports to be harmonized as far as possible. Such harmonization will be in the interests of the States, and also to the advantage of the ships utilizing the system.

The VTS must be projected as a service to facilitate safety for the benefit of users of the Straits. Enforcement, with penalties, must be carried out against ships that do not comply with the routing system and its regulations. Since the radar surveillance footprint will overlap international boundaries, an understanding will have to be reached between the Straits States on certain management aspects of the VTS. An integrated VTS system should be developed with the lead agency's role and responsibilities clearly defined to avoid duplication of effort.

2. Traffic and routing patterns for regional traffic should be planned and developed based on existing patterns and economic needs. The planned development of Karimun Island by Singapore, including an oil refinery complex with attendant ship-berthing and storage facilities should help alleviate tanker traffic in the Singapore Strait and lessen the dangers of pollution in the Singapore Port area. Through traffic using the narrow eastern end of the Straits (Philip Channel) should be restricted to traffic bound for Southeast Asia, East Asia and Northeast Asia (Hamzah and Basiron, 1996). Through traffic destined for Indonesia, except for Bintang Island, should use the Strait between Karimun Island and Rangsang Island, on to Berhala Strait, and from there on through the Bangka Straits to the Java Sea. Traffic originating from Western Europe or South Africa destined for Indonesia or Australia could use the route along the west coast of Sumatra to the Sunda Straits. Eventually, re-routing or diversion within the main body of water comprising the Straits and the Riau Islands may no longer be sufficient. Consideration should then be given to the diversion of shipping destined for Indonesia and East Asia through other waterways or Straits.

3. The cooperative development of arrangements which will provide appropriate incentives to ships using the Strait of Malacca to respect and observe the laws and regulations of the various bordering States regarding the conservation of marine resources, the protection of the health and welfare of the coastal population, and the promotion of policies on customs, and immigration.

4. The cooperative development of procedures to protect shipping from unlawful acts such as piracy, and other violent acts against persons and property on ships in the area.

5. Regarding shipments of ultrahazardous high-level radioactive waste, all concerned coastal and island nations should bring concerted pressure at the IMO to develop a comprehensive and binding legal regime governing such shipments. This regime should include, at a minimum, the following elements.

   a) The obligation to notify and consult, well prior to any shipments of high-level radioactive wastes through the territorial sea or EEZ of any other nation. Consultations should be held in good faith, and should include discussions regarding alternative routing and emergency contingency planning.

   b) The requirement of the informed consent of potentially affected states for any transit of ultrahazardous radioactive waste through their territorial waters or EEZ.

   c) The requirement to prepare an environmental impact assessment prior to such shipments. The process of preparing the assessment should be interdisciplinary and must include public input.

   d) A binding liability and compensation regime. Such a regime should not only spell out the conditions of liability, but should also include the creation or identification of a compensation fund to pay any victims of accidents.

   e) The exclusion of certain specific hazardous routes.

   f) Detailed provisions on accident and emergency procedures. These procedures must include access to appropriate ports, availability of tugboats and firefighting equipment, and plans for retrieval in the event of a sinking.

6. The establishment of coordinated arrangements for the enforcement of national and international standards for environmental impact assessment. For example, the three States could develop a common methodology for assessing impacts which could include baseline surveys and resource, risk and damage assessments at pre- and post-project development stages as well as assessment of impacts due to accidents. Such investigations could be planned and/or coordinated internationally but implemented on a national basis. Navigational aids could also be maintained and funded on a regional basis as encouraged by the convention.

7. Maintaining the integrity of the Straits of Malacca and Singapore as safe and clean international waterways can only be achieved if management measures are taken to regulate and reduce the inputs of pollutants to the Straits. Management measures should include: (1) integrated coastal management programs, applied at the local government level to address marine pollution from land-based sources; and (2) sustainable, subregional marine pollution prevention and management policies, strategies and action plans to address marine pollution arising from sea-based activities. The latter action plans need to include the ratification and implementation of marine pollution conventions, especially those of IMO.

8. The Straits States should establish an effective marine pollution monitoring mechanism and appropriate protocols so that the monitoring results from the three littoral States can be compared and used for management interventions. And there should be more effective PSC of all vessels. But this will entail the necessary waste reception facilities in the ports.

9. Information about the state of the marine environment of the Straits of Malacca and Singapore is far from complete. Despite hundreds of reports and publications on the Straits, relevant information on environmental conditions and shipping traffic is not adequate and readily available to support detailed management planning and interventions. A concerted effort among the littoral States is necessary to pool available information for the design and development of an effective subregional program action plan to be participated in by both the littoral and User States.

10. A dynamic atlas for marine policy-making is needed for the Malacca Straits. Such an atlas could be an expanded GIS—a computer database rather than hard copy and it would be capable of generating, superimposing and printing out maps of variables on command. The variables could be selected based on the immediate need, e.g., an oil spill at a particular site. An econometric valuation model could also be attached to or integrated into the database. The main categories of variables might include:

    a) The natural environmental setting: bathymetry, surface currents, surface temperature, nutrients and productivity;

    b) Scientific research: research coverage for physical, chemical, biological and geological oceanography;

    c) Maritime jurisdiction: boundaries, jurisdictional regimes;

d) Vulnerable resources: endangered species, scenic coastal areas, marine parks and reserves, research stations and aquaculture sites;

e) Shipping: important ports, shipping routes, traffic (by vessel type and flag) and maritime casualties;

f) Non-living resources: geology, hydrocarbon and mineral potential, exploration and leases;

g) Fisheries: distribution of major commercial species, migration patterns, catch statistics and geographic distribution, fisheries infrastructure and fishing agreements; and

h) Pollution: sewage and chemical oxygen demand, hydrocarbon pollution, hypothetical oil spill trajectories, ocean dumping, heavy metals and pollution standards.

These variables could be superimposed on each other in integrated outputs to identify areas of special concern, e.g., all vulnerable resources and all pollutants, shipping and vulnerable resources, fish distribution or catch and pollutants. A carefully designed and coordinated program of monitoring of ecological resources should be developed and fed into this database for the Straits. The current GEF/UNDP/IMO Malacca Straits Demonstration Project to produce a risk assessment/risk management framework is timely and important.

11. Establishment of a Fund.

One proposal being discussed is the establishment of a Fund for the management of the Straits. The Fund would solicit voluntary contributions from the maritime powers and international organizations and would be managed by the Straits States to enhance safety of navigation. Contributors to this Fund should be all those who benefit from the oil cycle, including producing countries and companies, refiners, tanker owners, and consuming countries and companies.

One approach to establishing this Fund would be to persuade users to fund specific projects related to navigational safety and pollution prevention measures (Hamzah and Basiron, 1996). The precedent is the Japan-supported Malacca Straits Council which funds hydrographic surveys, stockpiling of equipment for combating pollution and the installation and maintenance of navigational aids. Potential contributors might be attracted because the contributions are voluntary. They will be able to generate political good will and future costs may be defrayed.[7]

Another possibility is to propose and promote an International Convention on an International Straits Fund. This would require a concerted diplomatic initiative to mobilize support from all Straits States, e.g., Turkey, Italy and the Baltic States, for an international convention on Straits funding. There was already a proposal before for IMO to examine funding mechanisms in the Straits of Malacca as a work program.[8]

A third possibility is to introduce maritime dues. At the moment, only light dues and port dues are collected. Clearly, the present arrangement has not kept up with changing technology. Besides restructuring the Light Dues Board, maritime dues could be introduced to raise revenue from transiting vessels in the Straits to defray the cost of providing the services. The proposed maritime dues should be introduced only after consultation with the relevant parties, including IMO. Collecting dues from ships which do not call at Straits ports will be difficult.

---

[7] *Possible projects to be funded include the following. Environment and pollution: water quality monitoring; effective oil pollution preparedness and strategies for the Straits; assets building and deployment; capacity-building, inclusive of training and technology transfer; oil spill trajectory modeling; finger printing of oil and sludge and transfer of the capacity to identify sources of pollutants; reception facilities for fishing vessels, oil and garbage; marine pollution risk in the Straits; research and production of maps of protected areas in the Straits (e.g., marine parks) and maps of resources (e.g., fishing grounds) in the Straits vulnerable to oil spills; development of a database on physical, biological and economic parameters of the Straits; and development of a regional marine pollution surveillance and information management system.*

Navigational safety; navigational aids; updating of charts and hydrographic surveys; study of currents and tides; surveillance; search and rescue (SAR) including the Global Maritime Distress and Safety System; Vessel Traffic Management Schemes – including radar and command and control equipment; wreck removal; a Strait of Malacca Navigational Information System; and a study of alternative routes, including the Isthmus and Kra land bridge proposal.

[8] *The IMO strategy for extra budgetary activities relating to environmentally sustainable development for international straits is as follows:*

1. *Financing of capacity-building for coastal States bordering a Strait used for international navigation.*
2. *IMO should consider potential mechanisms by which user States and States bordering Straits used for international navigation could facilitate the development of appropriate financial mechanisms consistent with Article 43 of the 1982 United Nations Convention on the Law of the Sea to provide for the establishment and maintenance of necessary navigational aids and other safety aids to navigation as well as the prevention, reduction and control of pollution from ships.*
3. *Such financial mechanisms shall have due regard to the financial burden on coastal States created by the establishment and maintenance of such navigational aids and pollution prevention, reduction and control activities.*
4. *Such financial mechanisms should be designed to achieve an equitable sharing of this "burden". Annex 2 of MEPC 37/10.*

However, with the assistance of the IMO and a systematic PSC mechanism, revenue collection may be possible. Nevertheless, this proposal should be studied to ensure that the introduction of such a policy would not undermine the competitiveness of Straits ports.

12. A Malacca/Singapore Straits Management Authority?

While Malaysia continues to be concerned about navigational safety and pollution in the Straits, Indonesia remains concerned with the security aspects of its archipelagic claim, and Singapore with the big power balance and non-interference with transit passage. Geography and stage of development also influence their respective positions. Clearly, the disparate perspectives of the Straits States militate against joint action for the sole purpose of environmental protection. Other sectoral uses of the Straits, however, also require management, including fishing, hydrocarbon exploration/exploitation, security and transport (Valencia and Jaafar, 1985b). Perhaps a package arrangement, involving intersectoral tradeoffs between the three would provide an opportunity for enhanced order in the multinational, multipurpose use of this constricted and crowded waterway. A first step might be the formation of a tripartite, multiministerial level task force to review the conflicts in and between all use sectors in the Straits and to make recommendations to the three governments for further action.

Eventually, the three States might form an organization to manage the activities and uses of the Straits (a Malacca and Singapore Straits Management Authority—MASSMA). The organization might take various forms: existing organizations, a regional organ, a joint commission, or a joint authority. Or this range of organizational types could be considered as an evolutionary sequence.

Existing organizations which might serve as a core for building a broad-based management regime include the Council on Safety of Navigation and Control of Marine Pollution in the Straits of Malacca/Singapore, formed in 1971, the Tripartite Committee, or the Strait of Malacca Revolving Fund. The Tripartite Committee has been used successfully in the past by the three countries to negotiate with Japan on Straits safety and to provide technical support for these negotiations. These organizations already exist and focus specifically on the Straits. Additionally, the organizations encompass only the three Straits States. However, they deal solely with tanker shipping and were initially formed with a political objective in mind, not specifically to manage all activities in the Straits. Their use would require the establishment of a permanent office to collect funds, arrange for their replenishment after disbursement and to seek new donors.

A regional organ could be structured similar to the United Nations, i.e., it could have a governing council of policy-makers and a secretariat for technical support. The secretariat might be divided sectorally into shipping, fisheries, non-living resources, pollution/environment and security. Management of the environment of the Straits could be the common theme. The organization would centralize policy and provide some stability and predictability to management of use of the Straits. It also could have links with other international organizations. Its recommendations, however, similar to those of the United Nations, would not be binding on its members. Individual governments would approve policies affecting them. Additionally, there would also be issues of budget, cost and its allocation.

A joint commission could be given a legal mandate by the three governments to research and recommend options for action. The commission would be more independent than a regional organ, having its own arbitration machinery to settle differences. The commission could include representatives of the general citizenry and industry as well as government. Technical support would be *ad hoc*. The individual governments could set the agenda for the body. However, governments would probably be reluctant to surrender their control over the process and pace of policy recommendations affecting their interests.

The most comprehensive option would be a joint authority modeled after the existing Thai-Malaysia Joint Development Authority (Ariffin, 1981). It would be a ministerial level, intergovernmental, policy-making assembly, overseeing an executive branch with five organs: environment, shipping, fisheries, non-living resources and security. The decisions or findings of the assembly would be binding upon the member governments. Indeed, formation of such a Ministerial Council was once discussed at Tripartite meetings, but never materialized[9].

How would the Joint Authority work in practice? For example, development of hydrocarbon resources in the Straits could interfere with other activities such as fisheries and shipping. Such development might eventually either be constrained by protests of neighbors, or engender use and user conflict, thus reducing the total benefits of the Straits available to all three States. Therefore, the country with jurisdiction over the hydrocarbon resources would allow the Authority to manage their development while ensuring conflict avoidance. Of course, for this system to work, governments must yield some management control over activities in the Straits. Also, the Joint Authority, without checks and balances, could become very powerful. On the other hand, because the Authority would combine the political power of the three States, it would be a formidable negotiator with extraregional users of the Straits.

---

[9] *Personal communication with M. Thilagadurai, Director, Maritime Division, Ministry of Transport, Malaysia, 1984.*

Certainly, the establishment of such an Authority would require enormous political will and advance subsidies. The need would have to be obvious and urgent. Because it is not so perceived, and political and economic priorities of the Straits States are disparate and focused on domestic issues, further concrete steps toward joint management may await a more compelling and cooperative climate.

The most likely scenario is for international cooperation in management of the Straits to proceed *ad hoc*—issue by issue—as they arise and sufficient common concern is generated. Eventually this plethora of issues and *ad hoc* responses may form a web-like framework upon which can be constructed a broader, multisectoral management institution.

References

Andersen, S. 1989. The environmental North Sea regime: A successful regional approach, p. 378-401. *In* E.M. Borgese, N.S. Ginsburg and J.R. Morgan (eds.) Ocean yearbook 7. The University of Chicago Press, Chicago.

Andersen, S. 1995. The "effectiveness" of regional environmental co-operation in the Northern Seas. Paper presented at the Annual Meeting of the International Studies Association, 23-25 February 1995, Chicago.

Andersen, S. and B. Flostad. 1988. Sea use planning in Norwegian waters: National and international dimensions. Coastal Manage. 16: 183-200.

Ariffin, Datuk Harun. 1981. The Malaysian philosophy of joint development in the South China Sea. *In* M.J. Valencia (ed.) Hydrocarbon potential and joint development. Pergamon Press, New York.

Carison, H. 1978. Quality status of the North Sea. International Conference on the Protection of the North Sea. *In* J.K. Gamble (ed.) Law of the sea: Neglected issues. Proceedings of the Law of the Sea Institute Twelfth Annual Conference, 23-26 October 1978, the Hague, The Netherlands.

Chua, T.E., S.A. Ross and H. Yu, Editors. 1997. Malacca Straits environmental profile. MPP-EAS Technical Report 10, 259 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Dow, K. 1993. An overview of pollution issues in the Straits of Malacca. Paper presented at the National Conference on the Strait of Malacca, MIMA, 11 November, Kuala Lumpur.

Fairplay International, 26 August 1993.

Hamzah, B.A. and M.N. Basiron, 1996. Providing for safer and cleaner seas in the Malacca Strait. Tropical Coasts 3(2): 7-11.

Hand, M. 1998. Malacca Straits safer when two schemes take effect in December. Business Times, 26 October 1998.

Huang Yunlin. 1993. Sea use planning for the Yellow Sea. Department of Geography, University of Hawaii. PhD dissertation.

IPE. 1993. International Petroleum Encyclopedia.

Jaafar, A.B. and M.J. Valencia. 1985. Management of the Malacca/Singapore Straits: Some issues, options and probable responses. Academika 26: 93-117.

Kusuma-Atmadja, M. 1994. Overcoming navigational hazards and marine pollution in the Straits of Malacca and Singapore: The exercise of rights and duties of littoral states. Paper presented at the International Conference on the Strait of Malacca: Meeting the Challenges of the 21st Century, 14-15 June 1994, Maritime Institute of Malaysia, Kuala Lumpur.

MacDonald, A. and N. Anderson. 1997. ECDIS and sustainable finance mechanisms in the East Asian Seas, p. 234-242. *In* S.A. Ross, C. Tejam and R. Rosales (eds.) Sustainable financing mechanisms: Public sector-private sector partnership. MPP-EAS Conference Proceedings No. 6, 352 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Muhammad Razif bin Ahmad. 1997. The financial costs of risk management in the Straits of Malacca. *In* B.A. Hamzah (ed.) The Straits of Malacca: International cooperation in trade, funding and navigational safety. Pelanduk Publications and Maritime Institute of Malaysia (Ltd.), Selangor, Malaysia. 359 p.

Noer, J.H. and D. Gregory. 1994. Chokepoints: Maritime economic concerns in Southeast Asia. National Defense University, Institute for National Strategic Studies.

Peet, G. 1986. Techniques and methods for sea use planning and management in selected areas. Report of a Literature Study, commissioned by Directie Noordzee, Rijkswaterstaat.

Second Chamber of the State General, The Netherlands. 1989-1992. Harmonization of Netherlands North Sea policy, 1989-1992, 44-5, SDU uitgeverij.

Smith, A.J., E. Kennet and M.B.F. Ranken. 1984. Britain and the sea: Further dependence - further opportunities. Scottish Academic Press Limited, Edinburgh.

Smith, H.D. and C.S. Lalwani. 1984. The North Sea: Sea use management and planning. University of Wales Institute of Science and Technology, Cardiff.

Valencia, M.J. and A.B. Jaafar. 1985a. Marine pollution. *In* G. Kent and M.J. Valencia (eds.) Marine policy in Southeast Asian Seas. University of California Berkeley Press.

Valencia, M.J. and A.B. Jaafar. 1985b. Environmental management of the Malacca/ Singapore Straits: Legal and institutional issues. Nat. Res. J. 5(25): 195-232.

White, I.C. 1994. Liability and compensation for oil pollution from tankers. Paper presented at the International Conference on the Strait of Malacca: Meeting the Challenge of the 21st Century, 14-15 June 1994, Maritime Institute of Malaysia, Kuala Lumpur.

Young, E. and P.H. Fricke, Editors. 1975. Sea use planning. Fabian Society, London.

Assessment and Management of Pollution Risks in Large Marine Ecosystems

Kenneth Sherman

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Narragansett Laboratory
28 Tarzwell Drive, Narragansett, Rhode Island 02882, USA

Charles N. Ehler

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
Office of International Affairs
Silver Spring, Maryland 20910, USA

SHERMAN, KENNETH and CHARLES N. EHLER. 1999. Assessment and management of pollution risks in large marine ecosystems, p. 58-87. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

There is growing evidence of continuing degradation to coastal waters around the globe from habitat alteration, eutrophication, toxic pollution, aerosol contaminants, emerging diseases and excessive fishing effort. The recognition that coastal ecosystems are being adversely impacted by multiple driving forces has accelerated efforts by scientists and resource stewards to assess, monitor and manage coastal resources from an ecosystem perspective. A modular strategy is described for improving science-based pollution and ecosystem health assessments and linking them to mitigation and management actions to improve degraded global environmental conditions within the geographic limits of 50 large marine ecosystems (LMEs). The LMEs provide goods and services that contribute billions of dollars annually to the global economy. Included is a description of the National Oceanic and Atmospheric Administration's (NOAA's) pollution assessment strategy using productivity, fish and fisheries, bivalve molluscs, the pathological

examination of fish and the estuarine and nearshore measurements of water column, substrate and selected taxonomic groupings of pelagic and benthic species for monitoring exposures and effects of pollutants. The strategy includes socioeconomic and governance activities. It is being implemented, in part, by financial support from the Global Environment Facility to countries bordering LMEs in Asia, Africa, Central and South America and Eastern Europe.

Coastal Degradation

There is growing evidence of continuing degradation to coastal waters around the globe from habitat alteration, eutrophication, toxic pollution, aerosol contaminants, emerging diseases and excessive fishing effort (FAO, 1995; Epstein, 1996; Hedin, 1998; Stockholm Water Symposium, 1998). The recognition that coastal ecosystems are being adversely impacted by multiple driving forces has accelerated efforts by scientists and resource stewards to assess, monitor and manage coastal resources from an ecosystem perspective (Boesch, 1998). However, no single international institution has been empowered to monitor the changing ecological states of marine ecosystems on a global scale and to reconcile the needs of individual nations with those of the community of coastal nations in taking appropriate mitigation and management actions (IUCN, 1990; Meyers, 1990).

The need for an approach to implement the assessment and management of coastal ecosystems in support of resource development and sustainability at scales less than the global level has been recognized from a strategic perspective (Hey 1992; Taylor and Groom, 1998). The Intergovernmental Oceanographic Commission (IOC) of the United Nations Education, Scientific and Cultural Organization (UNESCO) is encouraging coastal nations to establish national programs for assessing and monitoring coastal ecosystems so as to enhance the ability of national and regional management organizations to develop and implement effective remedial programs for improving the quality of degraded ecosystems (IOC, 1992). This encouragement is underscored by the UN Conference on Environment and Development (UNCED) declaration on the ocean that recommended to coastal nations of the globe that they: *(1) prevent, reduce and control degradation of the marine environment so as to maintain and improve its life support and productive capacities; (2) develop and increase the potential of marine living resources to meet human nutritional needs, as well as social, economic and development goals; and (3) promote the integrated management and sustainable development of coastal areas and the marine environment.*

Ecosystem Management Principles

Development of strategic approaches to achieving the UNCED ocean goals from the ecosystem perspective is evolving from recent discussion, debate and reporting. The Ecological Society of America Committee on the Scientific Basis for Ecosystem Management concluded that the overarching principle for guiding ecosystem management is to ensure the intergenerational sustainability of ecosystem goods (e.g., fish, trees, petroleum) and ecosystem services or processes including productivity cycles and hydrological cycles (Christensen et al., 1996). This approach represents a paradigm shift from the highly focused short-term sector-by-sector resource assessment and management approach in general practice today by natural resource stewardship agencies, to the broader more encompassing ecosystem approach that moves spatially from smaller to larger scales and from short-term to longer-term management practice (Lubchenco, 1994). Included in the new paradigm is a movement from the management of commodities to the sustainability of the productive potential for ecosystem goods and services (Table 1).

The new paradigm has relevance to the management of large marine ecosystems (Figure 1). On a global scale, 50 LMEs produce 95% of the world's annual marine fishery yields and within their waters most of the global ocean pollution, overexploitation and coastal habitat alteration occurs (Kumpf et al., 1999; Sherman and Alexander, 1986, 1989; Sherman et al., 1990, 1991, 1993, 1996, 1998; Sherman and Tang, 1999). The ecosystem approach to resources development, management and sustainability in coastal waters is supported by the Global Environment Facility (GEF). The GEF is one of the post-UNCED international mechanisms organized to support projects for improving the assessment and management of terrestrial, freshwater and marine ecosystems among the developing countries of the globe (Bagla, 1998; Jayaraman and Masood, 1998). The GEF's International Waters Program is assisting developing countries around the globe in supporting incremental costs for innovative projects to improve the assessment and management of LMEs and increase the socioeconomic benefits to be derived from their resources (GEF, 1998).

Modular Strategies for Assessment and Management

Sustainability of resources and growth of economies are topics vital to countries in the developing world. The 50 LMEs around the globe represent areas of excessive nutrient loadings and toxic pollutants. They also produce 95% of the world's annual biomass yield. For 33 of the LMEs, retrospective analyses have been conducted on the principal driving forces leading to environmental and

Table 1. List of 33 LMEs and Subsystems for which Syntheses Relating to Primary, Secondary or Tertiary Driving Forces Controlling Variability in Biomass Yields have been Completed for Inclusion in LME Volumes.

Large Marine Ecosystem	Volume No.	Authors
U.S. Northeast Continental Shelf	1 6	M. Sissenwine and P. Falkowski S. Murawski
U.S. Southeast Continental Shelf	4	J. Yoder
Gulf of Mexico	2 4 9	W. Richards and M. McGowan B. Brown et al. R. Shipp
California Current	1 4 5	A. MacCall M. Mullin D. Bottom
Eastern Bering Shelf	1 8	L. Incze and J. Schumacher P. Livingston et al.
West Greenland Shelf	3	H. Hovgård and E. Buch
Norwegian Sea	3	B. Ellersten et al.
Barents Sea	2 4	H. Skjoldal and F. Rey V. Borisov
North Sea	1	N. Daan
Baltic Sea	1	G. Kullenberg
Iberian Coastal	2	T. Wyatt and G. Perez-Gandaras
Mediterranean-Adriatic Sea	5	G. Bombace
Canary Current	5	C. Bas
Gulf of Guinea	5	D. Binet and E. Marchal
Benguela Current	2	R. Crawford et al.
Patagonian Shelf	5	A. Bakun
Caribbean Sea	3	W. Richards and J. Bohnsack
South China Sea-Gulf of Thailand	2	T. Piyakarnchana
East China Sea	8	Y. Chen and X. Shen
Sea of Japan	8	M. Terazaki
Yellow Sea	2	Q. Tang
Sea of Okhotsk	5	V. Kusnetsov et al.
Humboldt Current	5	J. Alheit and P. Bernall
Pacific Central American	8	A. Bakun et al.
Indonesian Seas-Banda Sea	3	J. Zijlstra and M. Baars
Bay of Bengal	5 7	S. Dwivedi A. Hazizi et al.
Antarctic Marine	1 & 5	R. Scully et al.
Weddell Sea	3	G. Hempel
Kuroshio Current	2	M. Terazaki
Oyashio Current	2	T. Minoda
Great Barrier Reef	2 5 8	R. Bradbury and C. Mundy G. Kelleher J. Brodie
Somali Current	7	E. Okemwa
South China Sea	5	D. Pauly and V. Christensen

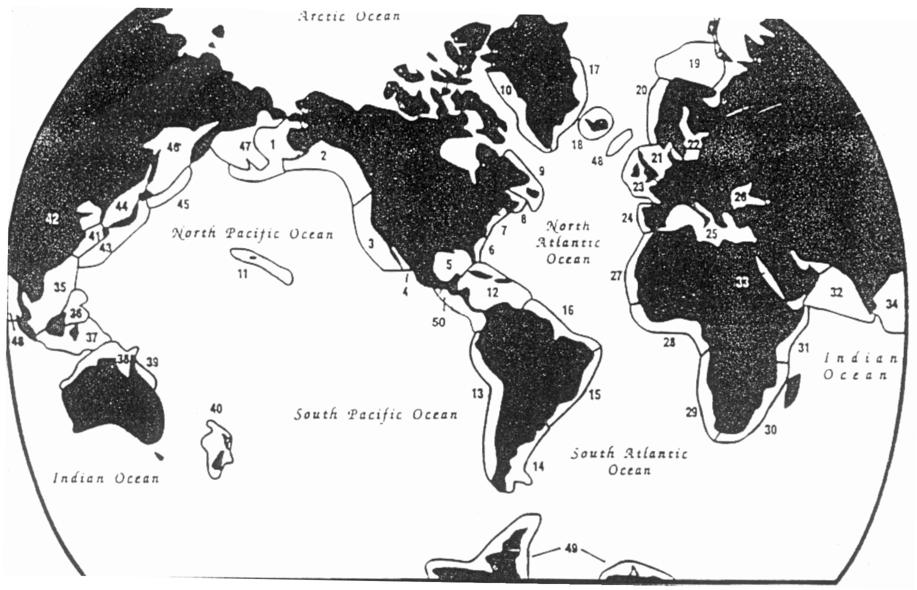
continued

Table 1 (continued)

Vol.1	Variability and Management of Large Marine Ecosystems. Edited by K. Sherman and L.M. Alexander. AAAS Selected Symposium 99. Westview Press, Inc., Boulder, CO, 1986. 319 p.
Vol.2	Biomass Yields and Geography of Large Marine Ecosystems. Edited by K. Sherman and L.M. Alexander. AAAS Selected Symposium 111. Westview Press, Inc., Boulder, CO, 1989. 493 p.
Vol.3	Large Marine Ecosystems: Patterns, Processes and Yields. Edited by K. Sherman, L.M. Alexander and B.D. Gold. AAAS Symposium. AAAS, Washington, DC, 1990. 242 p.
Vol.4	Food Chains, Yields, Models and Management of Large Marine Ecosystems. Edited by K. Sherman, L.M. Alexander and B.D. Gold. AAAS Symposium. Westview Press, Inc., Boulder, CO, 1991. 320 p.
Vol.5	Large Marine Ecosystems: Stress, Mitigation and Sustainability. Edited by K. Sherman, L.M. Alexander and B.D. Gold. AAAS Press, Washington, DC, 1993. 376 p.
Vol.6	The Northeast Shelf Ecosystem: Assessment, Sustainability and Management. Edited by K. Sherman, N.A. Jaworski and T.J. Smayda. Blackwell Science, Inc., Cambridge, MA, 1996. 564 p.
Vol.7	Large Marine Ecosystems of the Indian Ocean: Assessment, Sustainability and Management. Edited by K. Sherman, E.N. Okemwa and M.J. Ntiba. Blackwell Science, Inc., Malden, MA, 1998. 394 p.
Vol.8	Large Marine Ecosystems of the Pacific Rim: Assessment, Sustainability and Management. Edited by K. Sherman and Q. Tang. Blackwell Science, Inc., Malden, MA, 1999. 465 p.
Vol.9	The Gulf of Mexico Large Marine Ecosystem: Assessment, Sustainability and Management. Edited by H. Kumpf, K. Steidinger and K. Sherman. Blackwell Science, Inc., Malden, MA, 1999. 736 p.

biological changes within the ecosystems (Table 1). Based on the results of these studies, a modular approach has been developed for linking science-based assessments of the changing states of LMEs to the socioeconomic benefits expected from the long-term sustainability of their resources. The modules are consistent with the premise of Christensen et al. (1996) that ecosystem management is driven by explicit goals, executed by policies, protocols and practices and made adaptable by monitoring and research, based on the best available understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure and function. The five modules focus on ecosystem: (1) productivity; (2) fish and fisheries; (3) pollution and ecosystem health; (4) socioeconomic conditions; and (5) governance priorities. The pollution and ecosystem health module is focused on measurements of environmental quality and the status of biological indicator species, whereas the socioeconomic focus is on the economic benefits to society of long-term resource sustainability. The governance module addresses the framework for cross-sectoral and local, national, regional and international collaborative management of the natural resources of the ecosystem. The productivity and the fish and fisheries modules are structured to provide science-based assessments of the effects of ecological and human-induced changes on the sustainability of ecosystem biomass yields. The five-module approach can be adapted to the needs of developing countries where evidence indicates that

Figure 1. Boundaries of 50 Large Marine Ecosystems.



1. Eastern Bering Sea
2. Gulf of Alaska
3. California Current
4. Gulf of California
5. Gulf of Mexico
6. Southeast U.S. Continental Shelf
7. Northeast U.S. Continental Shelf
8. Scotian Shelf
9. Newfoundland Shelf
10. West Greenland Shelf
11. Insular Pacific-Hawaiian
12. Caribbean Sea
13. Humboldt Current
14. Patagonian Shelf
15. Brazil Current
16. Northeast Brazil Shelf
17. East Greenland Shelf
18. Iceland Shelf
19. Barents Sea
20. Norwegian Shelf
21. North Sea
22. Baltic Sea
23. Celtic-Biscay Shelf
24. Iberian Coastal
25. Meditterranean Sea
26. Black Sea
27. Canary Current
28. Guinea Current
29. Benguela Current
30. Agulhas Current
31. Somali Coastal Current
32. Arabian Sea
33. Red Sea
34. Bay of Bengal
35. South China Sea
36. Sulu-Celebes Sea
37. Indonesian Seas
38. Northern Australian Shelf
39. Great Barrier Reef
40. New Zealand Shelf
41. East China Sea
42. Yellow Sea
43. Kuroshio Current
44. Sea of Japan
45. Oyashio Current
46. Sea of Okhotsk
47. West Bering Sea
48. Faroe Plateu
49. Antarctic
50. Pacific Central American Coastal

degradation and overexploitation of natural resources are limiting the long-term socioeconomic benefits of LME and hence global resources.

Productivity Module

Productivity can be related to the carrying capacity of the ecosystem for supporting fish resources (Pauly and Christensen, 1995; Pauly et al., 1998; Williams, 1998). Recently, it has been reported that the maximum global level of primary productivity for supporting the average annual world catch of fisheries has been reached and further large-scale "unmanaged" increases in fisheries yields from marine ecosystems are likely to be at trophic levels below fish in the marine food chain (Beddington, 1995). Evidence of this effect appears to be corroborated by changes in the species composition of the catches of fisheries from the East China Sea LME (Chen and Shen, 1999). Measurement of ecosystem productivity can also serve as a useful indication of the growing problem of coastal eutrophication (NSQSR, 1993). In several LMEs, excessive nutrient loadings of coastal waters have been related to algal blooms that have been implicated in mass mortalities of living resources, emergence of pathogens (e.g., cholera, vibrios, red tides, paralytic shellfish toxins) and explosive growth of non-indigenous species (Epstein, 1996; HEED, 1998).

The ecosystem parameters measured in the productivity module are zooplankton biodiversity and information on species composition, zooplankton biomass, water column structure, photosynthetically active radiation (PAR), transparency, chlorophyll-*a*, NO_2, NO_3 and primary production. The plankton of LMEs can be measured by deploying continuous plankton recorder (CPR) systems from commercial vessels of opportunity (Glover, 1967). The advanced plankton recorders can be fitted with sensors for temperature, salinity, chlorophyll, nitrate/nitrite, petroleum, hydrocarbons, light, bioluminescence and primary productivity (Aiken et al., 1999), providing the means to monitor changes in phytoplankton, zooplankton, primary productivity, species composition and dominance and long-term changes in the physical and nutrient characteristics of the LME, as well as longer-term changes relating to the biofeedback of the plankton to the stress of environmental change (Colebrook, 1986; Dickson et al., 1988; Colebrook et al., 1991; Williams, 1993).

The Fish and Fisheries Module

Changes in biodiversity among the dominant species within the fish communities of LMEs have resulted from excessive exploitation (Sissenwine and Cohen, 1991), naturally occurring environmental shifts in climate regime (Bakun, 1993) or coastal pollution (Mee, 1992; Bombace, 1993). Changes in the biodiversity of the fish community can generate cascading effects up the food chain to apex predators and down the food chain to plankton components of the ecosystem (Overholtz and Nicolas, 1979; Payne et al., 1990). These three sources of variability in fisheries yield are operable in most LMEs. They can be described as primary, secondary and tertiary driving forces in fisheries yields, contingent on the ecosystem under investigation. For example, in the Humboldt Current, Benguela Current and California Current LMEs, the primary driving force influencing variability in fisheries yield and ecosystem productivity is the changing upwelling strength (MacCall, 1986; Crawford et al., 1989; Alheit and Bernal, 1993; Bakun, 1993, 1995). Fishing and pollution effects are secondary and tertiary effects on fisheries yields. In continental shelf LMEs including the Yellow Sea and Northeast US Shelf, excessive fisheries effort has been the cause of large-scale declines in catch and changes in the biodiversity and dominance in the fish community (Sissenwine, 1986; Tang, 1993). In these ecosystems, pollution and environmental perturbation are of secondary and tertiary influence. In contrast, significant coastal pollution and eutrophication have been the principal factors driving the changes in fisheries yields of the Northwest Adriatic (Bombace, 1993), the Black Sea (Mee, 1992) and the near coastal areas of the Baltic Sea (Kullenberg, 1986). Overexploitation and natural environmental changes are of secondary and tertiary importance. Consideration of the driving forces of change in biomass yield is important when developing options for management of living marine resources for long-term sustainability.

The fish and fisheries module includes fisheries-independent bottom trawl surveys and acoustic surveys for pelagic species to obtain time-series information on changes in biodiversity and abundance levels of the fish community (Ntiba, 1998). Standardized sampling procedures, when deployed from small calibrated trawlers, can provide important information on diverse changes in fish species. The fish catch provides biological samples for stock assessments, stomach analyses, age, growth, fecundity and size comparisons (ICES, 1991), data for clarifying and quantifying multispecies trophic relationships and the collection of samples to monitor coastal pollution. Samples of trawl-caught fish can be used to monitor pathological conditions that may be associated with coastal pollution. The trawlers can also be used as platforms for obtaining water, sediment and benthic samples for monitoring harmful algal blooms, virus vectors of disease, eutrophication, anoxia and changes in benthic communities.

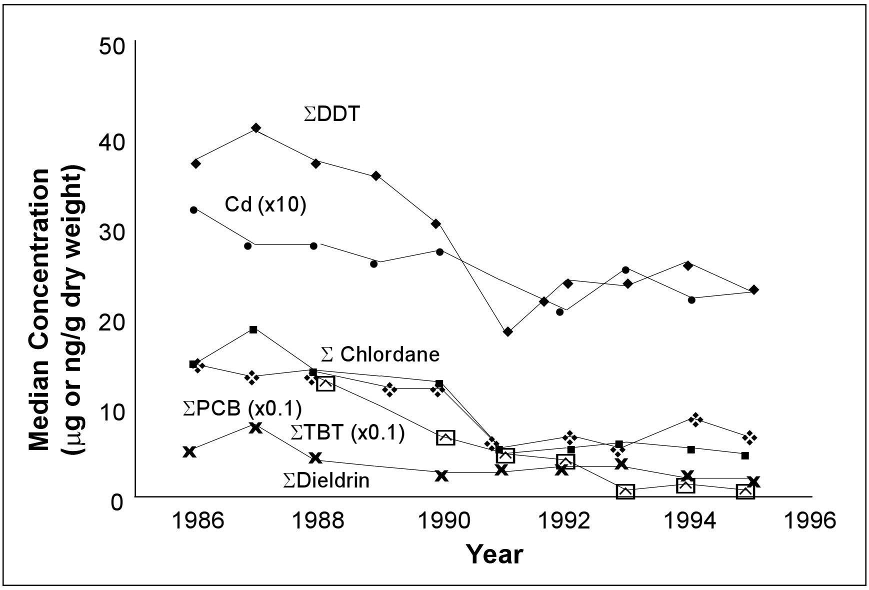
Pollution and the Ecosystem Health Module

In several LMEs, pollution has been a principal driving force in changes of biomass yields. Assessing the changing status of pollution and health of the entire LME is scientifically challenging. Ecosystem "health" is a concept of wide interest for which a single precise scientific definition is problematical. Methods to assess the health of LMEs are being developed from modifications to a series of indicators and indices described by several investigators (Costanza, 1992; Karr, 1992; Norton and Ulanowicz, 1992; Rapport, 1992; Costanza and Mageau, 1998). The overriding objective is to monitor changes in health from an ecosystem perspective as a measure of the overall performance of a complex system (Costanza, 1992). The health paradigm is based on the multiple-state comparisons of ecosystem resilience and stability (Holling, 1973, 1986, 1993; Pimm, 1984; Costanza, 1992) and is an evolving concept.

Following the definition of Costanza (1992) to be healthy and sustainable, an ecosystem must maintain its metabolic activity level, its internal structure and organization and must be resistant to external stress over time and space scales relevant to the ecosystem. These concepts were discussed by panels of experts at two workshops convened in 1992 by NOAA (NOAA, 1993). Among the indices discussed by the participants were five that are being considered as experimental measures of changing ecosystem states and health: (1) biodiversity; (2) stability; (3) yields; (4) productivity; and (5) resilience. The data from which to derive the experimental indices are obtained from time-series monitoring of key ecosystem parameters. The ecosystem sampling strategy is focused on parameters relating to the resources at risk from overexploitation, species protected by legislative authority (marine mammals) and other key biological and physical components at the lower end of the food chain (plankton, nutrients, hydrography). The parameters of interest include zooplankton composition, zooplankton biomass, water column structure, photosynthetically active radiation (PAR), transparency, chlorophyll-*a*, NO_2, NO_3, primary production, pollution, marine mammal biomass, marine mammal composition, runoff, wind stress, seabird community structure, seabird counts, finfish composition, finfish, biomass, domoic acid, saxitoxin and paralytic shellfish poisoning (PSP) (Sherman, 1994). The experimental parameters selected incorporate the behavior of individuals, the resultant responses of populations and communities, as well as their interactions with the physical and chemical environment. The selected parameters provide a basis for comparing changing health status within and among ecosystems.

Fish, benthic invertebrates and other biological indicator species are used in the pollution and ecosystem health module to measure pollution effects on the ecosystem including the bivalve monitoring strategy of "Mussel-Watch", the pathobiological examination of fish (Goldberg, 1976; Farrington et al., 1983; ICES, 1988; O'Connor and Ehler, 1991; White and Robertson, 1996) and the estuarine and nearshore monitoring of contaminants in the water column, substrate and selected groups of organisms (Figure 2). The methods used are based on NOAA's Status and Trends Program (Turgeon et al., 1992; O'Connor, 1998). The routes of bioaccumulation and trophic transfer of contaminants are assessed and critical

Figure 2. Decreasing Concentrations of Many Contaminants in Bivalve Tissue Since 1986.

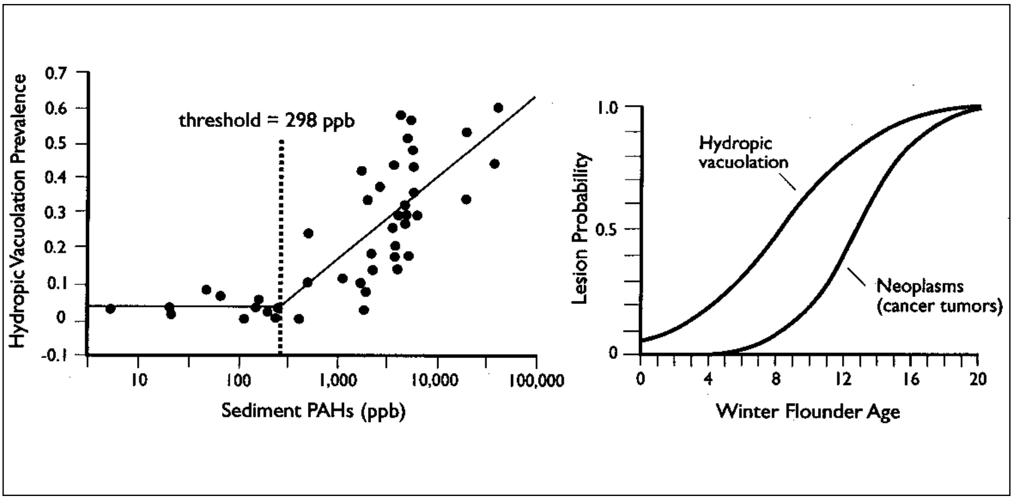


Source: NOAA (1998).

life history stages and selected food-chain organisms are examined for a variety of parameters that indicate exposure to and effects of, contaminants. Contaminant-related effects measured include diseases, impaired reproductive capacity and impaired growth (Figure 3). Many of these effects can be caused by direct exposure to contaminants, or by indirect effects, such as those resulting from alterations in prey organisms. The assessment of chemical contaminant exposure and effects on fisheries resources and food-chain organisms consists of a suite of parameters, including biochemical responses that are clearly linked to contaminant exposure coupled with measurements of organ disease and reproductive status that have been used in previous studies to establish links between exposure and effects (Figure 4). The specific suite of parameters measured will cover the same general responses and thus allow for comparable assessment of the physiological status of each species sampled as it relates to chemical contaminant exposure including endocrine disrupters and other effects at the individual species and population level (Figure 4) (Svanberg, 1992; Turgeon et al., 1992; Varanasi et al., 1992; NOAA, 1998). These results are compared to historical data obtained from sediment cores examined for toxic contaminants (Figure 5). In addition, the implementation of protocols for assessing the frequency and effect of harmful algal blooms (Smayda, 1991) and emergent diseases (Epstein, 1993) are included in the pollution module (Figure 6).

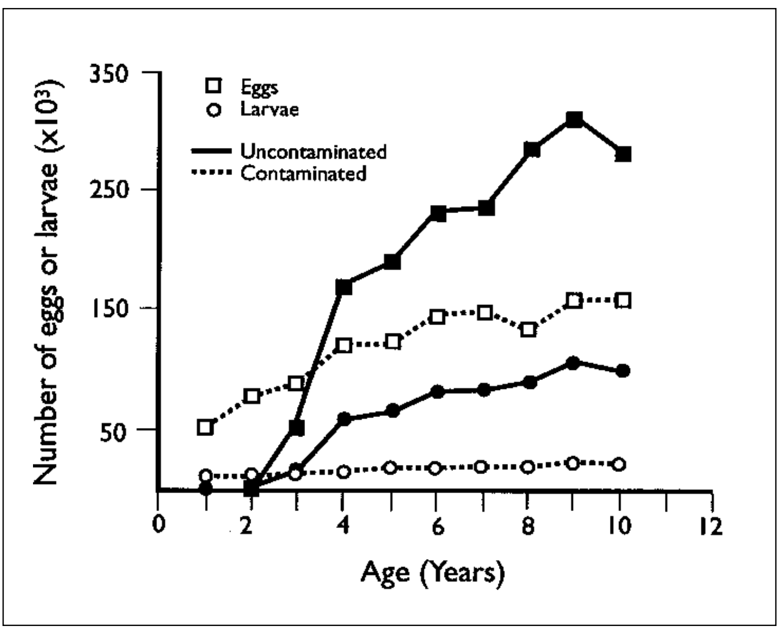
Figure 3. Incidence of Some Liver Lesions in Fish (e.g., winter flounder) Increases After Exposure to Certain Contaminants (e.g., PAHs) After a Specific Threshold is Reached.

Lesion probability increases with fish age.



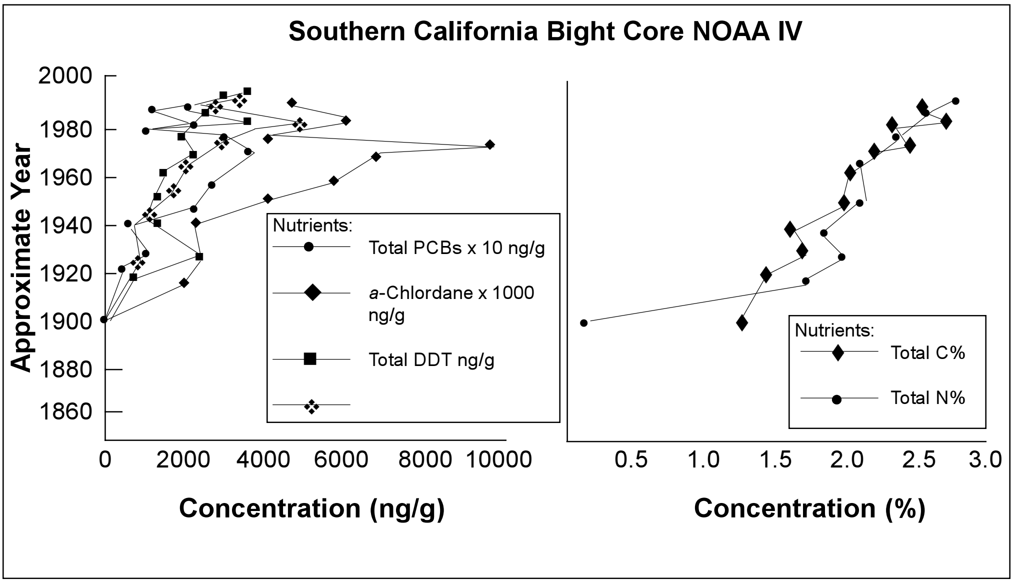
Source: NOAA (1998).

Figure 4. Comparison of Reproductive Outputs of English Sole from "Clean" and Contaminated Sites in Coastal Waters of the Gulf of Alaska LME.



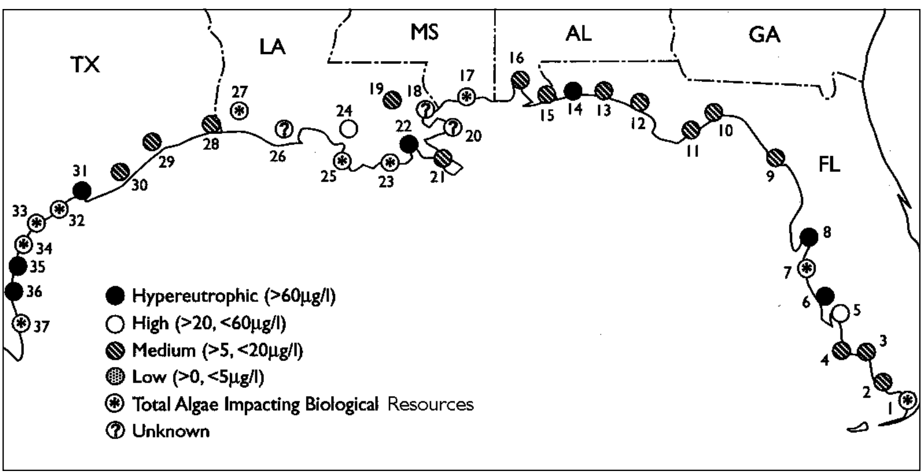
Source: NOAA (1998).

Figure 5. Trends in Toxic Contaminants (increasing then decreasing since the mid-1970s) and Nutrients (steadily increasing) from this Core's Data are Typical of All 10 NS&T Areas Examined.



Source: NOAA (1998).

Figure 6. Current Status of Chlorophyll *a* and Toxic Algal Blooms in the Gulf of Mexico Ecosystem Reported by the Experts in NOAA's National Estuarine Eutrophication Survey.



Source: NOAA (1998).

The Socioeconomic Module

This module is characterized by its emphasis on practical applications of its scientific findings in managing the LME and on the explicit integration of economic analysis including valuations of ecosystem goods and services with the science-based ecosystem structure and function assessments to assure that prospective management measures are cost-effective. Economists and policy analysts will need to work closely with ecologists and other scientists to identify and evaluate management options that are both scientifically credible and economically practical.

Published reports addressing the developing paradigm of ecosystem management based on economic valuations of ecosystem goods and services include the findings of an expert panel of the Ecological Society of America (Christensen et al., 1996), reports by NOAA (Baker, 1996; Griffis and Kimball, 1996) and reports of the U.S. Congressional Research Service (Lubchenco, 1994; Zinn and Corn, 1994). Examples of processes, goods and services expected from healthy ecosystems are listed in Boxes 1, 2 and 3.

Special consideration should be given to improved knowledge of how the natural system generates economic values. Many valuable services provided by natural systems are not traded in markets or included in planning evaluations, so extra care must be made to assure that they are not sacrificed through ignorance. The services provided by coastal wetlands as nurseries for fisheries, natural pollution filters and storm buffers are well-known examples that have particular relevance to coastal reclamation activities. Other examples are more subtle, including the importance of predator-prey relationships and the possibility of losing unrecognized “keystone” species in a valuable ecosystem. Experience indicates that growing economic values on aesthetic and recreational/tourism amenities are to be expected in the LMEs. A variety of sources of economic value arising from the natural diversity of the LME should be identified and assessed in regard to existing uses and potential management innovations.

Each project should include a generalized characterization of the ways in which human activities affect the natural marine system and the expected “sensitivity” of these forcing functions to various types and levels of human activity. Population dynamics, coastal development and land-use practices in the system’s drainage basin are clear examples. Work integrating the efforts of natural and social scientists should concentrate further on resolving apparent effects (such as eutrophication-associated red tide events or changing fish population structures) that are confounded by cycles or complex dynamics in the natural system itself. Progress is possible, too, in achieving better characterizations of the way in which

Box 1. Ecosystem Goods and Services.
Healthy ecosystems perform a diverse array of functions that provide both goods and services to humanity. Here, the term goods refers to items given monetary value in the market place, whereas the services from ecosystems are valued, but rarely bought or sold.

Ecosystem processes include: Hydrologic flux and storage Biological productivity Biogeochemical cycling and storage Decomposition Maintenance of biological diversity
Ecosystem "goods" include: Food Construction materials Medicinal plants Wild genes for domestic plants and animals Tourism and recreation
Ecosystem "services" include: Maintaining hydrological cycles Regulating climate Cleansing water and air Maintaining the gaseous composition of the atmosphere Pollinating crops and other important plants Generating and maintaining soils Storing and cycling essential nutrients Absorbing and detoxifying pollutants Providing beauty, inspiration and research

Source: Modified from Ehrlich and Ehrlich (1991), Lubchenco et al. (1993) and Richardson (1994) (From Lubchenco, 1994).

Box 2. Some Examples of the Goods and Services Provided by Ecosystems to Humans.

HEALTHY ECOSYSTEMS PROVIDE	
GOODS:	Food Medicinal plants Raw materials Wild genes
SERVICES:	Absorbing and detoxifying pollutants Cleansing water and air Generating and maintaining soils and reefs Maintaining hydrological cycles Maintaining the composition of the atmosphere Pollinating crops and other important plants Providing sites for tourism, recreation and research Regulating climate Storing and cycling essential nutrients

Source: McNeely et al. (1990), Ehrlich and Ehrlich (1991), Lubchenco et al. (1993) and Lubchenco (1994).

Box 3. Some of the Substantive Changes Between Traditional Resource Management and Ecosystem Management.

ECOSYSTEM MANAGEMENT: A PARADIGM SHIFT	
From	**To**
Individual species	Ecosystems
Small spatial scale	Multiple scales
Short-term perspective	Long-term perspective
Humans: independent of ecosystems	Humans: integral parts of ecosystems
Management divorced from research	Adaptive management
Managing commodities	Sustaining production potential for goods and services

Source: Lubchenco (1994).

human forcing is mediated by alternate management options. Emphasis should be on isolating and quantifying those forcing activities (sewage discharge, agricultural runoff, fishing effort) likely to be expressed most prominently in effects on the natural system.

Governance Module

The governance module is evolving based on case studies now underway among ecosystems to be managed from a more holistic perspective in projects supported by the Global Environment Facility (GEF), including the Yellow Sea Ecosystem, where the principal effort is underway in China (Tang, 1989) and Republic of Korea (Zhang and Kim, 1999) and also for the Gulf of Guinea LME by Ivory Coast, Ghana, Nigeria, Benin and Cameroon and Togo (UNIDO, 1997) and by the governments of South Africa, Namibia and Angola to conduct joint assessments of the resources of the Benguela LME to guide the development of the shared resources of the ecosystem to ensure their long-term sustainability, particularly with regard to food security. The Great Barrier Reef Ecosystem is also being managed from a holistic ecosystems perspective (Bradbury and Mundy, 1989; Kelleher, 1993) along with the Northwest Australian Continental Shelf Ecosystem (Sainsbury, 1988) under management by the state and federal governments of Australia; and the Antarctic marine ecosystem under the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and its 21 nation membership (Scully et al., 1986). Movement toward ecosystems management is emerging for the North Sea (NSQSR, 1993), the Barents Sea (Eikeland, 1992) and the Black Sea (Hey and Mee, 1993).

INTEGRATED MANAGEMENT

A framework for linking science-based assessments of the changing states of coastal ecosystems to support the long-term sustainability of environmental quality and renewable resources while also guiding environmentally sound economic development of ecosystem resources and management practices is now emerging from a series of regional efforts aimed at cross-sectoral integration of assessments of coastal productivity, fish and fisheries and pollution and ecosystem health, with socioeconomics and governance modules. The application of the modules is being supported, in part, by grants from the GEF in collaboration with national governments of countries bordering large marine ecosystems in Asia and Africa.

MODEL SYSTEMS

The Gulf of Guinea project is following the GEF Operational Strategy which calls for the development and implementation of projects in the International Waters Program that can achieve global benefits through the implementation by countries of more comprehensive approaches for restoring and protecting the "International Waters" (IW) environment. The goal of the Gulf of Guinea LME project

> *"is to assist countries in making changes in the ways that human activities are conducted in different sectors so that the particular water body and its multi-country drainage basin can sustainably support human activities."*

The project has placed priority on

> *"changing sectoral policies and activities responsible for the most serious root causes of transboundary environmental concerns and determining the expected baseline and additional actions needed to resolve each priority concern. Based on the countries' commitments to change sectoral policies or activities and to find baseline investments, the GEF has funded initial incremental costs of additional measures"* (GEF, 1997).

Operational methodologies are being developed for ensuring that near coastal and drainage basin effects on the LME proper are included in the overarching strategy for a systems approach to a management strategy that includes: (1) drainage basin, (2) near coastal and (3) offshore coastal components of the LME. Two model systems being adapted for filling this pressing need in the Gulf of Guinea for improved assessment strategies are: the Batangas Bay model in the Philippines and the Xiamen Municipality model in China. Both were developed as demonstration projects in integrated coastal management (ICM) of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (Chua et al., 1999). The approach provides a framework for management of the coast of the Batangas Bay Region of the Province of Batangas in the Philippines (PG-ENRO, 1996). It includes guidelines for the implementation of a core program of: (1) integrated waste management; (2) water pollution abatement; (3) conservation of stressed mangrove and coral reef areas; (4) coastal tourism development; and (5) improvements of the municipal fisheries. Special support programs addressing interests of the stakeholders of the region have been developed and are being implemented for: (1) development of legal and

Table 2. Key Environmental Management Issues in Batangas Bay Region.

Area of Concern	Issues	Contributory Factors
Solid waste generation, collection and disposal	Accumulation of uncollected solid waste Leachate pollution Indiscriminate mixing of solid waste and toxic and hazardous wastes	Inadequate dump sites Low collection efficiency Random dumping of uncollected waste Indiscriminate dumping from domestic passenger ships Absence of incinerators Lack of collection fleet/vehicles Narrow roads/streets for large garbage vehicles Irregular street sweeping and open-drain clearing Lack of incentives and penalties for waste minimization, segregation and recycling
Water and air pollution	Increased threats of oil discharges from industries and oil spill from heavy vessel traffic Disposal of untreated agricultural (poultry, piggery and farmland) and industrial wastes into tributaries and coastal waters Habitat destruction/loss, especially the coral reefs	Oil spill from ships, tanks and pipes of oil refineries Oily wastes from oil refineries, shipyard and marine construction industries Gas and particulate emissions from industrial and power-generating plants and motor vehicles Organic wastes and chemicals from crop and livestock raising Mine tailings and sediments from mining and quarrying operations Destructive fishing methods Indiscriminate dumping by households and commercial establishments Absence of sewage treatment plants Poor enforcement and monitoring of environmental laws and regulations
Municipal fishing	Declining fish harvest Decreasing effective fishing area in the bay Reduced income	Inappropriate fishing methods Overfishing Pollution from oil spill Encroachment of commercial fishing Unregulated waste disposal from land- and water-based sources Conversion of Batangas port to international port
Mining and quarrying	Unregulated environmentally destructive practices	Application of open-pit mining methods Lack of enforcement of environmental laws
Shipping and port development	Vessel traffic congestion Oil spill and ship collision Marine pollution	Small water area of the bay Incompatibility with some land and water uses of the bay Unregulated flow of cargo, passenger and fishing vessels Poor enforcement of vessel safety measures Absence of vessel traffic system Inadequacy of vessel traffic monitoring equipment Weak intersectoral cooperation in oil spill contingency plan execution
Human settlements and population growth, especially in coastal areas	Increasing settlements along coastal areas Poor health and sanitary conditions	Immigration of industrial workers and their families Limited alternative livelihood opportunities Improper household practices Inadequate health facilities and services

continued

Table 2. Key Environmental Management Issues in Batangas Bay Region (continued).

Participation of private sector and nongovernment organizations in environmental management	Lack of effective and sustained participation	Inadequate institutional and legal framework for participation and empowerment Insufficient incentive mechanisms for participation Lack of functional organization of coastal communities Low understanding and appreciation of development-environment nexus
Integrated policies, plans, programs and institutional support	Limited emphasis on environment in development planning and management Uncoordinated formulation and enforcement of policies, plans, programs and projects Occurrence of resource-use conflicts Low compliance to environmental laws and regulations	Absence of a central coordinating body for planning and development of the Batangas Bay Region Lack of an integrated land- and water-use policy and plan, including zonation scheme for the bay region Limited technical capability to integrate environmental concerns into development planning and management Most local planners have no formal training in environmental management Weak interagency, intersectoral and interdisciplinary coordination Lack of recognition of LGU powers under the Local Government Code and lack of technical ability to implement them Fragmented information base Poor law enforcement and monitoring of its compliance

Source: PG-ENRO (1996).

institutional mechanisms for ICM; (2) strengthening of provincial integrated planning and resource management; (3) improvement of policy support systems; (4) upgrading of monitoring and enforcement capabilities; (5) capacity building in technology transfer and coastal management; (6) community outreach; (7) establishment of a multisectoral information, education and communication system; (8) expansion of research and extension activities; (9) establishment of a management information system; and (10) development of sustainable financing mechanisms. A list of the key environmental management issues that are the root causes of the declining environmental quality of the region is given in Table 2.

An Action Plan has been adopted by the Provincial Government to mitigate the coastal stressors in Batangas Bay. The plan is to be implemented by the Batangas Bay Council for Integrated Coastal Management, a special Council created by legislation by the Provincial Government. This *Governance body* will move forward the actions necessary to mitigate the stressors on the coastal region while also allowing for environmentally sustainable development of the natural resources of the region.

This model system is being introduced by the GEF/UNDP/IMO Regional Programme to other candidate areas around the margins of the East Asian Seas. It is to be followed by a series of demonstration projects to be known as the Fast Track ICM-LME (FTICM-LME) projects around the margin of the Yellow Sea in China and Republic of Korea in support of the GEF-sponsored Yellow Sea LME project.

This initiative can provide a new opportunity for cooperating nations to link pertinent programs and instruments into regional comprehensive approaches to reduce pollution in international waters. Joint multicountry initiatives tackling transboundary freshwater, coastal and marine issues are essential for improving the health of and the prospects for the long-term sustainability and socioeconomic benefits of coastal environments.

References

Aiken, J., R. Pollard, R. Williams, G. Griffiths and I. Bellan. 1999. Measurements of the upper ocean structure using towed profiling systems, p. 346-362. *In* K. Sherman and Q. Tang (eds.) Large marine ecosystems of the Pacific Rim: Assessment, sustainability and management. Blackwell Science, Inc., Malden, Massachusetts.

Alheit, J. and P. Bernal. 1993. Effects of physical and biological changes on the biomass yield of the Humboldt Current ecosystem, p. 53-68. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Large marine ecosystems: Stress, mitigation and sustainability. AAAS Press, Washington, D.C.

Bagla, P. 1998. Global Environment Facility. Science moves up ladder in push for sustainable growth. Science 280: 374-375.

Baker, D.J. 1996. What do ecosystem management and the current budget mean for federally supported environmental research? Ecol. Appl. 6(3): 712-715.

Bakun, A. 1993. The California Current, Benguela Current and Southwestern Atlantic Shelf ecosystems: A comparative approach to identifying factors regulating biomass yields, p. 199-221. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Large marine ecosystems: Stress, mitigation and sustainability. AAAS Press, Washington, D.C.

Bakun, A. 1995. A dynamical scenario for simultaneous "regime-scale" marine population shifts in widely separated LMEs of the Pacific, p. 47-72. *In* Q. Tang and K. Sherman (eds.) The Large Marine Ecosystems of the Pacific Rim: A Report of a Symposium held in Qingdao, People's Republic of China, 8-11 October 1994. IUCN Marine Conservation and Development, Gland, Switzerland.

Beddington, J.R. 1995. The primary requirements. Nature 374: 213-214.

Boesch, D.F. 1998. An ecosystem approach: Drainage basin and coastal sea as a whole system. Synthesis. 1998. *In* Proceedings of the Stockholm Water Symposium, 10-15 August 1997, With Rivers to the Sea: Interaction of Land Activities, Freshwater and Enclosed Coastal Seas. Joint Conference, 7th Stockholm Water Symposium, 3rd International Conference on the Environmental Management of Enclosed Coastal Seas (EMECS). SIWI, SE-106 36. Stockholm International Water Institute, Stockholm, Sweden.

Bombace, G. 1993. Ecological and fishing features of the Adriatic Sea, p. 119-136. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Large marine ecosystems: Stress, mitigation and sustainability. AAAS Press, Washington, D.C.

Bradbury, R.H. and C.N. Mundy. 1989. Large-scale shifts in biomass of the Great Barrier Reef ecosystem, p. 143-167. *In* K. Sherman and L.M. Alexander (eds.) Biomass yields and geography of large marine ecosystems. AAAS Selected Symposium 111. Westview Press, Inc., Boulder, Colorado.

Chen, Y. and X. Shen. 1999. Changes in the biomass of the East China Sea ecosystem, p. 221-239. *In* K. Sherman and Q. Tang (eds.) Large marine ecosystems of the Pacific Rim: Assessment, sustainability and management. Blackwell Science, Inc., Malden, Massachusetts.

Christensen, N.L., A.M. Bartuska, J.H. Brown, S. Carpenter, C. D'Antonio, R. Francis, J.F. Franklin, J.A. MacMahon, R.F. Noss, D.J. Parsons, C.H. Peterson, M.G. Turner and R.G. Woodmansee. 1996. Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. Ecol. Appl. 6(3): 665-691.

Chua, T.E., S.A. Ross, H. Yu, G. Jacinto and S.R. Bernad. 1999. Sharing lessons and experiences in marine pollution management. MPP-EAS Technical Report No. 20, 94 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Colebrook, J.M. 1986. Environmental influences on long-term variability in marine plankton. Hydrobiologia 142: 309-325.

Colebrook, J.M., A.J. Warner, C.A. Proctor, H.G. Hunt, P. Pritchard, A.W.G. John, D. Joyce and R. Barnard. 1991. 60 Years of the continuous plankton recorder survey: A celebration. The Sir Alister Hardy Foundation for Ocean Science, Plymouth, England.

Costanza, R. 1992. Toward an operational definition of ecosystem health, p. 239-256. *In* R. Costanza, B.G. Norton and B.D. Haskell (eds.) Ecosystem health: New goals for environmental management. Island Press, Washington, D.C.

Costanza, R. and M. Mageau. 1999. What is a healthy ecosystem? p. 385-415. *In* K. Sherman, H. Kumpf and K. Steidinger (eds.) The Gulf of Mexico large marine ecosystem: Assessment, sustainability and management. Blackwell Science, Inc. , Malden, Massachusetts.

Crawford R.J.M, L.V. Shannon and P.A. Shelton. 1989. Characteristics and management of the Benguela as a large marine ecosystem, p. 169-219. *In* K. Sherman and L.M. Alexander (eds.) Biomass yields and geography of large marine ecosystems. AAAS Selected Symposium 111. Westview Press, Inc., Boulder, Colorado.

Dickson, R.R., P.M. Kelly, J.M. Colebrook, W.S. Wooster and D.H. Cushing. 1988. North winds and production in the eastern North Atlantic. J. Plankton Res. 10: 151-169.

Eikeland, P.O. 1992. Multispecies management of the Barents Sea large marine ecosystem: A framework for discussing future challenges. The Fridtjof Nansen Institute, Lysaker, Norway.

Epstein, P.R. 1993. Algal blooms and public health. World Res. Rev. 5(2): 190-206.

Epstein, P.R. 1996. Emergent stressors and public health implications in large marine ecosystems: An overview, p. 417-438. *In* K. Sherman, N.A. Jaworski and T.J. Smayda (eds.) The Northeast Shelf ecosystem: Assessment, sustainability and management. Blackwell Science, Inc., Cambridge Massachusetts.

FAO (Food and Agriculture Organization of the United Nations). 1995. FAO yearbook. Fishery statistics: Catches and landings. Fisheries Series No. 48, Statistics Series No. 134, Vol. 80. Fisheries Dept., FAO, Rome.

Farrington, J.W., E.D. Goldberg, R.W. Risebrough, J.H. Martin and V.T. Bowen. 1983. U.S. 'Musselwatch' 1976-1978: An overview of the trace metal, DDE, PCB, hydrocarbon and artificial radionuclide data. Env. Sci. Tech. 17:490-496.

GEF (Global Environment Facility). 1997. GEF operational programs. Global Environment Facility, Washington, D.C.

GEF (Global Environment Facility). 1998. Valuing the global environment: Actions and investments for a 21st century. Foreword by Fernando Henrique Cardoso, President of Brazil. Global Environment Facility, Washington, D.C. 162 p.

Glover, R.S. 1967. The continuous plankton recorder survey of the North Atlantic. Symp. of the Zool. Soc. Lond. 19: 189-210.

Goldberg, E.D. 1976. The health of the oceans. UNESCO Press, Paris.

Griffis, R.B. and K.W. Kimball. 1996. Ecosystem approaches to coastal and ocean stewardship. Ecol. Appl. 6(3): 708-711.

Hedin, L. 1998. From landscapes to the sea: Challenges to understanding how humans influence aquatic ecosystems. *In* Proceedings of the Stockholm Water Symposium, 10-15 August 1997, With Rivers to the Sea: Interaction of Land Activities, Freshwater and Enclosed Coastal Seas. SIWI SE-106 36. Stockholm International Water Institute, Stockholm, Sweden.

HEED (Health Ecological and Economic Dimensions of Global Change Program). 1998. Marine ecosystems: Emerging diseases as indicators of change. Year of the Ocean Special Report on Health of the Oceans from Labrador to Venezuela. The Center for Health and the Global Environment, Harvard Medical School, Boston, Massachusetts. 85 p.

Hey, E. 1992. A healthy North Sea ecosystem and a healthy North Sea fishery: Two sides of the same regulation? Ocean Develop. Int. Law 23: 217-238.

Hey, E. and L.D. Mee. 1993. Black Sea. The ministerial declaration: An important step. Env. Pollut. Law 2315: 215-217, 235-236.

Holling, C.S. 1973. Resilience and stability of ecological systems. Institute of Resource Ecology, University of British Columbia, Vancouver, Canada.

Holling, C.S. 1986. The resilience of terrestrial ecosystems: Local surprise and global change, p. 292-317. *In* W.C. Clark and R.E. Munn (eds.) Sustainable development of the biosphere. Cambridge University Press, London.

Holling, C.S. 1993. Investing in research for sustainability. Ecol. Appl. 3:552-555.

ICES (International Council for the Exploration of the Sea). 1988. Results of the 1985 baseline study of contaminants in fish and shellfish. Cooperative Research Report No. 151. ICES, Copenhagen, Denmark.

ICES (International Council for the Exploration of the Sea). 1991. Report of the Multispecies Assessment Working Group. ICES C.M. 1991/Assess 7.

IOC (International Oceanographic Commission of UNESCO). 1992. Global Ocean Observing System (GOOS). An initiative of the Intergovernmental Oceanographic Commission (of UNESCO). IOC, UNESCO, Paris.

IUCN (The World Conservation Union). 1990. Caring for the world. A strategy for sustainability. Second Draft, June 1990, prepared by the IUCN, the United Nations Environment Programme (UNEP) and the World Wide Fund for Nature (WWF), Gland, Switzerland.

Jayaraman, K.S. and E. Masood. 1998. UN eco-fund under pressure to open up. Nature 392: 640.

Karr, J. 1992. Ecological integrity: Protecting earth's life support systems, p. 223-228. *In* R. Costanza, B.G. Norton and B.D. Haskell (eds.) Ecosystem health: New goals for environmental management. Island Press, Washington, D.C.

Kelleher, G. 1993. Sustainable development of the Great Barrier Reef as a large marine ecosystem, p. 272-279. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Large marine ecosystems: Stress, mitigation and sustainability. AAAS Press, Washington, D.C.

Kullenberg, G. 1986. Long-term changes in the Baltic Ecosystem, p. 19-32. *In* K. Sherman and L.M. Alexander (eds.) Variability and management of large marine ecosystems. AAAS Selected Symp. 99. Westview Press, Inc., Boulder, Colorado.

Kumpf, H., K. Steidinger and K. Sherman, Editors. 1999. The Gulf of Mexico large marine ecosystem: Assessment, sustainability and management. Blackwell Science, Inc., Malden, Massachusetts. 736 p.

Lubchenco, J. 1994. The scientific basis of ecosystem management: Framing the context, language and goals, p. 33-39. *In* Ecosystem management: Status and potential. 103rd Congress, 2nd Session, Committee Print. U.S. Government Printing Office, Superintendent of Documents.

MacCall, A.D. 1986. Changes in the biomass of the California Current system, p. 33-54. *In* K. Sherman and L.M. Alexander (eds.) Variability and management of large marine ecosystems. AAAS Selected Symp. 99. Westview Press, Inc., Boulder, Colorado.

Mee, L. 1992. The Black Sea in crisis: A need for concerted international action. Ambio 21(4): 1278-1286.

Meyers, N. 1990. Working towards one world. Book review. Nature 344(6266): 499-500.

NOAA (National Oceanic and Atmospheric Administration). 1993. Emerging theoretical basis for monitoring the changing states (health) of large marine ecosystems. Summary Report of Two Workshops: 23 April 1992, National Marine Fisheries Service, Narragansett, Rhode Island and 11-12 July 1992, Cornell University, Ithaca, New York. NOAA Technical Memorandum NMFS-F/NEC-100.

NOAA (National Oceanic and Atmospheric Administration). National Ocean Service. 1998. National Status and Trends (NS&T) Program for Marine Environmental Quality. Silver Spring, Maryland.

Norton, B.G. and R.E. Ulanowicz. 1992. Scale and biodiversity policy: A hierarchical approach. Ambio 21(3): 244-249.

NSQSR (North Sea Quality Status Report). 1993. Oslo and Paris Commissions, London. Olsen and Olsen, Fredensborg, Denmark. 132 + vi p.

Ntiba, M.J. 1998. Trawl survey strategies and applications for assessing the changing state of fish communities in large marine ecosystems, p. 23-43. *In* K. Sherman, E.N. Okemwa and M.J. Ntiba (eds.) Large marine ecosystems of the Indian Ocean: Assessment, sustainability and management. Blackwell Science, Inc., Cambridge, Massachusetts.

O'Connor, T.P. 1998. The NOAA National Status and Trends Program. Mar. Pollut. Bull. 37(1-2): 3-5.

O'Connor, T.P. and C.N. Ehler. 1991. Results from the NOAA National Status and Trends Program on distribution and effects of chemical contamination in the coastal and estuarine United States. Env. Monit. Assess. 17: 33-49.

Overholtz, W.J. and J.R. Nicolas. 1979. Apparent feeding by the fin whale *Balaenoptera physalus* and humpback whale, *Megoptera novaeanglae*, on the American sand lance, *Ammodytes americanus*, in the Northwest Atlantic. Fish. Bull. (US) 77: 285-287.

Pauly, D. and V. Christensen. 1995. Primary production required to sustain global fisheries. Nature 374: 255-257.

Pauly, D., V. Christensen, J. Dalsgaard, R. Froese and F. Torres, Jr. 1998. Fishing down marine food webs. Science 279: 860-863.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittmann, P.J. Clapham and J.W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. (US) 88: 687-696.

PG-ENRO (Environment and Natural Resources Office of the Provincial Government of Batangas). 1996. Strategic environmental management plan for the Batangas Bay Region. MPP-EAS Technical Report No. 3, 96 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Pimm, S.L. 1984. The complexity and stability of ecosystems. Nature 307: 321-326.

Rapport, D.J. 1992. What is clinical ecology? p. 223-228. *In* R. Costanza, B.G. Norton and B.D. Haske II (eds.) Ecosystem health: New goals for environmental management. Island Press, Washington, D.C.

Sainsbury, K.J. 1988. The ecological basis of multispecies fisheries and management of a demersal fishery in tropical Australia, p. 349-382. *In* J.A. Gulland (ed.) Fish population dynamics. 2nd ed. John Wiley and Sons, New York.

Scully, R.T., W.Y. Brown and B.S. Manheim. 1986. The Convention for the Conservation of Antarctic Marine Living Resources: A model for large marine ecosystem management, p. 281-286. *In* K. Sherman and L.M. Alexander (eds.) Variability and management of large marine ecosystems. AAAS Selected Symposium 99. Westview Press, Inc., Boulder, Colorado.

Sherman, K. 1994. Sustainability, biomass yields and health of coastal ecosystems: An ecological perspective. Mar. Ecol. Prog. Ser. 112: 277-301.

Sherman, K. and L.M. Alexander, Editors. 1986. Variability and management of large marine ecosystems. AAAS Selected Symposium 99, Westview Press, Inc., Boulder, Colorado. 319 p.

Sherman, K. and L.M. Alexander, Editors. 1989. Biomass yields and geography of large marine ecosystems. AAAS Selected Symposium 111, Westview Press, Inc., Boulder, Colorado. 493 p.

Sherman, K., L.M. Alexander and B.D. Gold, Editors. 1990. Large marine ecosystems: Patterns, processes and yelds. AAAS Press, Washington, D.C. 242 p.

Sherman, K., L.M. Alexander and B.D. Gold, Editors. 1991. Food chains, yields, models and management of large marine ecosystems. Westview Press, Inc., Boulder, Colorado. 320 p.

Sherman, K., L.M. Alexander and B.D. Gold, Editors. 1993. Large marine ecosystems: Stress, mitigation and sustainability. AAAS Press, Washington, D.C. 376 p.

Sherman, K., N.A. Jaworski and T. Smayda, Editors. 1996. The Northeast Shelf ecosystem: Assessment, sustainability and management. Blackwell Science, Inc., Cambridge, Massachusetts. 564 p.

Sherman, K., E.N. Okemwa and M.J. Ntiba, Editors. 1998. Large marine ecosystems of the Indian Ocean: Assessment, sustainability and management. Blackwell Science, Inc., Cambridge, Massachusetts. 394 p.

Sherman, K. and Q. Tang, Editors. 1999. Large marine ecosystems of the Pacific Rim: Assessment, sustainability and management. Blackwell Science, Inc., Malden, Massachusetts. 465 p.

Sissenwine, M.P. 1986. Perturbation of a predator-controlled continental shelf ecosystem, p. 55-85. *In* K. Sherman and L.M. Alexander (eds.) Variability and management of large marine ecosystems. AAAS Selected Symp. 99. Westview Press, Inc., Boulder, Colorado.

Sissenwine, M.P. and E.B. Cohen. 1991. Resource productivity and fisheries management of the northeast shelf ecosystem, p. 1077-1123. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Food chains, yields, models and management of large marine ecosystems. Westview Press, Inc., Boulder, Colorado.

Smayda, T. 1991. Global epidemic of noxious phytoplankton blooms and food chain consequences in large ecosystems, p. 275-308. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Food chains, yields, models and management of large marine ecosystems. Westview Press, Inc., Boulder, Colorado.

Stockholm Water Symposium/EMECS. 1998. Stockholm, 10-15 August 1997. Proceedings: With Rivers to the Sea: Interaction of Land Activities, Freshwater and Enclosed Coastal Seas. SIWI SE-106 36. Stockholm International Water Institute, Stockholm, Sweden. 461 p.

Svanberg, O. 1992. Toxic effects monitoring in Baltic Sea coastal areas. *In* D.H. McKenzie, D.E. Hyatt and V.J. McDonald (eds.) Ecological indicators. Vol. 1. Proceedings of the International Symposium on Ecological Indicators, 16-19 October 1990, Fort Lauderdale, Florida. Elsevier Science Publishers Ltd., Essex, England.

Tang, Q. 1989. Changes in the biomass of the Yellow Sea ecosystems, p. 7-35. *In* K. Sherman and L.M. Alexander (eds.) Biomass yields and geography of large marine ecosystems. AAAS Selected Symp. 111. Westview Press, Inc., Boulder, Colorado.

Tang, Q. 1993. Effects of long-term physical and biological perturbations on the contemporary biomass yields of the Yellow Sea Ecosystem, p. 79-93. *In* K. Sherman, L.M. Alexander and B.D. Gold (eds.) Large marine ecosystems: Stress, mitigation and sustainability. AAAS Press, Washington, D.C.

Taylor, P. and A.J.R. Groom, Editors. 1998. Global issues in the United Nations framework. MacMillan, London.

Turgeon, D., S.B. Bricker and T.P. O'Connor. 1992. National Status and Trends Program: Chemical and biological monitoring of U.S. Coastal Waters, p. 425-457. *In* D.H. McKenzie, D.E. Hyatt and V.J. McDonald (eds.) Ecological indicators. Vol. 1. Elsevier Science, Essex, England.

UNIDO/UNDP/NOAA/UNEP. 1997. Gulf of Guinea Large Marine Ecosystem Project. Second Meeting of the Steering Committee, Cotonou, Bénin, 11-12 March 1997. Report GEF/GOG-LME/Sc-2.

Varanasi, U., J.E. Stein, L.L. Johnson, T.K. Collier, E. Casillas and M.S. Myers. 1992. Evaluation of bioindicators of contaminant exposure and effects in coastal ecosystems, p. 461-498. *In* D.H. McKenzie, D.E. Hyatt and V.J. McDonald (eds.) Ecological indicators. Vol. 1. Elsevier Science, Essex, England.

White, H.H. and A. Robertson. 1996. Biological responses to toxic contaminants in the Northeast Shelf large marine ecosystem, p. 259-283. *In* K. Sherman, N. Jaworski and T. Smayda (eds.) The Northeast Shelf Ecosystem: Assessment, sustainability and management. Blackwell Science, Cambridge, Massachusetts.

Williams, N. 1998. Overfishing disrupts entire ecosystems. Science 279: 809.

Williams, R. 1993. Evaluation of new techniques for monitoring and assessing the health of large marine ecosystems, p. 257-272. *In* D. Rapport (ed.) NATO Advanced Research Workshop Evaluating and Monitoring the Health of Large-scale Ecosystems. Springer-Verlag, Berlin.

Zhang Chang Ik and Suam Kim. 1999. Living marine resources of the Yellow Sea ecosystem in Korean waters: Status and perspectives. *In* K. Sherman and Q. Tang (eds.) Large marine ecosystems of the Pacific Rim: Assessment, sustainability and management. Blackwell Science, Inc., Malden, Massachusetts.

Zinn, J. and M.L. Corn. 1994. Ecosystem management: Status and potential: Summary of a workshop convened by the Congressional Research Service, 24-25 March 1994, Washington, D.C., p. 1-14. *In* Ecosystem management: Status and potential. 103rd Congress, 2nd Session, Committee Print. U.S. Government Printing Office, Superintendent of Documents.

An Assessment of the Integrated Marine Pollution Monitoring Program of Xiamen

Xu Kuncan

The Third Institute of Oceanography, State Oceanic Administration
No. 178 Daxue Road, Xiamen, People's Republic of China

Yuan Dongxing

Environmental Science Research Center, Xiamen University
Xiamen, People's Republic of China

XU KUNCAN and YUAN DONGXING. 1999. An assessment of the integrated marine pollution monitoring program of Xiamen, p. 88-95. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Marine pollution monitoring plays a key role in coastal management. Results of the monitoring provide useful information on the quality and trend of environmental variables. Monitoring also allows assessment of the efficiency of marine pollution management.

The few existing pollution monitoring programs undertaken by sectoral agencies have obvious deficiencies: 1) lack of concrete monitoring objectives; 2) low quality database; 3) overlapping monitoring plans and lack of data exchange; and 4) monitoring data are not translated into information that can be used for policy or management interventions.

In solving the above problems, an integrated marine pollution monitoring program involving interdisciplinary and multidepartmental cooperation and building upon the existing monitoring programs had been established in Xiamen. This paper briefly introduces the contents and operation of the integrated marine pollution monitoring program and assesses the effectiveness of its implementation.

INSTITUTIONS INVOLVED IN MARINE POLLUTION MONITORING

The institutions involved in marine environmental monitoring in Xiamen are listed in Table 1. Each individual monitoring unit implements its own monitoring task. The Xiamen Demonstration Project under the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (GEF/UNDP/IMO Regional Programme) has brought together the existing monitoring efforts, encouraged sharing of experiences and information and developed a collaborative network and program under which monitoring efforts are optimized, resources are shared and methods, standards and results are exchanged.

Table 1. Institutions Involved in Marine Pollution Monitoring in Xiamen.

Institution	Affiliation	Scope	Previous Monitoring Activities
Third Institute of Oceanography, SOA	State Oceanic Administration	Marine science research, monitoring technical study	Xiamen marine pollution investigation Red tide study Specific pollution study Tasks from SOA
Environmental Monitoring Station of Xiamen	Xiamen Environmental Protection Bureau	Environmental monitoring	Routine marine monitoring Routine nearshore monitoring Xiamen seas monitoring Tasks from Environmental Protection Bureau
Environmental Research Center of Xiamen University	State Education Committee	Environmental science research and education	Various tasks funded by National Natural Science Fund
Monitoring Stations of Fujian Fishery Institute	Fujian Aquaculture Department	Marine aquaculture environmental monitoring	Routine monitoring at aquaculture sites Tasks from Fujian, Xiamen Aquaculture Departments
Fujian Oceanography Research Institute	Fujian Science & Technology Committee	Marine environmental research and study	
Monitoring Station of Xiamen Port	Xiamen Port Office	Port environmental monitoring	Port environmental routine monitoring (was not carried out before executing this project)

Approaches in the Execution of the Monitoring Program

The following measures were undertaken in the full execution of the monitoring program:

- Establishment of the monitoring network where network members cooperate in the execution of the program, provision of technical aid and facilitation of data exchange;
- Adoption of uniform and standard sampling and analytical methods;
- Organization of training workshops and interlaboratory calibration;
- Exercising quality assurance and quality control in laboratory analyses; and
- Periodic submission of monitoring information and proposals for evaluation and assessment of concerned administrative departments for management improvement.

Components of the Monitoring Program

The program integrated the existing monitoring plans of the cooperating monitoring units in Xiamen. The following eight subprojects were included:

- Large-scale water quality monitoring;
- 24-hr water quality monitoring at fixed stations;
- Port water quality monitoring;
- Water quality monitoring in mariculture sites;
- Recreational beach water quality monitoring;
- Sediment monitoring;

- Monitoring of bioaccumulation in bivalves; and
- Monitoring during major environmental calamities.

Setting Up the Marine Monitoring Network

The summary of the division of work among the network members is presented in Table 2. The units carry out their respective tasks as listed in the table. Tasking was based on uniform standards, cooperation with each other and sharing of information. Each participating institution designates one coordinator. The coordinators form a panel to guide the network activities. The responsibilities of the coordinators are to:

- Carry out the integrated marine pollution monitoring plan of Xiamen and organize and coordinate the implementation of the plan;
- Integrate and standardize the monitoring techniques of the network members;
- Organize training and interlaboratory calibration exercises;
- Ensure quality control and supervise data collection and analysis;
- Analyze the monitoring data and translate the results into recommendations for management actions;
- Assess the results of management interventions;
- Exchange the monitoring information with other network members; and
- Exchange data with members of the Regional Network of Marine Pollution Monitoring and Information Management established by the GEF/UNDP/IMO Regional Programme.

Table 2. Responsibilities of the Members of the Network of Marine Pollution Monitoring in Xiamen.

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

Assessment of the Monitoring Program

The accomplishments of the integrated marine pollution monitoring program suggest that it is practical and effective. The following positive results were obtained: 1) effective monitoring mechanism and operational program; 2) strengthened institutional capacity for integrated monitoring; 3) improved quality of monitoring data; 4) accurate analysis of environmental data; and 5) reduction of duplication and sharing of results.

Marine Pollution Monitoring Mechanism

The marine pollution monitoring program has successfully integrated the existing monitoring schemes of the cooperating monitoring units/institutions of Xiamen into a standard marine pollution monitoring program. The monitoring network was established with specific allocation of tasks to each network member, hence avoiding duplication of efforts. Other advantages of the program include:

- The specific allocation of tasks were based on comparative advantage, thus reducing inputs in labor, money and time;

- The quality and comparability of data were enhanced, hence promoting efficient utilization of pollution monitoring information;

- Data exchange has promoted sharing of information and enabled speedy response to management needs; and

- The monitoring capability of the network members has been upgraded through technical cooperation, training and technical assistance among the network members.

The following conditions are needed for the successful operation of the monitoring network in Xiamen:

- Voluntary participation and cordial cooperation among the fellow monitoring units/institutions;

- Free exchange of monitoring information and technical aids;

- An efficient coordinating group is necessary. The interdisciplinary nature of the monitoring program coupled with the technical expertise of the members of the coordinating group contributed to the efficiency of the program in carrying out its tasks;

- Concern and support from relevant government departments; and

- A monitoring fund for the sustainability of the monitoring network.

In summary, the establishment of the marine pollution monitoring network of Xiamen greatly strengthened the existing monitoring mechanism and made monitoring activities more efficient. The network encouraged the fellow monitoring units to tap their own potentials and to enhance cooperation among them.

Monitoring Capacity

The development of marine management practices calls for the continuous improvement of pollution monitoring capacity. The program took various measures to build monitoring capacity in Xiamen. Training workshops in marine environmental monitoring were held to increase awareness of the monitoring team. Interlaboratory analytical calibration was also conducted among the network members before carrying out the monitoring program. Technical assistance and access to information from the other members of the network ensured that monitoring capability and performance is continuously upgraded.

- Awareness on the quality of monitoring data was raised where quality control and quality assurance is taken into serious consideration among the monitoring units/institutions. Realizing that accurate and comparable monitoring results are the foundation for the success of a monitoring project, the monitoring units/institutions strengthened quality control and analyses contentiously. Reference samples for instance, which were taken as "blind samples" for analytical quality control were used. The monitoring data would be rejected if the analytical results of the "blind sample" were not within the range value of the standards. In another case, some analytical data on petroleum generated by non-standard analytical methods were eliminated.

- The monitoring capability and technical know-how of the network members including beginners who lack relevant knowledge in marine pollution monitoring was improved through training workshop, technical aids, and actual demonstration and instruction. The monitoring techniques particularly field sampling, instrument operation, analytical skill and data processing were therefore enhanced. For instance, competent technical staff provide actual instruction to some monitoring units that require field-sampling experience, operation and maintenance of analytical instruments. Substandard analytical data are also corrected with the help of other monitoring network units. As a result, the overall monitoring level is strengthened.

Marine Pollution Monitoring Services

The role of environmental monitoring was previously perceived as collecting data to compare with standards. This concept has now changed because pollution monitoring data can be effectively used to administer appropriate policy and management actions. The monitoring procedures, including sampling and analytical design, management of monitoring data, and processing of information are established in accordance with the management needs. With clearer goals and more accurate monitoring results, the usefulness of marine pollution monitoring can be better appreciated.

Based on the data of the marine pollution monitoring program in Xiamen, the monitoring team can confidently conclude that:

- Organic pollution is still the biggest pollution problem in the Xiamen coastal water. Domestic sewage, not organic industrial wastewater, was identified as the major pollution source at present. Inappropriate mariculture practices in some areas have led to serious eutrophication problems, thus requiring the enforcement of management measures on the mariculture sites. The risk of red tide occurrence still exists. Collection and discharge of domestic sewage into the deep sea, and limiting the use of phosphate detergents are possible solutions to mitigate and prevent red tide occurrence;

- Petroleum pollution is less severe in Xiamen seawater; and

- The high concentrations of fecal coliform bacteria indicate organic pollution caused by domestic sewage discharge. Coliform bacteria were found to be widespread in Xiamen seawater, especially in the inshore coastal area close to urban centers. For safer use of the recreational beaches, effective counter-measures should be taken to reduce pollution load from sewage.

Marine pollution monitoring provides valuable services in environmental management. Such services should be built into the coastal management plans of the local government.

Efforts Toward Marine Pollution Management in Jakarta Bay, Indonesia

Aprilani Soegiarto

Indonesian Institute of Sciences-LIPI
Sasana Widya Sarwono
Jl. Jenderal Gatot Subroto 10, Jakarta 12710, Indonesia

SOEGIARTO, APRILANI. 1999. Efforts toward marine pollution management in Jakarta Bay, Indonesia, p. 96-116. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Jakarta Bay is a semi-enclosed body of water that lies adjacent to the metropolitan city of Jakarta, capital of Indonesia. The bay covers an area of about 490 km^2 with a coastline of 78 km. The city of Jakarta has a coastline of approximately 32 km. Many rivers drain into the bay. They affect the seasonal hydrographic conditions of the coastal waters and at the same time carry sediments as well as various pollutants into the bay area.

Jakarta Bay has multiple and conflicting uses which range from fisheries, mariculture, navigation, international and interinsular trades, oil and gas exploration and exploitation, recreation and tourism, to nature conservation. In the last decades, the bay has been subjected to environmental pressures from increasing population, land- and sea-based pollution, and socioeconomic as well as institutional causes.

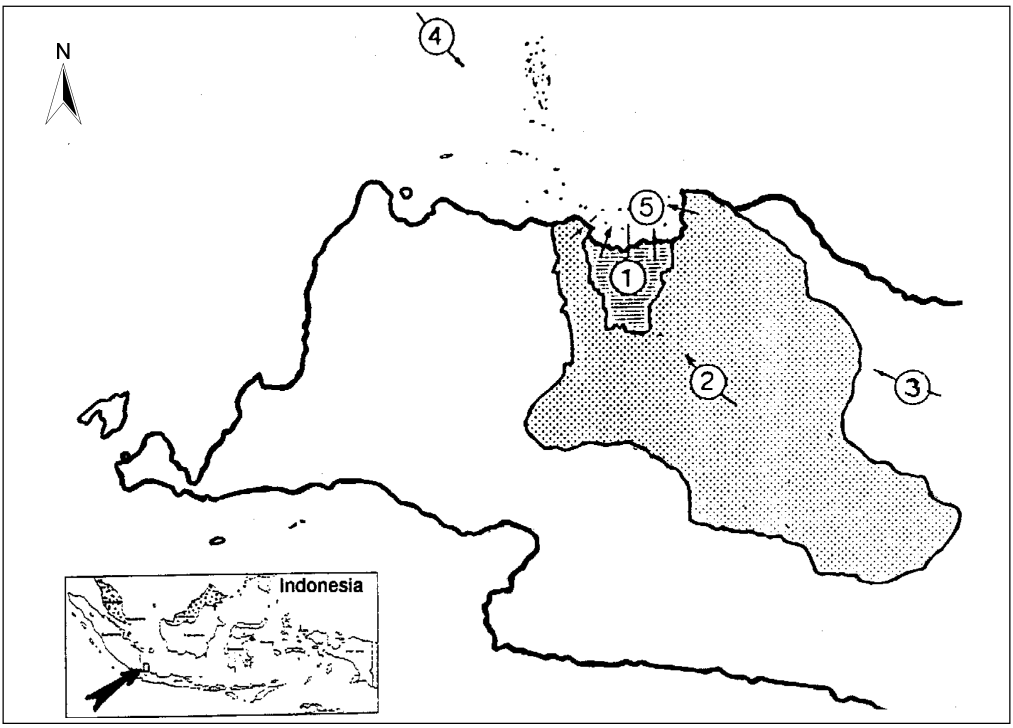
Since the 1970s, scientific studies and monitoring of various environmental parameters have been conducted by a number of marine research institutions, universities and local as well as international consultants. Efforts and recommendations have been proposed to mitigate the environmental problems as well as to manage marine pollution in the bay.

This paper briefly reviews the efforts and studies undertaken in Jakarta Bay.

INTRODUCTION

Jakarta Bay, a semi-enclosed body of water, is an integral part of the Java Sea. It lies adjacent to the metropolitan city of Jakarta, the country's capital. The special province of the Greater Metropolitan Jakarta (or DKI for Daerah Khusus Ibukota) which covers an area of 656.34 km^2 occupies the coastal area of the central part of the bay. The coastal areas of the east and west are under the jurisdiction of the West Java Province, in particular the Bekasi county and Tangerang county, respectively (Figure 1). Due to the different provincial administrative authorities, management of the bay is difficult.

Figure 1. Jakarta Bay and its Surrounding Region.



1 = Jakarta Metropolitan area; 2 = The watershed of the river systems; 3 = West Java Province; 4 = Java Sea; 5 = Jakarta Bay

Source: Adapted from Soerjani (1987).

The population of Jakarta has increased twenty-fold from 0.5 million in 1950 to about 10 million today. On working days, this population could increase to as much as 12 million from the commuting workers from Bogor, Tangerang and Bekasi. The four cities are collectively called JABOTABEK, abbreviated from Jakarta-Bogor-Tangerang-Bekasi.

In the last 25 years through the First Twenty-Five Year Long-Term Development Plan and the series of Five-Year Development Plans, various industrial estates, housing and other economic development activities have encroached on the JABOTABEK area. These industrial estates together with thousands of small- and medium-scale industries in JABOTABEK, generate substantial quantities of various pollutants. The increasing domestic solid wastes, sewage and sediments that are carried by the river systems in addition to those from the sea-based activities from tankers, fishing cargo and passenger vessels cause tremendous pressure on the bay. This paper briefly reviews the continuous efforts in studying, monitoring and developing integrated management of marine pollution in Jakarta Bay.

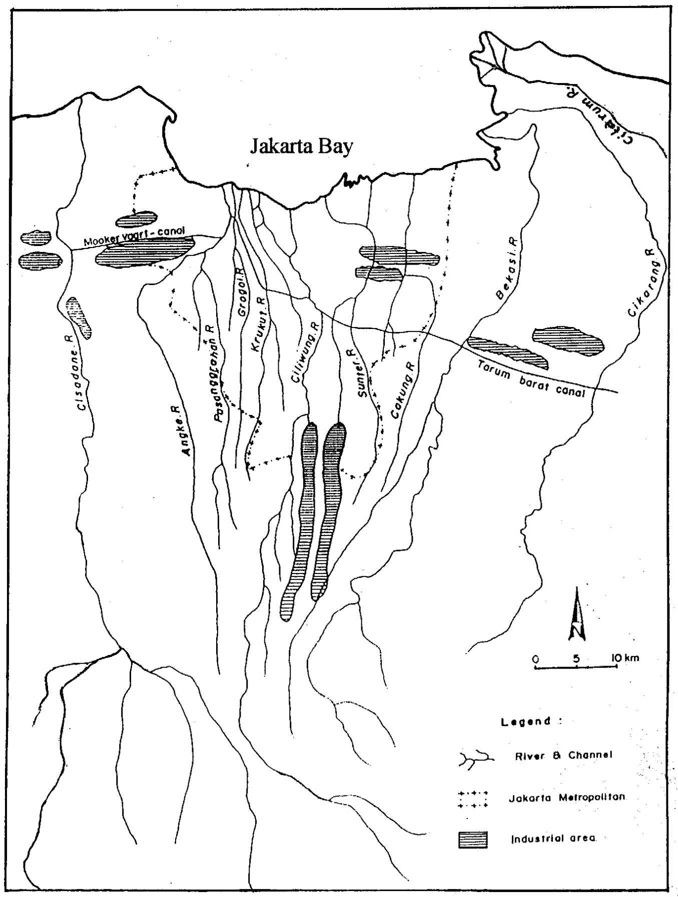
Physical Setting

Jakarta Bay is located between 106°40′, 107°05′E and 6°06′, 5°55′S. The bay is extended as far north as 5°24′S to include the Seribu Islands, which is part of the North Jakarta municipality. Jakarta Bay is an integral part of the Java Sea. It is a shallow body of water with a gradual slope. The deepest part, about 30 m, is located in the Java Sea. The bay covers an area of 490 km^2 with 78 km of coastline.

The warm, humid tropical climate allows extensive coral reefs and dense mangrove ecosystems to flourish along the coast of Jakarta Bay. Mangrove forests used to be abundant in the coastal areas of the bay. At present, only a limited mangrove area is left in the protected and conservation areas. Loss of mangrove cover is attributed to extensive conversion into other uses, such as for international sea ports, fishing harbors, housing complexes, electric generator plants, industrial estates, office buildings, recreation and tourist resorts, brackishwater ponds, etc. Some 108 coral islands called the Seribu (meaning one thousand) Islands are scattered on the northwest part of the bay. No island is found on the eastern part of the bay due to high deposition rate of sediments from various rivers that drain in that part of the bay. According to Ongkosongo et al. (1987), there are 18 river systems including their tributaries that drain into the bay (Figure 2). In recent years, a number of canals such as Jaya, Cakung, Ancol, Muara Karang, Cengkareng and Dadap were constructed to serve as flood control systems. The rivers in addition to the canals carry nutrients and sediments into the bay.

The bay is strongly influenced by the seasonal condition of the Java Sea, which is in turn influenced by the monsoons. A detailed description of the oceanographic conditions of the bay is given in Soegiarto and Birowo (1975) and Suyarso (1975).

Figure 2. The River Systems and the Industrial Areas in JABOTABEK Region.



Source: Soemantojo and Arief (1987).

Multiple and Conflicting Uses

Fisheries

Jakarta Bay supports high fisheries productivity as well as marine biodiversity. In 1996, the volume of fish recorded in the fish market was about 64,000 tons* wet weight. This figure, however, does not represent the fish caught from the bay,

* *1 ton = 0.907 tonnes*

as additional fish supply in the metropolitan Jakarta comes from other regions (e.g., West, Central and East Java, Lampung, South Sumatra, West and South Kalimantan, etc.). Due to the ever-increasing demand for fish and marine products, illegal fishing practices were common, hence fish production in the bay has decreased substantially. This problem has been compounded by the destruction of the different coastal habitats and increasing pollution loads. Trawl fisheries in the Indonesian waters have been banned in 1984. The decline of fish supply, however, continues until today.

The fish species caught in Jakarta Bay are mostly coral reef fishes such as siganids, red snappers, groupers, barramundi, sea bream and pelagic fishes such as anchovy, *Sardinella, Decapterus* spp., *Caranx* spp. and migratory fishes, such as mackerel, skipjack, tuna, *Rastrelliger* spp., etc. A series of reports published by the National Institute of Oceanology on Jakarta Bay such as the one edited by Nontji and Djamali (1980) provide information on the major fish species caught in Jakarta Bay.

A number of non-fish products are also marketed in Jakarta, such as shellfish, *Anadara* sp., shrimps, lobsters, crabs, cuttlefish, squids, etc.

Mariculture

Almost a century ago, Jakarta Bay was developed as the center for brackishwater ponds. The brackishwater ponds are concentrated in the coastal areas at the northeast, east, southeast and southwest parts of the bay. Originally, these ponds were intended for milkfish *(Chanos chanos)* culture. In the last twenty years, however, they were also used for penaeid shrimp *(Penaeus monodon)* culture. Both traditional, semi-intensive as well as intensive culture was practiced. The production ranged from 0.5 tons to as high as 6.0 tons/ha/yr. Jakarta Province has only about 40 ha of brackishwater ponds while the surrounding counties have developed about 20,000 ha of brackishwater ponds.

Due to more lucrative economic returns, more and more ponds were developed into intensive penaeid shrimp culture mostly for export to Japan, Hongkong, Europe and the USA. Due to the increasing frequency of viral and bacterial diseases, polluted water supply in addition to the recent economic and security crises, shrimp culture in the area has decreased in the last few years.

Additional mariculture farms have also been developed in various coral islands in the bay (e.g., seaweed cultures for *Eucheuma* spp., siganid fish and green mussels).

Marine Park

Part of the Seribu Islands was declared as National Marine Park by the Minister of Agriculture Decree No. 527 dated 21 July 1982. A number of islands and coastal ecosystems were also declared as conservation or sanctuary areas which include the Rambut Island, Bokor Island, Tanjung Pasir and Muara Angke mangrove ecosystem. The principal aim of establishing protected areas has been elaborated in the National Conservation Strategy as follows (Atmawidjaja, 1987):

- Maintenance of ecological processes that are essential for the life support system;
- Preservation of a variety of genetic resources;
- Sustainable utilization of natural resources;
- Management of reef species, communities and habitats in their natural state;
- Enhancement of scientific research; and
- Development of limited and controlled recreation and tourism in the buffer zone.

A management plan for the Seribu Islands Marine Park has been developed. The marine park is divided into four separate zones: 1) core reserve zone; 2) protected zone (low intensity use); 3) productivity zone; and 4) buffer zone. The staff of an authority that has been established carries out monitoring of the condition of the marine park. Since 1990, the World Wide Fund for Nature (WWF) has supported the management of the Seribu Islands Marine Park by establishing a Marine Nature and Protection Information Center in the Pramuka Island in the southern part of the marine park. A series of training and meetings on the protection of the marine park have been carried out every year.

Recreation and Tourism

Facilities for recreation and tourism have encroached along the coast of the bay. Examples are the Ancol Recreation Center, Maritime Museum, Sunda Kelapa traditional boat harbor, etc. The famous Ancol Recreation Center offers a number of activities and amenities, such as golf course, seaworld, oceanarium with marine and freshwater dolphins and other animal shows, aquarium, swimming, boating, sailing, art bazaar, marina, etc. The Ancol Recreation Center has attracted around 10 million visitors a year, both domestic and foreign.

Similarly, recreation centers and beach resorts were built in many of the coral islands in the Seribu Islands, including along the buffer zone of the marine park. They offer a variety of activities, such as boating, swimming, snorkeling, diving, sailing, fishing and other water sports. There are also a good number of bungalows and other types of accommodations for visitors who want to spend overnight or weekends on the island resorts. Before the economic crisis, the resorts attracted about 300,000-500,000 visitors a year.

Shipping and Ports

As an archipelagic nation, Indonesia relies on shipping as an important mode of transportation for goods and people. In Jakarta, the most important harbor is the Tanjung Priok which is by far the largest port in the country. The Tanjung Priok port serves the city of Jakarta in addition to the surrounding provinces. The volume of import and export cargoes is therefore very large. The port occupies a major segment of the coastal area of Jakarta. The length of the berth is about 16 km, with water depth of 5-20 m such that it can accommodate ships from 60,000 to 100,000 DWT. The port has a very large container yard in Koja and it is equipped with panamax, the new and modern container port. Before the economic crisis in 1997/1998, Tanjung Priok handled almost 13,500 ships annually or about 40 ships daily. The operation has decreased by 20-30% since the economic crisis.

There are other smaller but busy harbors such as the Sunda Kelapa harbor, which caters to the traditional wooden ships for interinsular trades as well as fishing fleets. The traditional ships (e.g., the Madurese, Buginese, Banjarese) are very unique such that they have become tourist attractions. Hundreds of these ships are berthed in the crowded Sunda Kelapa harbor together with the smaller fishing boats.

Another fishing harbor in Jakarta is the more modern Ocean Fishing Harbor at Kali Baru, which serves larger fishing boats from 50 to 100 DWT or larger sizes. Located between the port of Tanjung Priok and the Sunda Kelapa harbor, one can find the Ancol Marina, a part of the Ancol Recreation Center. The marina was established in 1979 and caters to private recreation boats as well as tour boats. From the original 100 m long pier, Ancol Marina now has a 1,200 m long pier and can accommodate up to 25 private and tour boats.

Despite the modern equipment installed in the ports and harbors, there are no facilities for oily wastes and other wastes as well. Enforcement of rules and regulations to keep the ports and harbors clean are not very efficient. The waters in the vicinity of the ports and harbors are, therefore, filthy and have become sources of a number of pollutants, such as hydrocarbon and its derivatives, solid wastes, heavy metals, etc.

The above examples show the conflicting uses of the bay (e.g., marine park versus oil and gas fields and shipping routes; mariculture versus industrial wastes, fisheries and environment protection versus sand and coral mining). The bay is further threatened by increasing land-based and destructive human activities such as sand and coral mining, which cause beach erosion and disappearance of some small coral islands (e.g., Air Kecil, Payung Kecil, Ubi Besar, Dapu and Gosong Islands). Illegal fishing practices are also becoming rampant. The proposed major coastal reclamation to develop waterfront facilities, expansion of port and marina and construction of the Jakarta Tower are expected to aggravate the negative environmental impacts on the bay. The proposed plan will reclaim a coastal area of 27.5 km long and 2.5 km wide requiring 160-200 million m^3 of soil, sand and rocks. Due to the recent economic crisis, this ambitious proposal is temporarily shelved (Soerjani, 1987).

Sources of Pollution

Pollution monitoring initiatives have been carried out in Jakarta Bay as early as the 1970s. A series of papers edited by Nontji and Djamali (1980), Setiapermana and Hutagalung (1994), and Suyarso (1975) are some of the published results of the past studies. From these sources, the major pollutants in Jakarta Bay are summarized below.

Sediments

All the 18 rivers and their tributaries discharge their waters into Jakarta Bay. Most of the river discharges particularly from the Citarum, Cikarang, Bekasi, Ciliwung and Cimanuk Rivers are associated with high sediment loads (Figure 2). The source of the sediments is erosion and bad land management in the upper watershed region.

It is recognized that siltation is probably one of the worst kinds of pollutant in the tropical marine and coastal environments. It affects the physical, chemical and biological properties of freshwater and coastal biological communities.

Soemarwoto (1974) monitored the sediment load of Citarum River, where the Jatiluhur dam is located. The Citarum River delta is located in the northeastern corner of Jakarta Bay. He found out that the sediment load has increased six-fold in two years. An average of 3.5‰ was recorded in 1970 and increased to 9.3‰ in 1971 and subsequently increased further to an average of 20.9‰ in 1972. Preliminary measurements of other rivers in Java revealed a similar trend.

Millions of tons of sediments are transported annually by rivers to the coastal waters of Jakarta Bay. Sediments cause accretion, thus, extending the coastline seaward, particularly in the river deltas. Although the process provides excellent grounds for mangrove succession and contributes to the increase in productivity of the coastal waters, the deposition of sediments blocks the navigation channels and smothers coral reefs. As a consequence, no coral island can be found in the eastern part of the bay due to high siltation. In the southwest part of the bay, corals are dying due to high sediment load, especially during the west monsoon period (December-March).

Solid Wastes and Sewage

Seventy-five percent of the large cities in Indonesia with a population over 100,000 are located in the coastal areas (e.g., Jakarta, 10 million; Surabaya, 3 million; Semarang, over 1 million; Ambon, 1 million; and Medan, 2.5 million). In general, these cities have no functional solid waste treatment facilities. A large percentage of the solid wastes are transported by rivers to the coastal areas and to the open sea.

The volume of solid wastes or garbage in the metropolitan city of Jakarta is estimated to be 18,000 m^3/day (Suprianto et al., 1987). These wastes consist of organic materials (77.30%), paper (6.58%), wood (3.29%), textile (2.48%), plastic (4.50%), metals (2.66%), sand, soil and dust (2.09%) and others (1.1%). The sources of the wastes are: households (65%), market and food vendors (15%), industries (10%), offices, construction and public facilities (10%). Of the 18,000 m^3/day solid wastes, only about 13,300 m^3 could be managed daily by recycling, burning or buried in landfills. Thus, almost 5,000 m^3 of solid wastes end up daily in rivers, canals and coastal areas and into the bay.

Domestic sewage pollution in the Jakarta metropolitan area is very high. It is estimated that almost 40% or about 4 million people discharge their wastewater directly into the river system, resulting in a biological oxygen demand (BOD) load of more than 120 tons/day. In addition, various surveys carried out in the coastal waters of Jakarta Bay indicated high contamination of fecal coliform bacteria the sources of which can be traced to domestic sewage, hospital wastes and abattoir wastes.

Hydrocarbon and Its Derivatives

It is estimated that about 35% of oil production in Indonesia are derived from the coastal and offshore fields. There are a few oil rigs in Jakarta Bay. One of them is the Arjuna field managed by Independent Indonesia-American Petroleum Company (IIAPCO) and Atlantic Richfield Company (ARCO).

Petroleum industries can contribute to the environmental problems in the bay through the process of prospecting, drilling, extraction and production, transportation of crude and refined products including their derivatives. Jakarta Bay is a major route for transporting oil products from refineries to the various parts of Indonesia. Oil spilled in the water can be in emulsified form, tank bottom sludge and other hydrocarbon compounds. Shipping activities, especially from tanker ships, fuel and lube oil wastes from many other activities contribute to the oil pollution in the bay. Oily wastes spilled into the ground may eventually reach nearby streams after heavy rains.

The first report on hydrocarbon pollution was probably made by Hutomo (pers. comm.) who noted the widespread occurrence of tarballs, 2-20 cm in diameter on the beaches of Air and Air Kecil Islands in Jakarta Bay in 1971. Further surveys made in 1974 in Pari Island revealed more tarballs on the beaches of the Pari Island Group. Hutomo and Djamali (1980) and Toro and Djamali (1982) made seasonal studies on the tarball concentration on the beaches of Pari Island. High concentrations were recorded ranging from 0.28 to 2,101.37 g/m^2 and there was a notable seasonal variation. The possible source of the tarballs was traced to the discharges of ballast water from oil tankers after depositing their oil cargoes in Tanjung Priok harbor.

A more extensive tarball survey was carried out by a joint Indonesian-French team in 1983. The team has noted the presence of tarballs on the beaches of Pari and Tikus Islands in Jakarta Bay, the Island of Takong, Pelampong, Nirupan Labon Kecil of the Riau archipelago and the southern coast of Jogjakarta. More than 100 stations have been sampled. However, only 52 tar samples were analyzed by chromatography, infrared spectrophotometry, specific gravity and sulphur contents. Concentration ranged from 0.6 to 2,876 g/m, the highest level of which was found on the northern coast of Pari Island. Results of the gas chromatography analysis classified the tars as light-weathered crude oil (57%), tanker sludge residues (27%), fuel oil (9%) and strongly-weathered tar (13%). The sulphur contents on the other hand, ranged from 0.35 to 3.27% weight (Bilal et al., 1986). Wicaksono (1974) noted that hydrocarbon pollution in Jakarta Bay is rather critical. Samples taken around the harbor have concentrations of 60 to 100 ppm, whereas concentrations ranging from 3 to 25 ppm were recorded in samples collected far from the harbor. Santoso et al. (1977) and Martin et al. (1983) undertook similar surveys on hydrocarbon pollution in Jakarta. Martin et al. (1983), for instance, sampled water and sediments from 25 stations and found out that the hydrocarbon concentration ranged from 0.5 to 4.0 µg/l. In sediments, the range was between 9.0 and 331 µg/l. The highest concentration was found in sediment samples collected just outside the Sunda Kelapa as well as the Tanjung Priok harbors.

Chlorinated Hydrocarbons

The amount of pesticides and herbicides distributed in Indonesia has been increasing since 1968 particularly when Indonesia launched the agricultural mass intensification (INMAS) and mass extension guidance (BIMAS) programs. A few high-yielding rice varieties, such as IRI-5 and IRI-8 were used in these programs. Due to their higher vulnerability to pests, these strains have received intensive pesticide treatments. In order to reach the goal of self-sufficiency in rice production, Indonesia has to apply more and more pesticides, herbicides and rodenticides. It is suspected that a certain percentage of the pesticides applied in the agricultural BIMAS/INMAS programs leached out to the coastal and estuarine environments. As the Jakarta Bay is surrounded by a watershed area which is predominantly rice fields, the coastal areas of the bay are receiving a good share of the chlorinated hydrocarbon utilized in the agriculture sector. Table 1 shows the DDT and polychlorinated biphenyl (PCB) concentrations in some locations in Jakarta Bay.

Table 1. Pesticides (DDT) and Polychlorinated Biphenyl (PCB) Pollution in Jakarta Bay.

Location	DDT Concentration		PCB (µg/g)
	Total (µg/g)	%	
Along the shore	2.3 ± 1.7	-	2
In front of the city	13	27	6
In front of the harbor	8.6	27	9 and 4

Source: Martin et al. (1983)

Heavy Metals

Levels of heavy metals in some locations of the bay have been reported to be very high. In some isolated cases, the values exceeded the maximum permissible limit, thus, limiting the use of these waters for fisheries and aquaculture particularly for the collection and culture of shellfish for human consumption. The possible cause of the heavy metal pollution (e.g., cadmium, mercury, lead, etc.) is improper management of wastewater by the industries in the area.

Heavy metal pollution in Jakarta Bay has been studied by Santoso et al. (1977), Hutagalung and Razak (n.d.) and Martin et al. (1983). Razak et al. (1984) also surveyed the heavy metal concentrations in the Malacca Straits. They compared the concentrations of Cu, Hg, Pb and Cd found in the Malacca Straits to that with Jakarta and Banten Bays. In almost all cases, the heavy metal concentrations were always higher in Jakarta Bay, which indicates the severity of heavy metal pollution in the bay. Preliminary analyses of several heavy metals in samples of various marine biota in Jakarta Bay also indicated relatively high concentrations.

Industrial Wastes

As part of the economic development, there was a strong drive for industrialization in Indonesia. In the JABOTABEK area, a number of industries and industrial estates have been established (Figure 2). Soemantojo and Arief (1987) reported that there were more than 2,000 industrial plants in the area. These industries produce various products and services and provide job opportunities for people. Therefore, they attracted workers from many parts of Indonesia who seek a better life in JABOTABEK.

Industries, however, have high potential for generating pollution particularly if the waste effluents are not properly managed. The provincial and local governments could enforce the regulations on the management of waste effluents from large industries and industrial estates. However, there are tens of thousands of medium- and small-scale industries scattered all over the JABOTABEK area serving as sources of small volumes of wastes, most of which are beyond government's control.

The metal industries contribute significantly to heavy metal pollution, including wastes from refining mills and plating mills. Among these are steel, brass, copper, gold and aluminum plants, where metals are worked and fabricated into final usable products. There are also a number of automotive industries in the JABOTABEK area where wastes are generated by stamping and assembly plants.

The stamping plants produce no significant liquid processing wastes. However, large amounts of oil (both lubricating and hydraulic) are used, and in many cases, some of these found their way into the sewer system. The wastewater discharged from the assembly plants contains high organic suspended solids originating from painting and paint-sanding operations. In addition, heavy metals such as zinc and chromium that originate in metal treating operations may be present. There are also shipping industries in Jakarta, which construct new ships and repair faulty ships. These industries produce the same waste as the automotive industries.

Battery making plants in the JABOTABEK area generate heavy metal wastes such as Hg and Pb. Leather factories produce chromium-containing waste from chrome tanning operation in addition to high content of total solids, hardness, sulfides, precipitated lime and BOD. Other industries in the JABOTABEK area are textile industries. Textile wastes are generally colored, highly alkaline, high in BOD and suspended solids and high in temperature. Some textile industries also produce chrome-containing wastes from chromic dyeing process.

Pulp and paper and food processing industries including many other industries in JABOTABEK discharge liquid wastes with high BOD content. Pulp wastes contain sulfite liquor, fine pulp, bleaching chemicals, mercaptans, sodium sulfides, carbonates and hydroxides, sizing, casein clay, ink, dyes, waxes, grease, oils and fibers. Most paper industries use waste paper and usually the coated and printed materials are removed from it to form usable pulp. The water effluent, therefore, contains lost fibers, clay, coating materials, ink particles and deinking chemicals. This waste is characterized by high BOD, high suspended solids and high pH.

The food processing wastes on the other hand may be characterized by BOD content of as low as 100 ppm to as high as 100,000 ppm. Suspended solids, almost completely absent from some wastes, are found in others in concentration as high as 12,000 ppm. The wastes may be highly alkaline (pH 11.0) or highly acidic (pH 3.5). Nutrients (N & P) may be absent or may be present in high concentrations. Food processing waste usually contains organic matter in varying concentrations in dissolved or in colloidal state.

Some plastic and resin industries are also operating in the JABOTABEK area that utilize polymerization process in making plastic goods. Very few chemical industries are present in the JABOTABEK area. Pesticide industries, for instance, have great potential in polluting the environment. They discharge highly toxic wastes that are considered to be carcinogens. PCBs can be found not only from the manufacture of pesticides such as aldrin, dieldrin, eldrin and DDT, but can also be found in many other industries such as the manufacture of transformers and power capacitors, hydraulic fluids, diffusion pump oil, heat transfer applications, xerox toners, printing ink and many others.

Efforts in Managing Pollution

A step by step approach had been developed in order to reduce and manage pollution and monitor the overall environmental quality of the bay. These efforts are briefly summarized below.

Institutional Arrangements

The principal agency in Indonesia responsible for resolving environmental issues is the Office of the State Minister for the Environment. The office coordinates national efforts on environmental matters, including drafting of laws and regulations, issuing policy guidance and establishing environmental standards.

An enforcement agency, BAPEDAL (Badan Pengendalian Dampak Lingkungan-Environmental Impact Control Agency) was created in the late 1980s to enforce rules and regulations. The Minister of the Environment acted as the chairman of BAPEDAL. Officially, the vice chairman acted as the executive head of BAPEDAL. As of February 1999, BAPEDAL was integrated with the office of the State Minister for the Environment and the integration process is expected to be completed before the general election in June 1999.

In every province, a BAPEDAL-DA (BAPEDAL-Daerah or Provincial BAPEDAL) is established as an extended arm of BAPEDAL. The BAPEDAL-DA is supported by the governor and the provincial government. In the Jakarta Metropolitan area, the BAPEDAL-DA is integrated and supported by Kantor Pengkajian Perkotaan Lingkungan (KPPL-DKI-Office of Urban and Environment Study of the Jakarta Metropolitan Area). The special Province of Greater Jakarta has five municipalities, namely the North-Jakarta, West-Jakarta, Central-Jakarta, South-Jakarta and East-Jakarta, each headed by a mayor. Each municipality has also a smaller branch of KPPL-DKI. In undertaking study and assessment of environmental problems, KPPL-DKI can always request the cooperation and assistance of universities, research institutions and other relevant agencies. Thus, any decision on enforcement of regulation is always based on scientific facts that can stand in court, particularly if there is a need to bring the matter in court.

Legal Instruments

Laws, regulations, decrees and decisions on environment and resource management and development in Indonesia have their primary source in the 1945 constitution. The main source of environment and natural resource management legislation in Indonesia is Law No. 4/1982 entitled, "Basic Provisions for the Management of the Living Environment". After enactment for about 15 years, this law was revised and further strengthened in 1997. From the "Basic Provision", environmental legislation, rules and regulations were derived in the form of "Law", "Government Regulation", "Presidential Decree", "Ministerial Decree/Decision", "Governor Decree", "Provincial Regulations", "Mayor Decisions", or even detailed technical guidelines. Hardjasumantri (1985) provides a detailed account on the legal aspects of environmental issues in Indonesia.

From the above-mentioned sources of laws and regulations, the DKI provincial government could generate more specific rules and regulations, including their mode of enforcement, methods of monitoring and their sanctions. The following are examples of Governor Decisions:

- No. 582/1995: Establishment of the Use of Standards in River Water/Water Body and Wastewater in DKI; and

- No. 299/1996: Guidelines on the Enforcement of Governor Decision No. 582/1995.

In many cases, however, enforcement of rules and regulations is considered to be one of the weakest links in the whole system. The provincial government started enforcing rules and regulations in a more serious and consistent manner only in the last few years. Whenever necessary, the provincial government could take the industries or polluters to court which is in line with the basic strategy and approach to enhance environmental education among the industries, private sector and the public at large and specifically to:

- Enhance environmental awareness;

- Provide information on rules and regulations;

- Enhance consultation and coordination;

- Persuade;
- Offer rewards and punishment;
- Implement and enforce; and
- Enforce the 'polluter pays' principle.

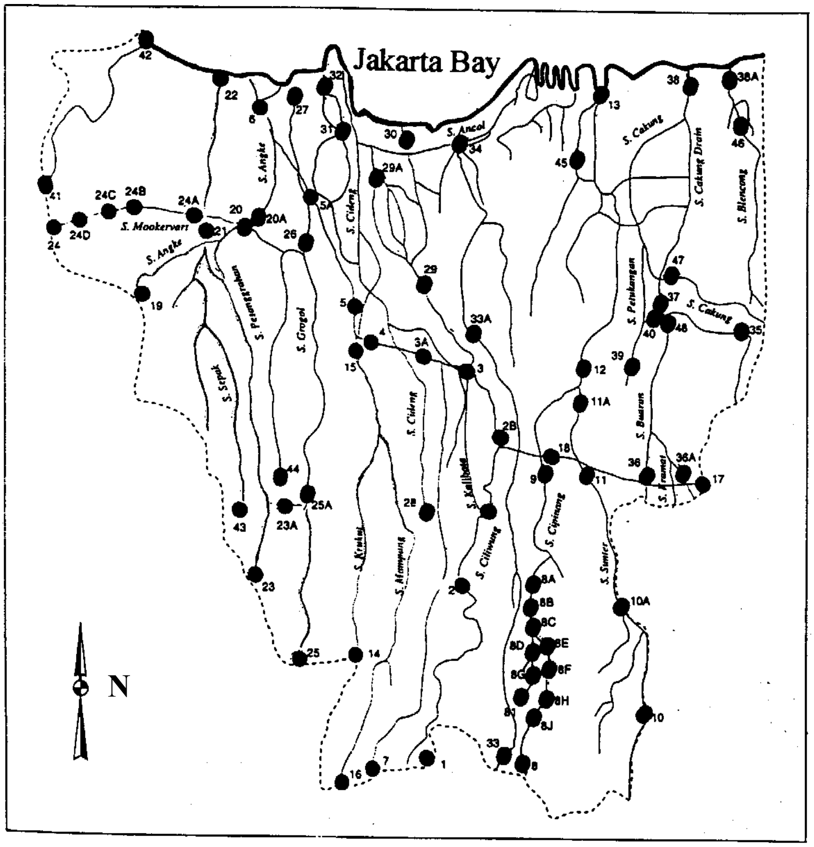
Research and Monitoring Programs

Pollution studies, research and monitoring programs have been carried out in the JABOTABEK area as well as in Jakarta Bay. Initially, these activities were carried out rather haphazardly. A more regular sampling schedule equipped with sound scientific methodologies was later adopted. In recent years, the SEAWATCH system was put to use, which utilizes modern and real-time measurement technology.

Since the 1970s, the Research and Development Center for Oceanology has established monitoring stations in the coastal waters of the Jakarta Bay area. The oceanography, physics, chemistry, geology and geophysics, biotechnology and biological characteristics of the bay have been studied. The monitoring results starting 1975 (Suyarso, 1975) have been published in a series of the Center's publications on Jakarta Bay. The database was used as baseline information for further monitoring and research.

In 1983, the KPPL-DKI had established 50 permanent monitoring stations in the 13 river systems in the municipalities of Jakarta and 31 stations in Jakarta Bay (Figures 3 and 4). The river stations were monitored more frequently, that is once every two weeks or once a month. Automated monitoring equipment were installed in some key stations (KPPL-DKI, 1996). Since monitoring and sampling activities at sea are costly, sampling was carried out quarterly (e.g., during the west, east and two transitional-monsoon periods). In cooperation with OCEANOR of Norway, four SEAWATCH monitoring buoys with various meteorological, oceanographic and pollution sensors have been established around Jakarta Bay and the Seribu Islands since 1996. The monitoring and sampling stations provide invaluable data and information on the water quality of the river systems as well in Jakarta Bay. The results of the study are also used to trace sources of pollution allowing the authorities to issue warnings to the polluter or, if necessary, to bring the polluter to court for possible punishment.

Figure 3. The Monitoring Stations in the Jakarta River System.

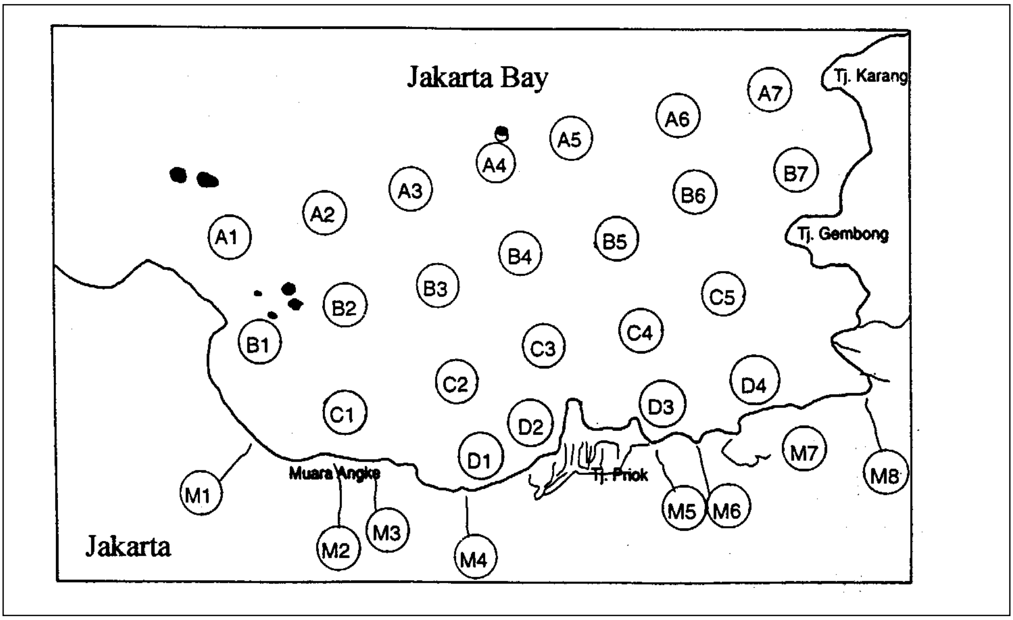


Source: KPPL-DKI (1996).

Integrated Approach with Stakeholders

Another approach being developed in order to lessen the environmental pressures in Jakarta Bay is through the development of an integrated approach to strengthen partnerships with relevant stakeholders. A series of meetings have been organized in recent years to coordinate the overall development plans between the DKI government and the West Java Provincial Government, as well as among the DKI city mayors and the heads of the Bekasi, Bogor and Tangerang Counties (Bupati). Among the agenda discussed and coordinated include the enforcement mechanism of pollution control on the watershed and the river systems and the sharing of responsibilities of water resources management.

Figure 4. The Monitoring Stations in Jakarta Bay.



M-at the river mouths; D-on coastal waters; C-about 5 km; B-between 5-10 km; and A-more than 10 km distance from coastline.
Source: KPPL-DKI (1996).

One of the results of the reform movement in Indonesia in the last two years is the formulation of a new paradigm of development. If in Suharto's New Order regime, "economic growth" and "security" were the bases for development, in the new reform era, a social and community-based development is being contemplated. Although the government still leads the development effort, other stakeholders become equal partners in the planning and decision-making process.

This is also in preparation of the broader autonomy, which will be given to the local county and municipality for planning on development matters. Similarly, a new development approach is being formulated in the DKI and West Java Provinces where the stakeholders include the central and local governments, the local community, the scientific community and universities, the nongovernment organizations and the private sector.

References

Atmawidjaja, R. 1987. Conservation and management of marine environment in the Jakarta Bay. Paper presented at the Workshop on Coastal Water Management and the Bay of Jakarta, 11-14 May 1987, Jakarta. 6 p. + map.

Bilal, J., E.H. Legowo, B. Prasetyo, G. Bodennec and L. Loubersac. 1986. Occurrence of tar pollution along the shore of Indonesia: Kepulauan Seribu, Riau, West coast of South Sulawesi, South coast of Central Java. Unpublished Report of France, Indonesia Research Cooperation in Oceanography. 111 p.

Hardjasumantri, K. 1985. Environmental legislation in Indonesia. Gadjah Mada University Press. 41 p.

Hutagalung, H.P. and H. Razak. n.d. Kandungan logam berat dalam beberapa perairan laut Indonesia, p. 223-246. *In* K. Romimohtarto and S.S. Thayib (eds.) Kondisi lingkungan pesisir dan laut di Indonesia. Lembaga Oseanologi-Nasional-LIPI, Jakarta.

Hutomo, M. and A. Djamali. 1980. Pengamatan gumpalan minyak (tar balls) yang terdampar di gugus Pulau Pari, Pulau-pulau Seribu. Paper presented at the Symposium on the Water Quality and Development, 1-3 September 1980, Bogor.

KPPL-DKI (Kantor Pengkajian Perkotaan dan Lingkungan DKI Jakarta). 1996. Informasi Kualitas Lingkungan DKI. 44 p.

Martin, S.L., M. Marchand, A.M. Le Gueblec and J.P. Caprais. 1983. Determination de la pollution chimique des Baies de Jakarta, Banten, Cilacap (Indonesie), hydrocarbonnes, organochlores, metane. CNECO-COB-ELGEM, EL/Chinie/ YLM-MW/233/83, 57 p.

Nontji, A. and A. Djamali, Editors. 1980. Teluk Jakarta: Pengkajian Fisika, Kimia, Biologi dan Geologi. Tahun 1975-1979. Lembaga Oseanologi Nasional-LIPI, Jakarta. 414 p.

Ongkosongo, O.S.R., Sofwan Hadi, Y. Kartawiria, R. Ariani and S. Setiadi. 1987. The natural system and environmental quality aspects of Jakarta Bay. Paper presented at the Workshop on Coastal Waters Management and the Bay of Jakarta, Jakarta, 11-14 May 1987. 34 p.

Razak, H., H. Hutagalung and S. Surtipanti. 1984. Pengamatan kebutuhan oksigen kimiawi (KOK), oksigen biologi (KOB) dan logam berat di perairan Selat Malaka, p. 31-38. *In* M.K. Moosa, D.P. Praseno and W. Kastoro (eds.) Evaluasi kondisi perairan Selat Malaka 1978-1980. Lembaga Oseanologi Nasional-LIPI, Jakarta.

Santoso, W., Aboejoewono, J. Bilal and I. Bachtiar. 1977. Inventarisasi kualitas air permukaan daerah Teluk Jakarta Timur, p. 197-226. *In* M. Hutomo, K. Romimohtarto and Burhanuddin (eds.) Teluk Jakarta: Sumber daya, sifat-sifat oseanologis, serta permasalahannya. Lembaga Oseanologi Nasional-LIPI, Jakarta.

Setiapermana, D. and H. Hutagalung, Editors. 1994. Prosiding Seminar Pemantauan Pencemaran Laut. Pusat Penelitian dan Pengembangan Oseanologi-LIPI, Jakarta. 75 p.

Soegiarto, A. and S. Birowo. 1975. Atlas Oseanologi Perairan Indonesia dan Sekitarnya. Buku I: Status pengetahuan kita tentang ilmu pengetahuan laut di Indonesia. Lembaga Oseanologi Nasional-LIPI, Jakarta. 79 p.

Soemantojo, R. and A. Arief. 1987. The source of pollutants in Jakarta Bay. Paper presented at the Workshop on Coastal Waters Management and the Bay of Jakarta, 11-14 May 1987, Jakarta. 11 p. + Appendices.

Soemarwoto, O. 1974. An ecosystem approach to the problem of dam. Paper presented in the Environmental Week, 21-26 January 1974, Jakarta. 11 p. + 5 figures.

Soerjani, M. 1987. Additional information on the proposed further study of the Jakarta Bay. Paper presented at the Workshop on Coastal Waters Management and the Bay of Jakarta, 21-26 January 1987, Jakarta. 7 p. + Appendices.

Suprianto, B., A. Arief, H. Syarain and N.E. Wahyuningsih. 1987. Waste disposal in Jakarta Bay. Paper presentated at the Workshop on Coastal Waters Management and the Bay of Jakarta, 21-26 January 1987, Jakarta. 4 p. + Appendices.

Suyarso, Editor. 1975. Atlas Oseanologi Teluk Jakarta. Pusat Penelitian dan Pengembangan Oseanologi-LIPI, Jakarta. 160 p.

Toro, V. and A. Djamali. 1982. Fluctuation of tar balls. *In* P. Pari (ed.) Kepulauan Seribu. Lembaga Oseanologi Nasional-LIPI, Jakarta. Unpublished report.

Wicaksono, W. 1974. Beberapa aspek pencemaran minyak di perairan Indonesia. Paper presented during the Environment Week, 21-26 January 1974, Jakarta. 25 p. + 4 maps.

Marine Environmental Monitoring and Prediction in the Coastal Waters of Korea and the West Pacific Region

Dong-Young Lee

Korea Ocean Research and Development Institute
Ansan P.O. Box 29, Republic of Korea

LEE, DONG-YOUNG. 1999. Marine environmental monitoring and prediction in the coastal waters of Korea and the West Pacific Region, p. 117-141. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Marine environmental monitoring and prediction system is necessary for the proper use of space and resources as well as for the preservation of the environment in the coastal zone. Detailed information for the area of interest can be produced by means of local prediction models interfaced with large-scale models covering the regional seas.

This paper describes and demonstrates the coastal environmental information system developed along the coast of Korea by means of integration of field monitoring, remote sensing and numerical modelling. The coastal environmental information at each grid point of local area along the coast of Korea is produced by fine mesh coastal models with the boundary conditions obtained from the large-scale models covering the Northeast Asian Region. Extension of the system to the Southeast Asian Seas to cover the East Asian Region is discussed.

By preparing systematic databases for the regional sea, it is possible to generate coastal environmental information for all areas of interest for various engineering applications. The databases prepared for the East Asian Seas are shown and the necessity of regional cooperation for the abatement and management of marine pollution in each country in the region is discussed.

Introduction

In recent years, the utilization of the coastal areas for various activities has been increasing for most coastal countries and this tendency is expected to increase. Harbor construction, coastal industrial complex development, land reclamation, artificial islands and other coastal construction are some common activities. One of the major concerns in the development of the coastal area is how to maximize the socioeconomic benefits provided by coastal developments and to minimize the negative environmental impacts. Many weather sensitive activities have taken place in the coastal zone. Proper and accurate reports of present sea state and its short range impact predictions for the coastal zone is highly desired. There are dire needs for real-time coastal environmental parameters for large sea areas. The task can be accomplished by integrating modern technology of field data acquisition and numerical modelling technology.

Coastal information can be obtained either by means of *in situ* measurement or by numerical prediction models. Direct measurement using instruments can provide very accurate information, albeit limited to the site of measurement. However, this is very expensive compared to the indirect production of information through numerical models. Optimization between field measurement and numerical models is necessary. Technology for numerical modelling, which will supplement the needed data for arbitrary sites of interest without observatories is also needed.

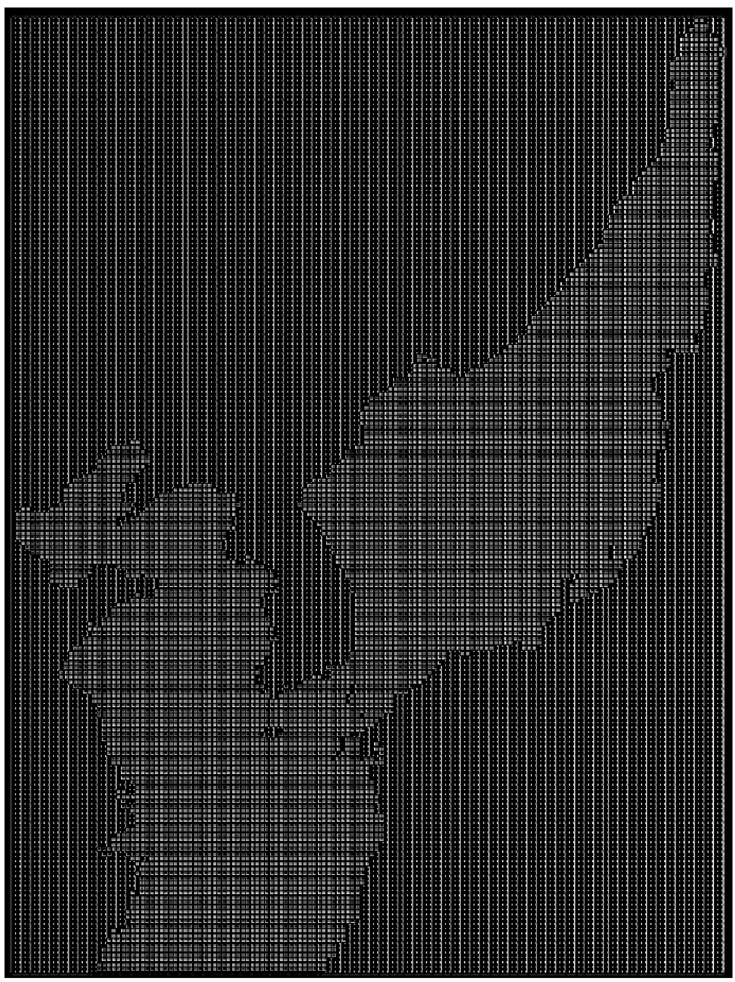
An intensive research program, the "Development of Integrated Coastal Monitoring System" was sponsored by the Ministry of Marine Affairs and Fisheries (MOMAF) of the Republic of Korea. The program aimed at building an integrated ocean monitoring network for the waters around the Korean peninsula by developing instruments for real-time field observations as well as complementary methods such as coastal numerical modelling. By synchronizing the real-time coastal data with numerical modelling, detailed information on the spatial and temporal variations of the coastal environmental conditions are provided.

Environmental Information on the Coastal Waters of Korea and the East Asian Seas

Coastal numerical modelling requires information on boundary conditions of various marine environmental parameters at the offshore boundaries, which must be obtained by means of regional scale ocean prediction models. Regional scale ocean observing system is needed for efficient service in the coastal waters of the region. These models can be interfaced with the coastal models for estuaries and coastal processes to produce coastal information.

The grid system for wave, tide and storm surge models to produce offshore boundary conditions of the coastal models in Korea covers all the area of the Northeast Asian Seas (Figure 1). Marine environmental conditions are predicted first by means of regional scale model from which the boundary conditions of the local models are obtained.

Figure 1. Grid System of Marine Environmental Models to Obtain the Boundary Conditions of the Local Models for the Coastal Waters of Korea.



Basic Databases

Basic databases for the Northeast Asian Seas have been established for automatically generating coastal environmental conditions for the coastal waters of Korea and other areas in the region.

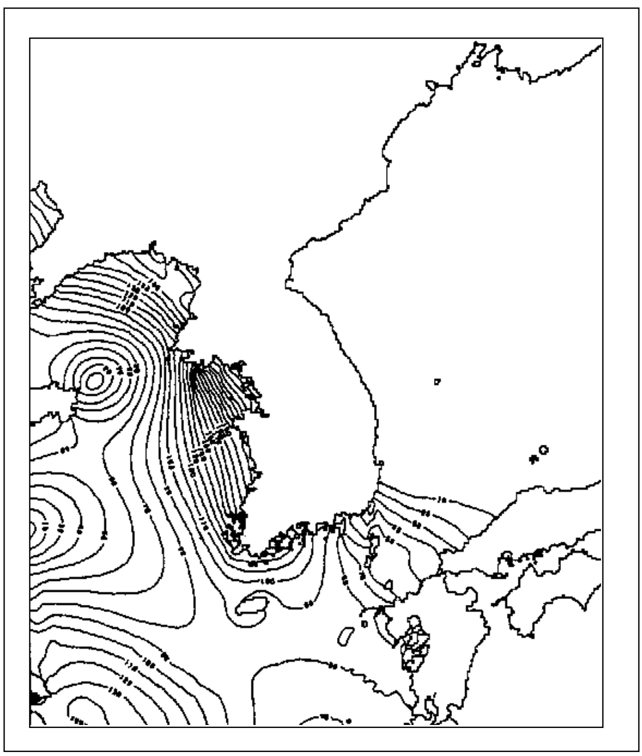
1. Depth

A depth grid system is automatically generated for any area of interest along the coast of Korea with grid size of 250 m using the depth data retrieved from the database of the 90 electronic charts. For the nearshore, fine mesh model, the depth grid system is prepared manually for a given area of interest. The areas are selected from which depth grid system with desired grid size is generated to be used for coastal models of that area.

2. Tide

Major tide and tidal current harmonic constants *(M_2, S_2, K_1, O_1)* have been prepared for each grid point with grid size of 4 km covering all the Northeast Asian Seas, from which boundary conditions of the local tide model are obtained directly from the database for any area of interest in the region (Figure 2).

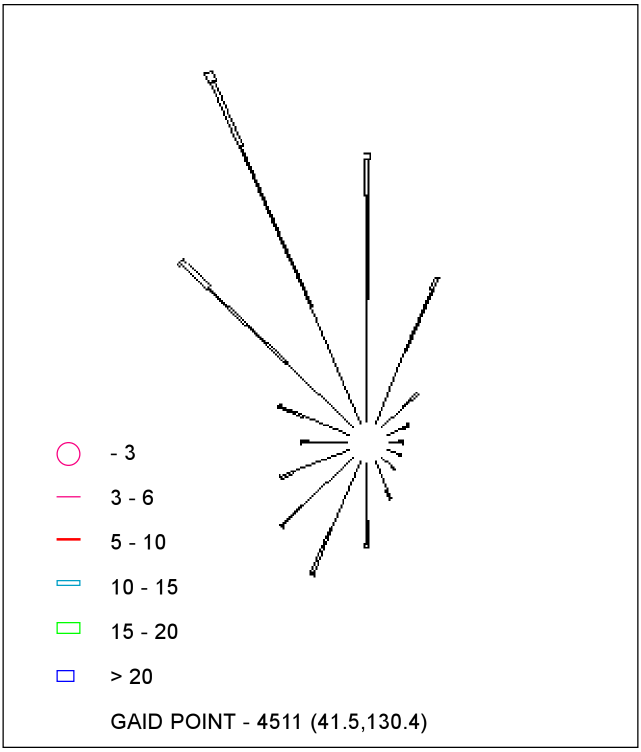
Figure 2. Tidal Co-amplitude Chart of M_2 Tide Component.



3. Wind

The output of numerical weather predictions carried out by meteorological agencies such as the Korean Meteorological Administration, US NOAA (National Oceanic and Atmospheric Administration), etc. are used as input data to ocean modelling for operational ocean prediction. To hindcast the sea states for a longer period of time, winds over the sea for the Northeast Asia Regional Global Ocean Observing System (NEAR-GOOS) region has been calculated continuously from the digitized weather maps together with the sea surface temperature for more than 15 years. The re-analyzed surface weather data for 20 years from 1979 by European Center for Mid-range Weather Forecast (ECMWF) is also used. An example of wind rose for Chongjin, North Korea is shown in Figure 3.

Figure 3. Wind Rose for November at Chongjin, North Korea.



3. Wave

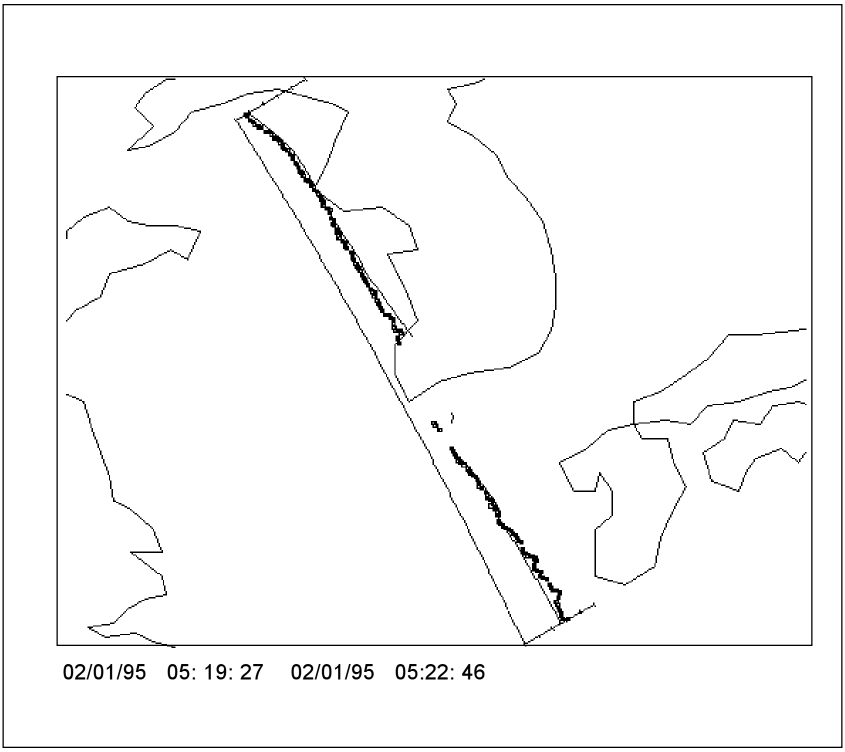
The database for offshore wave conditions has been established via long-term wave simulations. The database includes hindcast wave and wind parameters including significant wave heights, peak periods and directions, wind velocity with 3-hr intervals for 20 years starting from 1979 for each grid point of Northeast Asian Seas with grid size of 27 km. The input offshore wave conditions of the shallow water wave model are retrieved for calculating shallow water wave conditions at arbitrary time of interest.

4. Remote sensing data

Verification of the simulated data for all the regional seas can be performed using field data measurements from the offshore buoys and also from the available remote sensing data. An example of comparison between the simulated data with remote sensing data is shown in Figure 4.

The remote sensing data prepared for the East Asian Region are GeoSat data, TOPEX/POSEIDON data, ADEOS data and ERS-1,2 data which are presently available.

Figure 4. Comparison of Simulation Result and Satellite Measurement by TOPEX/POSEIDON on 2 January 1995.

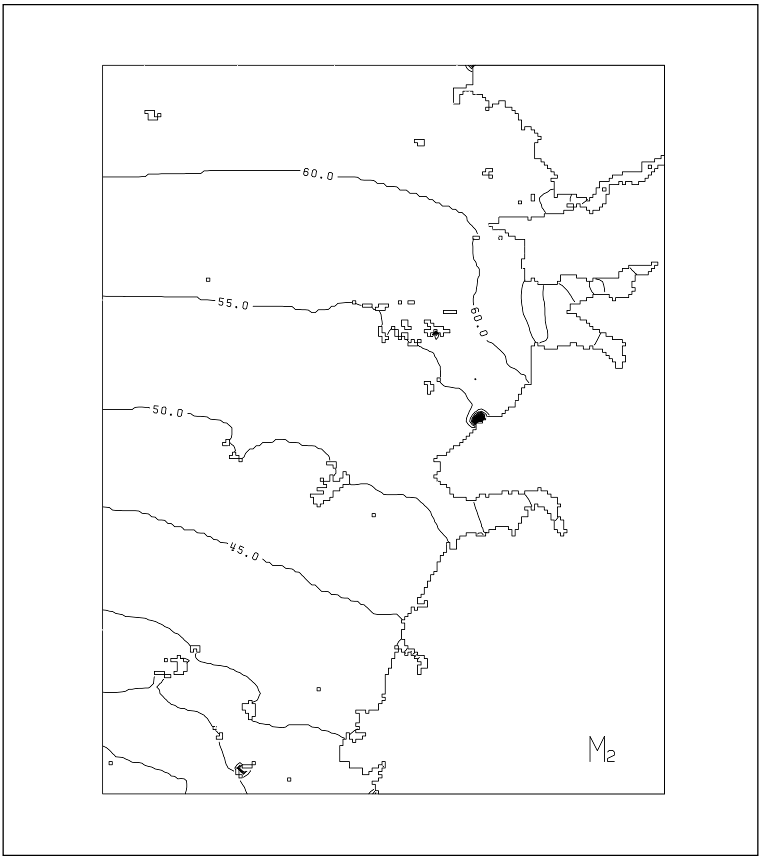


Application of the Databases

By using the electronic nautical charts, a coastal model grid system can be generated by means of automatic grid generation system for all the coastal waters of Korea by choosing the model area. Coastal environmental information at each grid point of the local area is produced by means of fine mesh coastal models using the boundary conditions of the local coastal models which are obtained from large-scale models covering the Northeast Asian Region.

The local tide model in any arbitrary area of interest can be established using boundary conditions directly from such database. For coastal waters, operational tidal current prediction systems have been established by means of a 2-D hydrodynamic model, which can be set up for an arbitrary area of interest (Kang et al., 1991; Choi et al., 1997). For the fast operational simulation system, the database of major harmonic constants of tide and tidal current components for each grid point of the coastal model have been prepared from the long-term simulation of tide and tidal currents for local coastal area of interest. For areas of frequent vessel traffic, tidal currents are more efficiently predicted using the precalculated tidal current harmonic constants. An example of the tidal harmonic constants of M_2 components at a given coastal area west of Korea is shown in Figure 5.

Figure 5. Example of Coastal Tidal Harmonic Constants Retrieved from the Database.



The wave information in the coastal region can be obtained by means of shallow water wave transformation models based on the wave energy conservation equation in general together with a mild slope equation for the local areas near the harbor using the offshore boundary conditions either from the database of long-term wave simulation or from the deep water wave models using the wind input obtained from numerical weather prediction model up to 72 hours in advance. Wave conditions at each grid point are obtained applying the shallow water spectral transformation model developed by the Korea Ocean Research and Development Institute (KORDI) based on the wave energy conservation equation, which is recently replaced by the Simulating Waves Nearshore (SWAN) shallow water wave model released by Delft University. Shallow water wave modelling is also time consuming work for long-term simulation. A simple method of shallow water wave information system has been developed for all the coastal waters of Korea (Lee et al., 1996). The wave model is carried out in approximately 100 combinations of offshore boundary conditions with different wave directions, periods and heights. Conversion ratios from offshore boundary wave conditions to each grid point are calculated and stored in the database. For a given offshore wave condition, which is retrieved from the database of long-term wave simulation, the shallow water wave conditions at each grid point of the sediment transport model is produced by means of interpolation of conversion ratios retrieved from the database.

Tides and tidal currents and wave conditions at each grid point of the transport model are instantly provided whenever the information is needed just by encoding the time (year, month, day, hour and minutes for tidal current). Examples of tidal current and wave for a given time calculated from this method are shown in Figures 6 and 7, respectively.

Figure 6. Example of Coastal Tidal Current Calculation at Any Given Time.

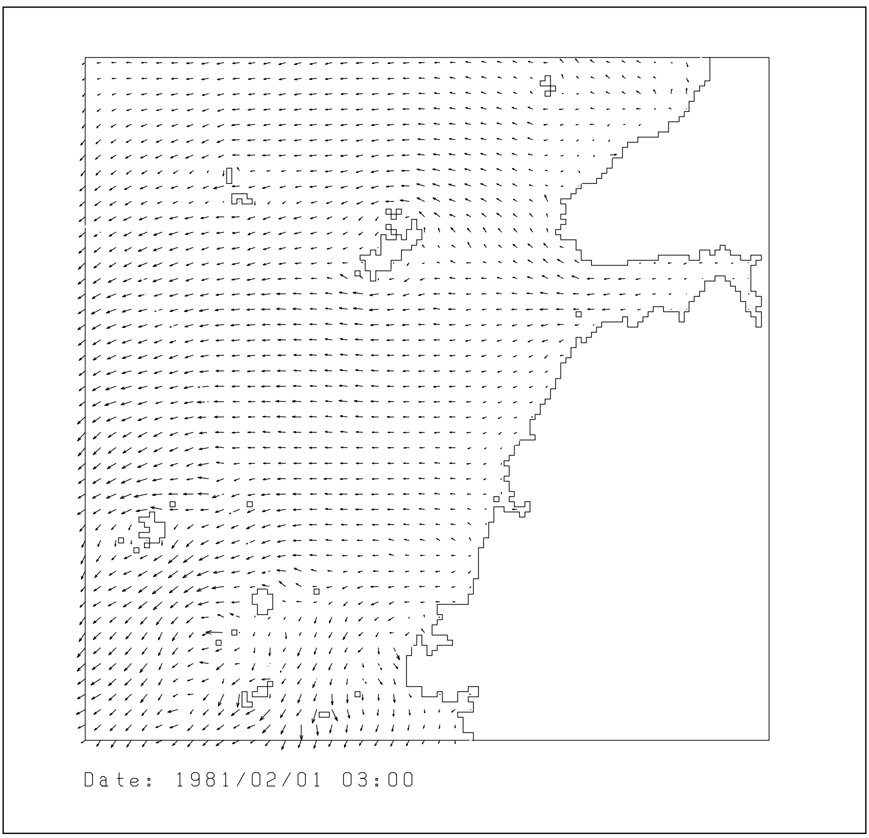
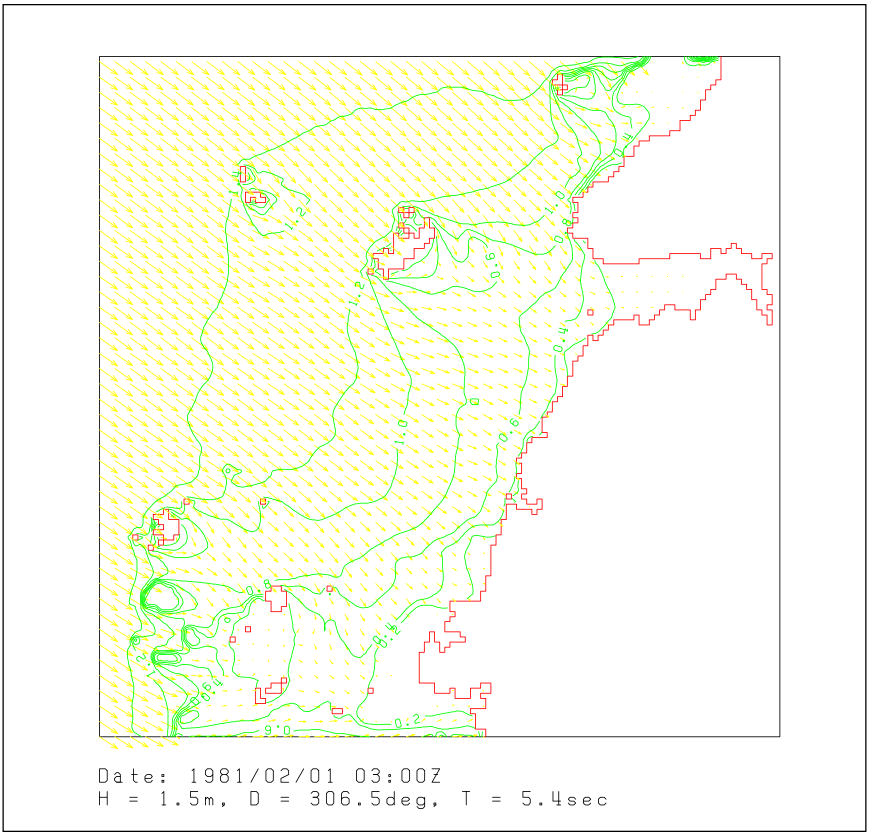


Figure 7. Example of Coastal Wave Calculation at Any Given Time.



The output of the 2-D circulation model can be roughly modified using an empirical or analytical vertical profile. For more detailed prediction of the surface or vertical profile of the wind driven current, 3-D circulation models can be used: one is a quasi-3-D model with a finite difference grid in the horizontal and function expansion through the vertical and the other uses grid boxes in three dimensions. Storm surge is either obtained from these 3-D models or using 2-D storm surge models operated by means of an automatic connection with numerical weather prediction output.

The general ocean circulation model is not ready to provide ocean current operationally mainly due to the difficulties in providing the initial and boundary conditions of 3-D circulation models. A possible approach at present is to provide approximate information for the application such as oil spills and search and rescue (SAR).

Figure 8 shows the surface currents of the East Sea (Japan Sea) for January. The monthly current data are interpolated for the grid points of coastal oil spill or SAR models, which are not reliable for the complex coastal waters. For more reliable interpolation for the coastal waters from the course grid model, the sea level variation related to the oceanic current as shown in Figure 9 is used as the boundary condition of the coastal model.

Figure 8. Simulated Monthly Mean Surface Current in January.

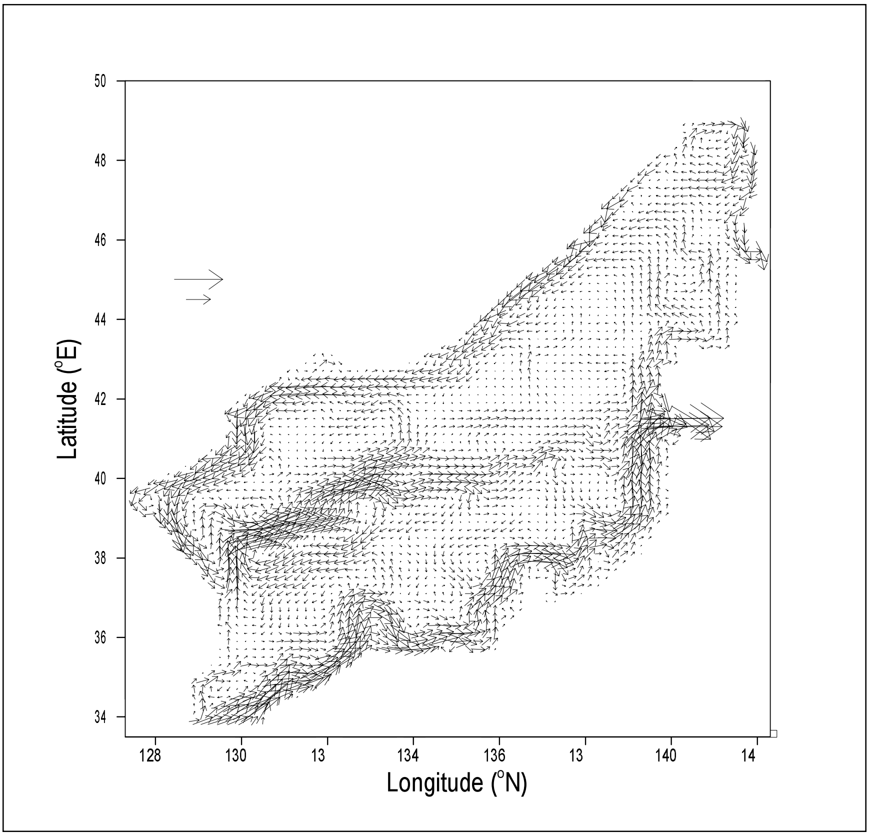


Figure 10 shows the schematic diagram for estimating currents and sea surface elevations, while Figures 11 and 12 show the procedure for coastal tide and tidal current prediction, and for water level prediction due to the combined effect of tide, storm surge and wave setup, respectively.

Based on the above-mentioned approaches, a marine and coastal information system had been developed for the coastal waters of Korea (Lee, 1998; Lee et al., 1998) (Table 1).

Figure 9. Horizontal Distribution of Sea Surface Elevation in September.

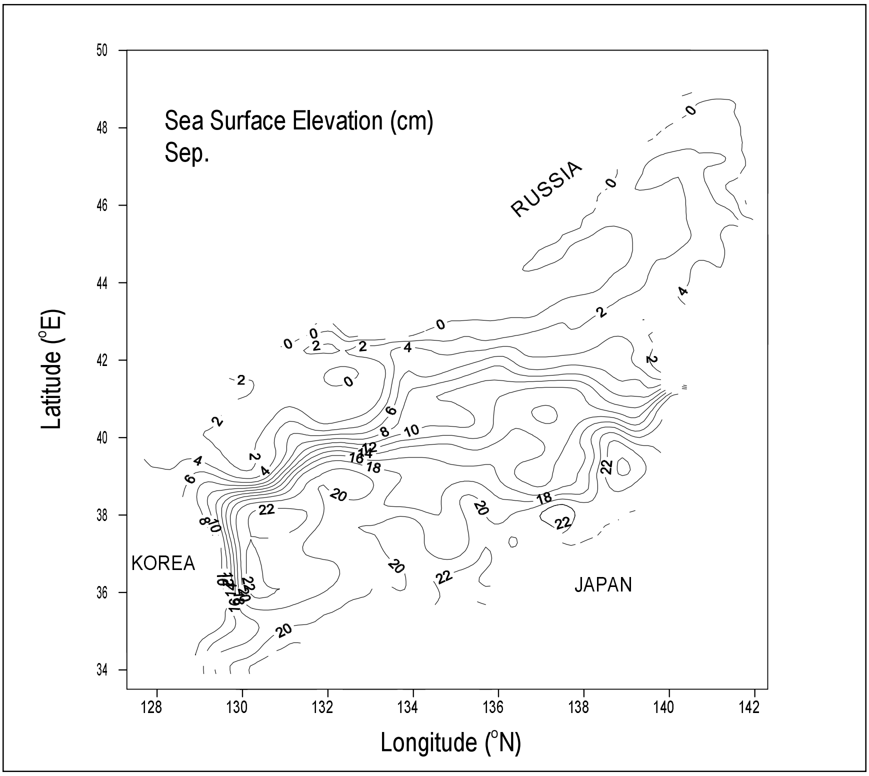


Figure 10. Schematic Diagram for Estimating Currents and Sea Surface Elevations.

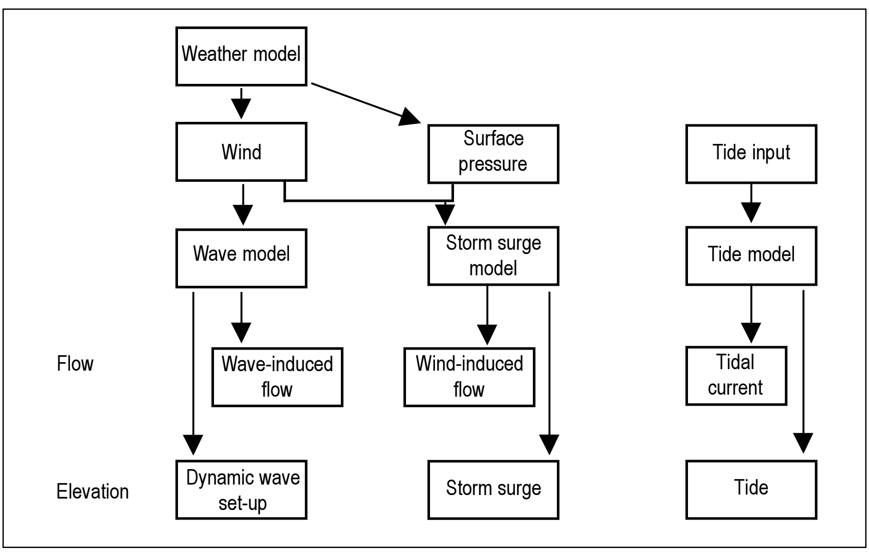


Figure 11. Procedure for Coastal Tide and Tidal Current Prediction.

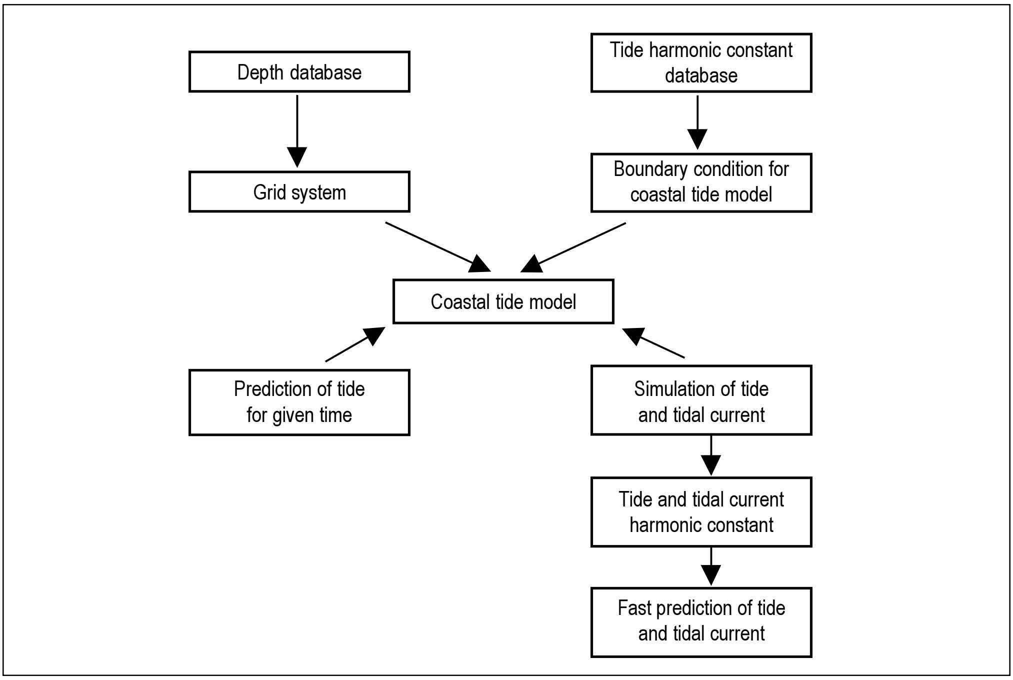


Figure 12. Procedure for Water Level Prediction due to the Combined Effect of Tide, Storm Surge and Wave Setup.

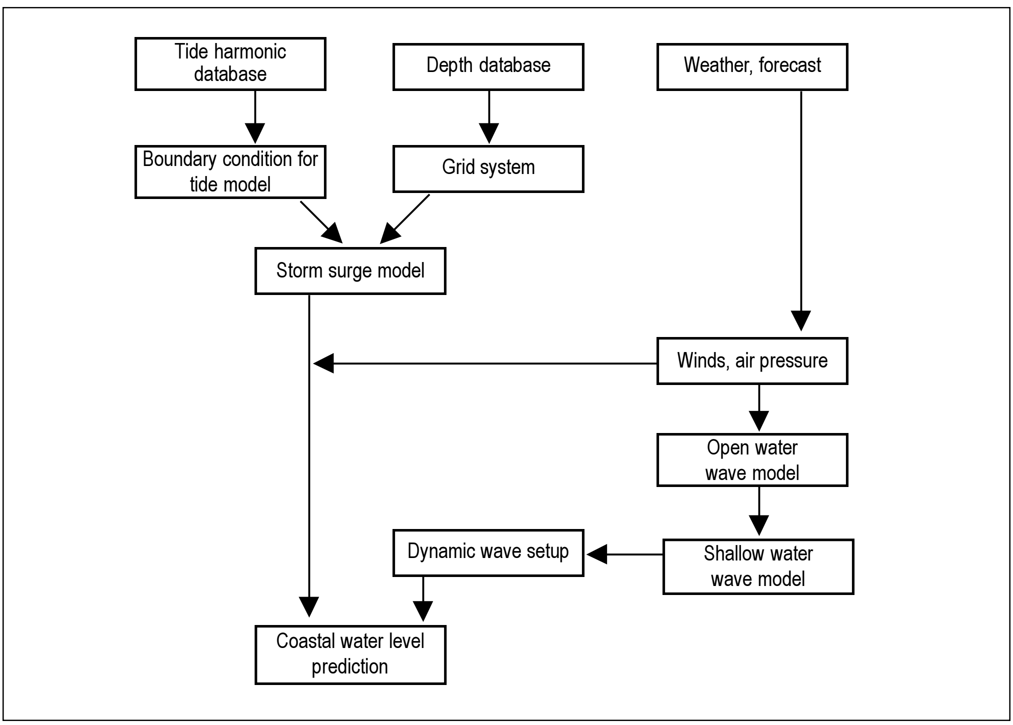


Table 1. Marine and Coastal Information System for an Operational Ocean Service in Korea.

Contents	End-users	Program
Winds over sea caused by typhoon	Harbor Construction Bureau Disaster Prevention Bureau Navy, Coast Guard Consulting Firm University Research Institute	Integrated coastal monitoring
Hindcast (20 years) nowcast and forecast (3 days) of wave field	Harbor Construction Bureau Consulting Firm Disaster Prevention Bureau University Research Institute Navy, Coast Guard Shipping Company Coastal Construction Fisherman Rural Government	Shallow water wave simulation
Nowcast and forecast of coastal tide and tidal current (500 m or 250 m)	Harbor Construction Bureau Disaster Prevention Bureau Consulting Firm Navy, Coast Guard Coastal Construction Fisherman Local Government	Integrated coastal monitoring
Local fine mesh storm surge modelling (grid size: 250–500 m)	Disaster Prevention Bureau Consulting Firm Coastal Construction Local Government Coastal Resident	Integrated coastal monitoring
Operational oil spill spreading prediction system (grid size: 500 m or 250 m)	Coast Guard Oil Company	Integrated coastal monitoring
Operational search and rescue forecasting system (grid size: 1 km offshore, 250 m nearshore)	Coast Guard	Integrated coastal monitoring

Extension to the Southeast Asian Coastal Waters

The coastal information system developed in Korea can be systematically extended to the Southeast Asian coastal waters by applying the technology used in establishing the system for the Northeast Asian Seas (Choi et al., 1997). At present, the depth information is not available for all the coastal waters of the Southeast Asian Seas. Depth data are obtained only for the major coastal areas shown in Figure 13. The depth grid system is generated in advance only for those areas with different grid size. An example of the depth contour plotted using the gridded depth data for Manila Bay is shown in Figure 14. Harmonic constants of major tide and tidal current components (M_2, S_2, N_2, K_2, K_1, O_1, P_1, Q_1) have been calculated for each grid point with grid size of 1/12° covering all the Southeast Asian Seas. An example of the tide harmonic constants of M_2 components for the Southeast Asian Seas is shown in Figure 15.

Figure 13. Areas with Coastal Depth Data.

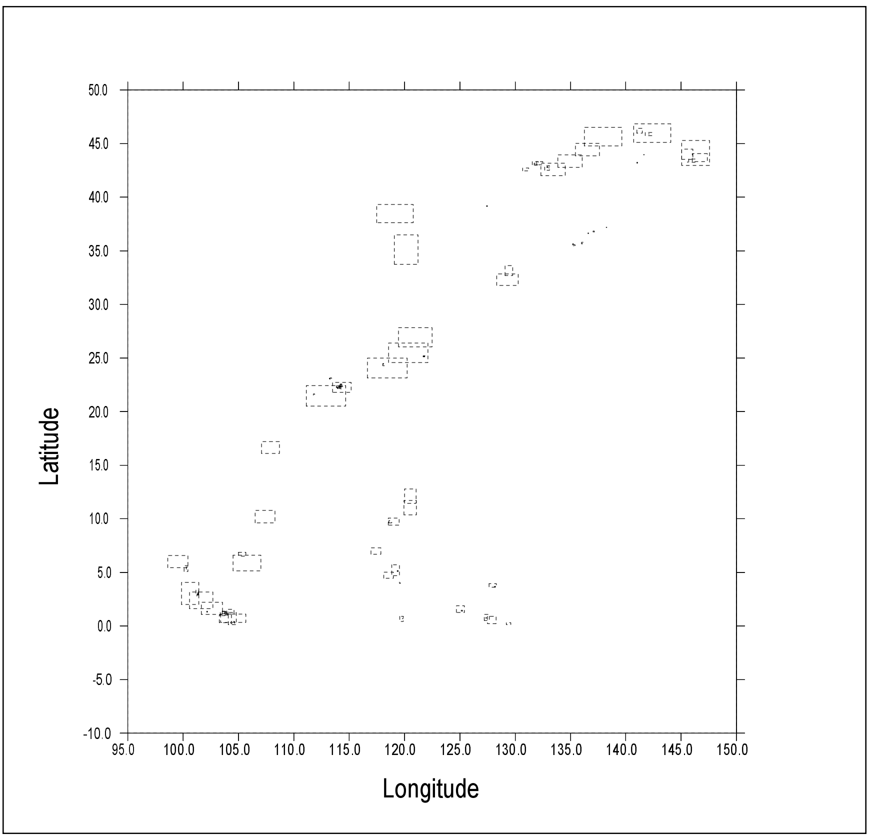


Figure 14. Depth of Manila Bay.

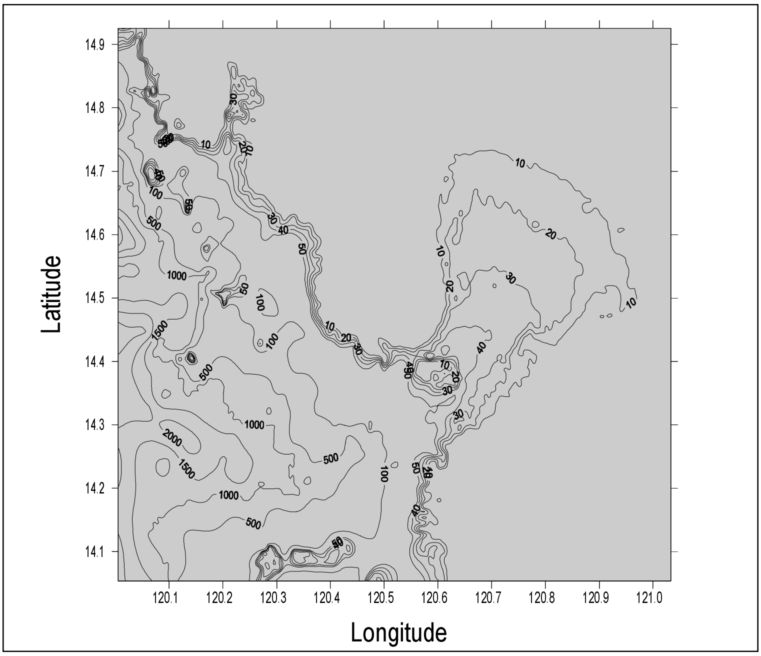
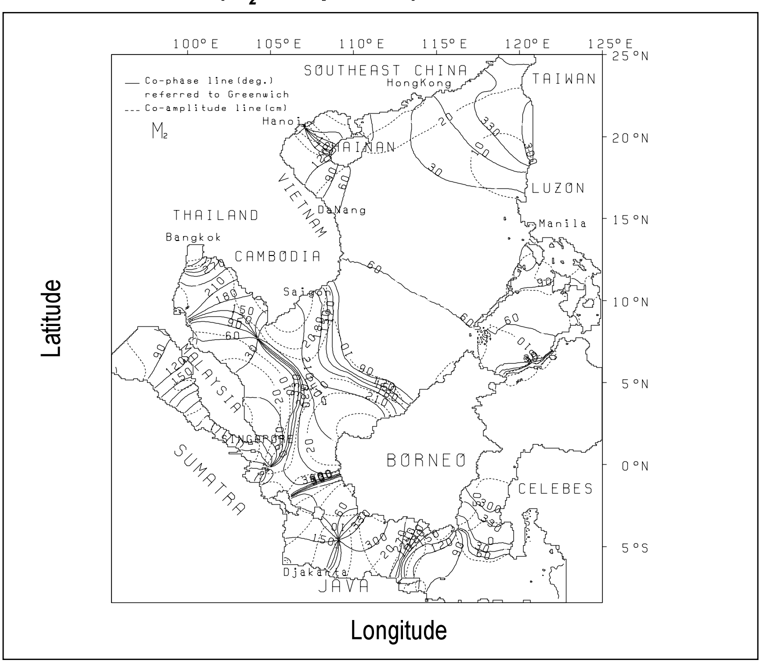
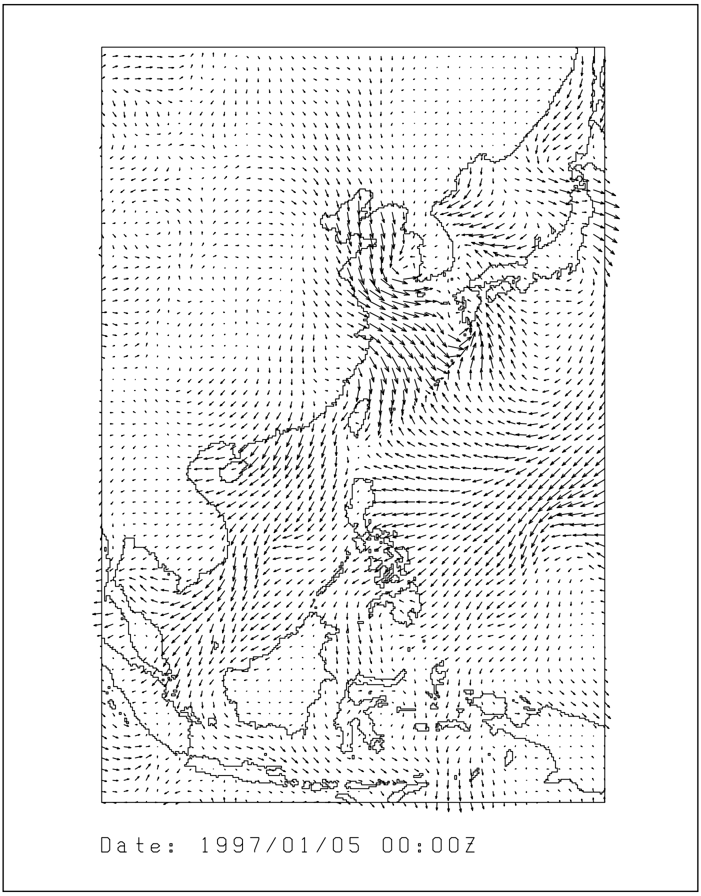


Figure 15. Example of Co-tidal Chart for Southeast Asian Seas (M_2 component).



Twenty years of wind and surface pressure data re-analyzed by ECMWF for the East Asian Region had been prepared. These data can be used in hindcasting waves, storm surges and oceanic current. An example of wind field is shown in Figure 16.

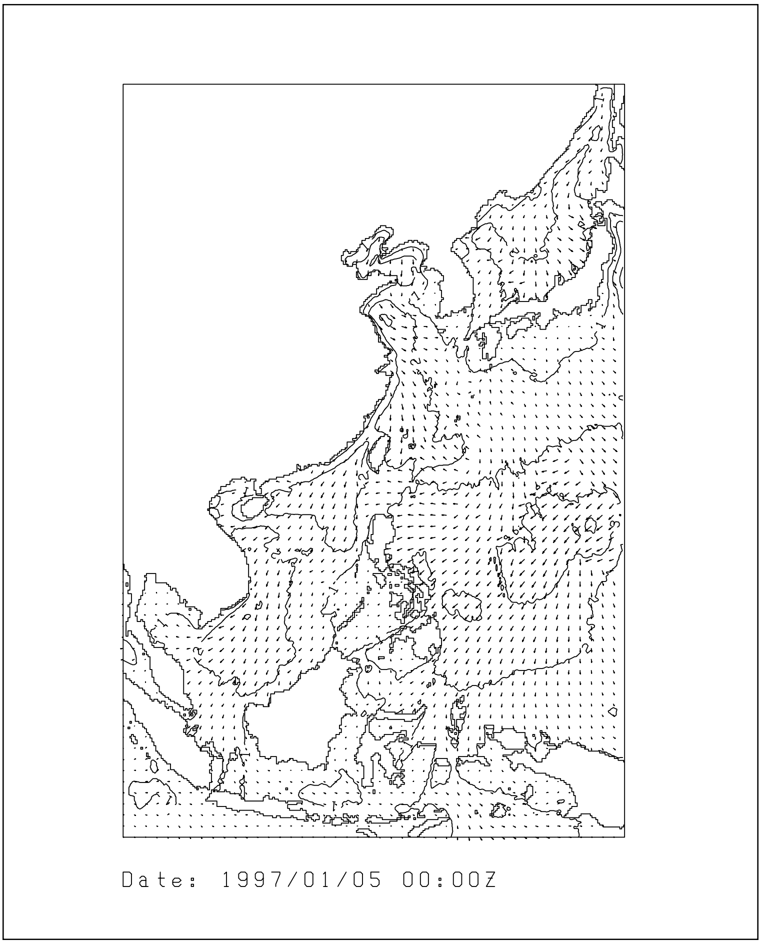
Figure 16. Example of Wind Input of Ocean Model for the East Asian Seas.



Using the wind input covering all the areas of East Asia, the long-term wave simulation can be developed. An example of wave simulation is shown in Figure 17.

Using the depth data and tidal harmonic constants retrieved from the database, a tidal model can be established for the major coastal areas in the Southeast Asian Seas. An example of the tide and tidal current calculated for the Manila Bay is shown in Figure 18.

Figure 17. Example of Wave Prediction for the East Asian Seas.



A coastal wave model can also be established as shown in Figure 19. Using the long-term simulation of the waves in this region, various information on the wave climate and design parameters can be produced.

Application of the Databases for Integrated Coastal Models

Many of the problems in the coastal waters need information on winds, waves, water level, tide and wind-induced as shown in Table 2.

Figure 18. Example of Tide and Tidal Current Prediction for Manila Bay.

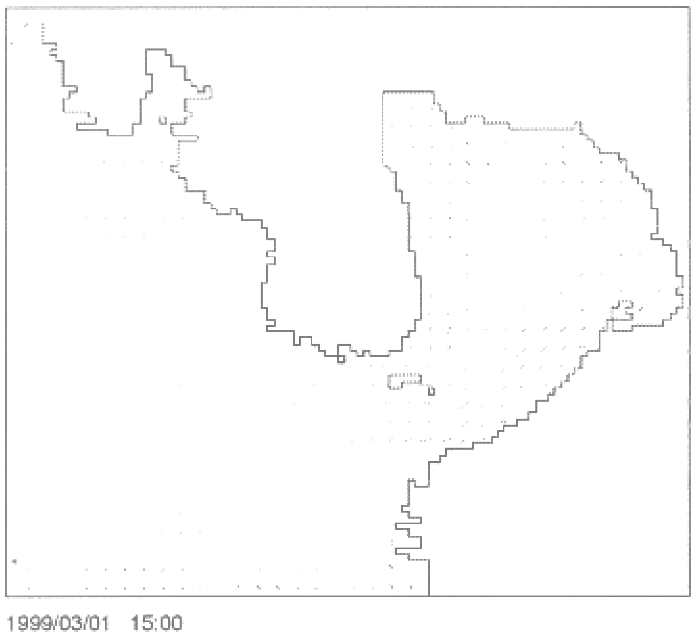


Figure 19. Example of Shallow Water Wave Model Output at the Coastal Waters of Hong Kong.

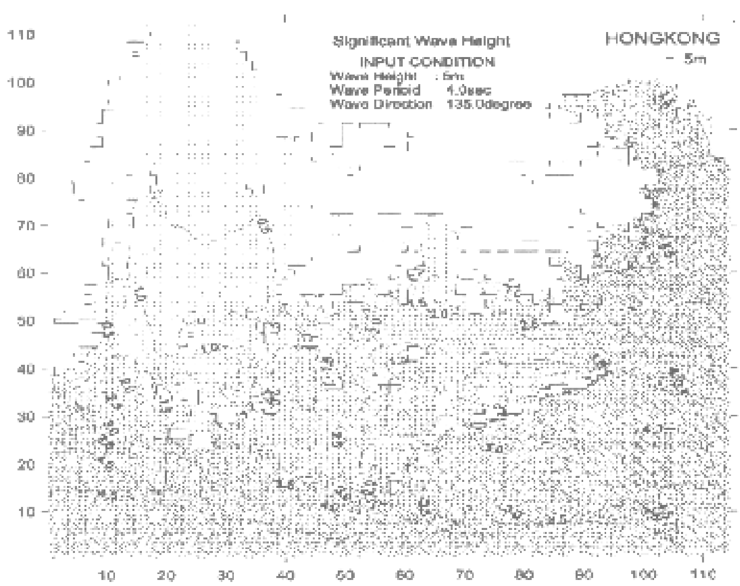


Table 2. Example of Coastal Environmental Information Needed for Ocean Service.

Activities or Problems	Marine Environmental Parameters Needed	Type of Information
Disaster mitigation	Waves, storm surge, high tide, typhoon wind	Long-term statistics Nowcasting and forecasting
Fisheries and mariculture	Temperature, salinity, nutrients, current	Nowcasting and forecasting
Coastal development	Wave, tide, storm surge	Long-term statistics
Marine pollution and red tide	Coastal circulation, nutrients, pollutants	Long-term statistics Long-term forecasting
Oil spill and search and rescue (SAR)	Wind, tide, current, wave	Nowcasting and forecasting
Vessel traffic system (VTS)	Tide, current, wave, wind	Nowcasting and forecasting
Coastal erosion and shoreline change, harbor siltation	Wind, wave, storm surge, tide	Long-term statistics
Recreation	Temperature, wave, wind, tide, tidal current	Nowcasting and forecasting

1. Disaster mitigation

The prevention and reduction of damages caused by natural disasters are of major concern. Most common natural disasters in this region are associated with severe storms like typhoon. To reduce and minimize costly damages caused by storms, a real-time monitoring and prediction of the sea condition is essential together with reliable long-term statistical information of the sea condition.

A system to predict waves, storm surges for arbitrary coastal area around the Korean peninsula and designated area for the East Asian Seas using fine mesh coastal models with offshore boundary condition obtained from large-scale models had been established.

2. Coastal development

Coastal construction is a common feature in most developing countries especially in the East Asian Region. Information on the coastal environment is essential for the optimal design of safe and economical coastal structures.

One major responsibility of coastal engineers is to provide advice to the developers on maximizing the economic benefits and minimizing the negative impacts of the development as well as on safety and reliability of the coastal structures. The information needed by coastal engineers can be obtained from the database of long-term simulation.

3. Ocean services

To reduce costly damages by storms, it is essential to establish an integrated ocean monitoring and warning system for accurate forecasting and timely response operation.

4. Oil spill and search and rescue (SAR)

Accidental oil spills and toxic chemical releases are also serious problems in the region. The coastal information system can help to reduce shipping accidents as well as to effectively combat oil spills and promote search and rescue (SAR) operation. When a spill occurs, an operational oil spill modelling could help the response team limit the adverse effects of the spill. Many types of oil spill models are available either commercially or in public domain. However, not many institutes in the region can simulate oil spill spreading in a short span of time. Most countries in the region that have access to oil spill models do not have the capacity to use them for operational application.

To be able to predict oil spill movement operationally, the marine environmental conditions such as wind, tidal current, wind drift current, ocean current are needed as input data of the operational oil spill model. To be able to use the available oil spill models for both spill response and contingency planning, the models should be easily and quickly applied to any affected coastal or marine area.

5. Sediment transport, harbor siltation and beach erosion

There are multitudes of problems along the coast of Korea related to the transport of cohesive sediments and the adsorbed pollutants, especially along the west and south coasts of Korea, which are characterized with fine-grained cohesive sediments. Many large-scale coastal development projects are under construction or being planned along the west coast of Korea. These constructions could cause complicated and difficult coastal environmental problems. An operational sediment transport model is urgently required. However, the capability for long-term prediction of the morphological changes is not yet available. Most of the already developed models are not in functional forms to easily test the long period simulation especially in verification and calibration of the models. KORDI is planning an ambitious task of developing an operational prediction system that can be used semi-automatically for longer intervals at any area of interest along the coast of Korea.

6. Marine pollution and harmful algal blooms

Marine environmental problems are usually localized. However, it becomes a regional problem when the local pollution becomes transboundary, especially for a semi-enclosed sea like the Yellow Sea. Common environmental problems of the East Asian countries include eutrophication of coastal waters, harmful algal blooms and to a certain extent nuclear waste discharges.

7. Fisheries and mariculture

The fisheries sector is one of the main potential users of NEAR-GOOS. Physical, chemical and biological parameters are needed to identify fishing grounds and to assess the long-term effects of aquaculture on the environment and vice versa.

Regional Cooperation for Monitoring of the National Coastal Waters

The damage and loss will certainly be reduced by the joint efforts of the countries and regions to increase the ocean and sea state monitoring capability and to improve the accuracy of ocean disaster forecasting. As a first step of regional cooperation, exchange of information, knowledge and technology among neighboring countries is needed. If possible, joint development and testing of the models is desirable. This job can be carried out more efficiently if the nations cooperate both in modelling and data exchange. The basic databases can be prepared jointly instead of doing the same job independently for the same regional seas.

The Intergovernmental Oceanographic Commission (IOC) is developing NEAR-GOOS as a pilot program of the Regional Ocean Observing System (ROOS) to demonstrate the capability of a region to establish an operational ocean observation system and to establish linkages between global and regional GOOS activities. NEAR-GOOS is a real-time and near real-time oriented activity by exchanging the real-time oceanographic data collected from ships, moored buoys, drifters and satellites in the Northeast Asian Seas (IOC, 1996; Lee and Taira, 1996). The area of NEAR-GOOS is almost the same as the numerical model area shown in Figure 1.

In the implementation plan of NEAR-GOOS, a centralized data exchange system is developed, in which data producers are asked to submit data to the NEAR-GOOS regional data centers, Real-time Database (Japan Meteorological Agency) and Delayed Mode Database (Japan Oceanographic Data Center) so that the centers may distribute the data to the end-users in the region efficiently. There have not been many experiences in real-time data exchange in the oceanographic community except for the marine meteorological data. It is not easy to expect the data producers to submit the data in real-time to the centers from the beginning stage of the program. In a decentralized system, each data producer is expected to open the data in exchangeable form instead of submitting the data to the centers so that users can access the data directly from the data producers.

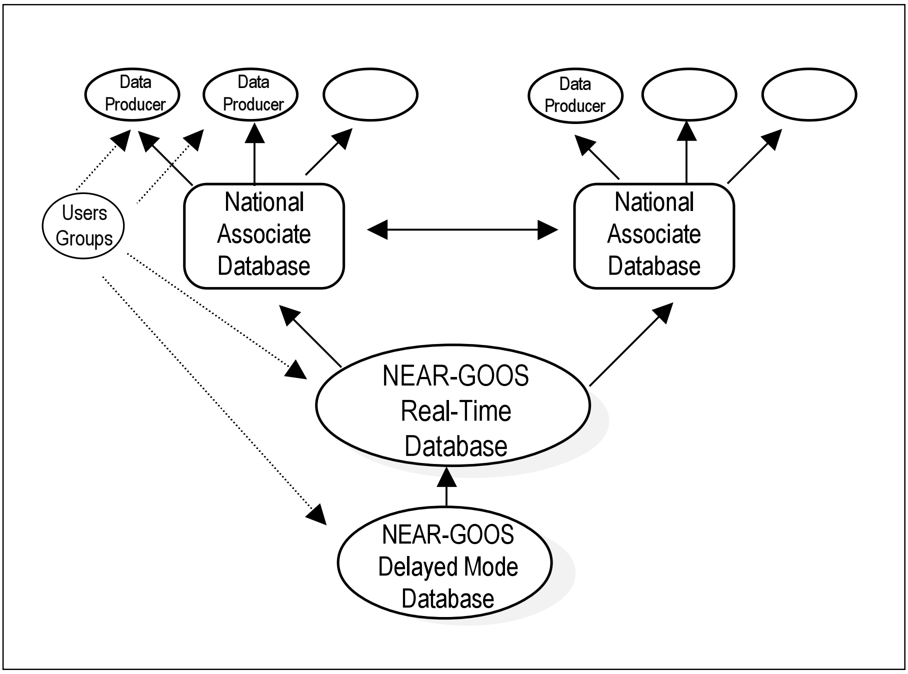
The revision of the data exchange manual is basically aimed at adapting the decentralized system asking each data producer to open the observed data in real-time or near real-time through the website. To help in more efficient data flow, data centers would be designated for each country to archive all the data in the country by visiting all the available sites and retrieving the data from all the data producers and making them available for the users in the country. For the efficiency of the data exchange between the national data center, Global Telecommunication Systems (GTS) can be used together with internet data exchange system. Figure 20 shows the suggested decentralized data exchange flow.

To help the domestic users, KORDI developed a website in which NEAR-GOOS data from other agencies both domestic and abroad are collected and displayed together so that the users would save time in obtaining the NEAR-GOOS data. The address of the website is http://near-goos.kordi.re.kr.

Discussion

To meet the various needs for coastal development, environmental information needs to be produced along the coast of each country by means of coastal prediction models. Scientific information for the wide area of the regional sea is needed for preparing the offshore boundary conditions of the coastal models. Real-time *in situ* measurements and satellite observations in the region are essential for the operational oceanography together with numerical prediction modelling. A good example of a regional cooperation among the countries sharing the same water body is the implementation of the ROOS.

Figure 20. Revised NEAR-GOOS Data Exchange.



The existing observation systems and capacities need to be expanded by improving the spatial and temporal resolution, increasing data exchange, product distribution capabilities and developing near real-time communication capabilities through international cooperation. Successful implementation of the ROOS in the Northeast Asian Seas will accelerate the implementation of such system in other regions such as Southeast Asia by demonstrating its usefulness in solving the immediate national and local problems. The exchange of ideas and experiences in the development of the ROOS as well as cooperation in the development of the technology among the ROOS would also be helpful for the successful implementation of the ROOS and eventually the GOOS.

Satellite observations are important components of the ocean observing system as they cover the sea area with high spatial and temporal resolution. The application of remote sensing techniques and new sensors for buoy observations provides an opportunity to obtain real-time data on the condition of the marine environment, that will be of great importance for management and development of coastal aquaculture, fisheries and recreation. Ocean color measured from satellites can provide near real-time data on coastal zone productivity, suspended solids content and oil slicks on the sea surface.

Enormous amounts of human and financial resources were spent for each stage of large-scale coastal construction in resolving immediate problems by each agency usually carried in an *ad hoc* manner, instead of solving the problems systematically and economically. An efficient way of building national coastal monitoring system is the establishment of a well-designed local monitoring system for large-scale coastal development projects. Local and national governments would be more willing to invest in the coastal monitoring programs that help solve their local problems. The coastal monitoring program should be established to obtain marine environmental information by means of coastal prediction technology using up-to-date coastal models and utilizing the field data taken from a limited number of coastal stations along the coast of Korea to improve the reliability of the prediction model.

Close cooperation among the ocean service agencies is fostered to develop more efficient ocean service system in the region. It would be most helpful if the agencies involved in the routine oceanographic survey in the region adjust their sampling schedules and data analysis so as to make use of the data gathered for the region that will enhance operational ocean prediction. It is expected that personnel involved in ocean modelling in the region provide proper guidance in optimizing the ocean service system. Ocean prediction models can be developed and tested cooperatively using the data obtained in the regional seas. Such cooperation could lead to the development of a joint ocean prediction center in the future.

References

Choi, B.H., D.G. Kim and D.H. Kim. 1997. A numerical tidal model for the Southeast Asian seas, p. 38-53. *In* H. Yu, L.K. Sang, N.M. Son and D.-Y. Lee (eds.) Oil spill modelling in the East Asian Region. MPP-EAS Conference Proceedings 5, 304 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

IOC (Intergovernmental Oceanographic Commission). 1996. Draft pilot implementation plan for North-East Asian Regional Observing System (NEAR-GOOS).

Kang, S.K., S.R. Lee and K.D. Yum. 1991. Tidal computation of the East China Sea, the Yellow Sea and East Sea, Oceanography of Asia Marginal Seas. Elsevier Oceanography Series 54.

Lee, D.Y. and K. Taira. 1996. Development of NEAR-GOOS. Elsevier Oceanography Series 62. Operational oceanography. The challenge for European Cooperation.

Lee, D.Y. et al. 1996. Development of shallow water wave prediction system. Technical Report for Korea Maritime and Port Administration.

Lee, D.Y. et al. 1998. Integrated coastal monitoring systems. Technical Report BSPN 97345-00-1092-2. Korea Ocean Research and Development Institute.

Lee, J.L. 1998. A high-accuracy for modelling flow-dominated transport. *In* C.A. Brebia (ed.) Environmental coastal regions. Proceedings of the Second International Conference on Environmental Coastal Regions, Cancun.

Environmental Impacts of Coastal Development in Xiamen

Hong Huasheng and Xue Xiongzhi

*Environmental Science Research Center, Xiamen University
Xiamen, People's Republic of China*

HONG HUASHENG and XUE XIONGZHI. 1999. Environmental impacts of coastal development in Xiamen, p. 142-148. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The coastal zone of Xiamen is under increasing pressure from economic development. Earlier studies on coastal resources and their utilization contributed to the understanding of the coastal processes and identification of the environmental issues. However, management actions have been limited.

This paper describes some of the major environmental impacts of urban and economic development in Xiamen.

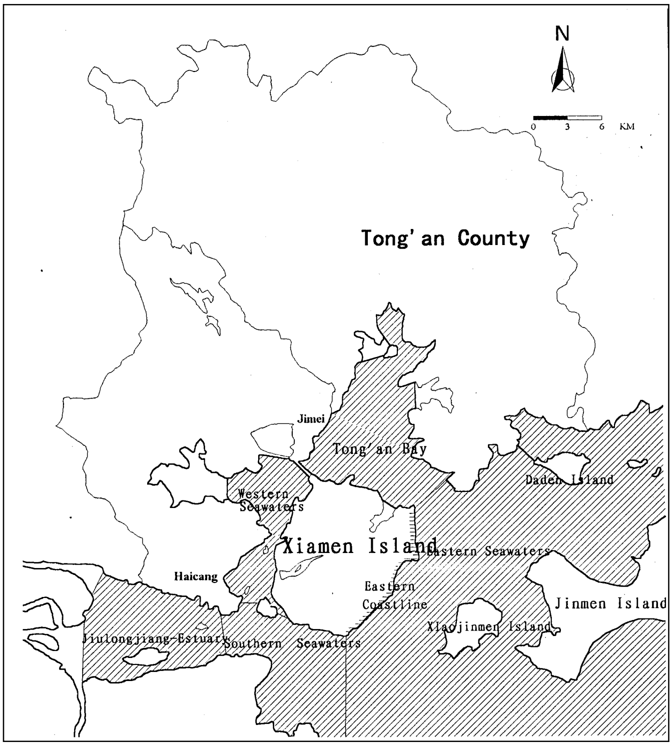
Cumulative Impact Assessment in the Xiamen Coastal Zone

Geographical Location

Xiamen is located at the southeast coast of China. Its coastal waters include the Jiulong River Estuary, the West Sea, the South Sea, the East Sea and the Tong'an Bay. With the construction of Gaoqi-Jimei dike in 1956, Xiamen Island became a peninsula connected to the mainland and the West Sea area. Tong'an Bay became a semi-enclosed bay (Figure 1).

Xiamen, formerly known as Amoy, is one of China's earliest international ports after the Opium War. As one of the five special economic zones of China,

Figure 1. Xiamen Coastal Waters.



economic development has been rapid especially in recent years. Xiamen's gross domestic product (GDP) has exceeded 20% before the recent financial crisis. Xiamen is a free port, and thus becomes an attractive site for foreign investment. Like many coastal cities in the world, Xiamen's coastal zone is under increasing pressure from rapid industrial and urban development and from the increasing use of its limited coastal resources.

Urban and Economic Development

Between 1990 and l995, the local population has increased from 1.1 to 1.2 million with an annual growth rate of 1%. Due to high demand for manpower and availability of jobs, the migrant population increased from 100,000 to 290,000. In Xiamen Island alone, the migrant workers make up almost 40% of the total population (Xiamen Statistics Yearbooks, 1991-1994).

One interesting feature of economic development in Xiamen is the gradual change in percentage contribution to the GDP by the first, secondary and tertiary industries. The light and heavy industries in the secondary sector are now the major contributors to the GDP. On the other hand, the tertiary industry (including commercial, communication and tourism) is fast catching up. The mechanical, electronic, petrochemical and construction industries have also developed rapidly in recent years.

Urban population and industries are concentrated in the old urban area of Xiamen Island, notably along the eastern coast of the West Sea. Haicang district, which is located on the opposite site, is being developed into a new, modern urban center with a large industrial investment complex.

Most recent development projects are located along the western coast of the West Sea. The West Sea has been traditionally used for port development and for navigation. Port and shipping industries contribute significantly to the economy of Xiamen. The Harbor will be constructed as a multifunction comprehensive port engaged in both transport of passengers and cargoes. Seventy-seven berths are being constructed, 11 of which have a capacity of 10,000 to 50,000 tons*. The handling capacity of the port has increased significantly since 1990 and will expand with an annual rate of 17.6% in the next five years. In 1990, the handling capacity was only 1.68 million tons of cargoes and 45,400 containers. This has increased to 11.4 million tons of cargoes and 224,700 containers in 1994. It is expected that the Xiamen Harbor will handle 30.1 million tons of cargoes and 780,000 containers in the year 2000 (Xiamen Statistics Yearbooks, 1991-1994).

The West Sea has been used as a site for waste disposal. An increase from 49 million tons of wastewater discharge from land-based industries and domestic sources in 1985 to 90 million tons in 1994 was recorded. In recent years, there has been a reduction in the amount of industrial wastes as a result of strict enforcement of industrial waste treatment and recycling. A large part of the wastes is from domestic sources with high contents of nutrients and organic matter, about 80% of which is discharged into the West Sea. At present, the sewage treatment capacity in the municipality is about 100,000 tons/day. However, only 40% of the total sewage in the municipality are treated. There are plans to install additional sewage treatment plants with the treatment capacity reaching 250,000 tons/day in the year 2000. As such, 70% of the sewage will be treated before discharged into the West Sea (Hong et al., 1994).

The most important pollutants at sea are oil and garbage originating from berths and vessels, and organic pollution arising from mariculture activities. Oil

* *1 ton = 0.907 tonnes*

pollution at sea increased from 275 tons in 1990 to 325 tons in 1994, of which 55% is documented in the West Sea. To a certain extent, the semidiurnal tidal current flushes out some of these wastes to the open ocean.

Environmental Impacts of Urbanization and Economic Development

Since 1979, China has imposed environmental impact assessment (EIA) requirements for development projects. However, this does not effectively arrest the continuing deterioration of the quality of the marine environment. Current EIA procedure assesses the possible impacts of individual development project but neglects to consider the cumulative impacts caused by several development projects in the same area. The continued degradation of the water quality of the West Sea is a case in point. Some of the adverse environmental and socioeconomic impacts could be felt several years or decades later.

From 1950 to 1970, Gao-Ji, Ji-Xing and Maluan dikes were constructed to create more land for rice cultivation. Part of the Maluan Bay was fully enclosed. Maluan Bay is located within the West Sea. The direct impacts of this large reclamation project are changes in geomorphology and reduction in water surface area (Figure 2). Since 1955, the tidal flushing area has been reduced significantly to 57.91 km^2 which is 69.4% of the original area. The volume of tidal influxes has also been reduced to 1.2×10^8 m^3. At present, the water surface area of the West Sea at low tide is only 22.5 km^2. According to estimates, an additional 2.65 km^2 will be lost in the next five years.

The reclamation project caused changes in the hydrological circulation pattern and siltation velocity which are influenced by the change in geomorphology. As the tidal influx volume is reduced, the tidal flushing capacity is correspondingly weakened and the sedimentation process is accelerated in the West Sea. From the ^{210}Pb study in 1985, the sedimentation rate at both sites in the Gao-Ji dike area increased two- to six-fold, giving rise to heavy siltation. As siltation rate accelerated, the channel shoaled up, posing obstacle to navigation.

In order to maintain the depth of the channel for navigation, the frequency of dredging and the associated cost increased dramatically. In 1984, 150,000 m^3 of silt deposited at the channel was dredged for the first time. In 1993, 190,000 m^3 of silt deposit was again dredged. Two years later, another 160,000 m^3 needed to be dredged again. On an annual basis, an average of 80,000 m^3 of silt deposits need to be dredged. The increasing siltation rate has become a threat and has posed a limitation to the development of port and shipping industry in the area.

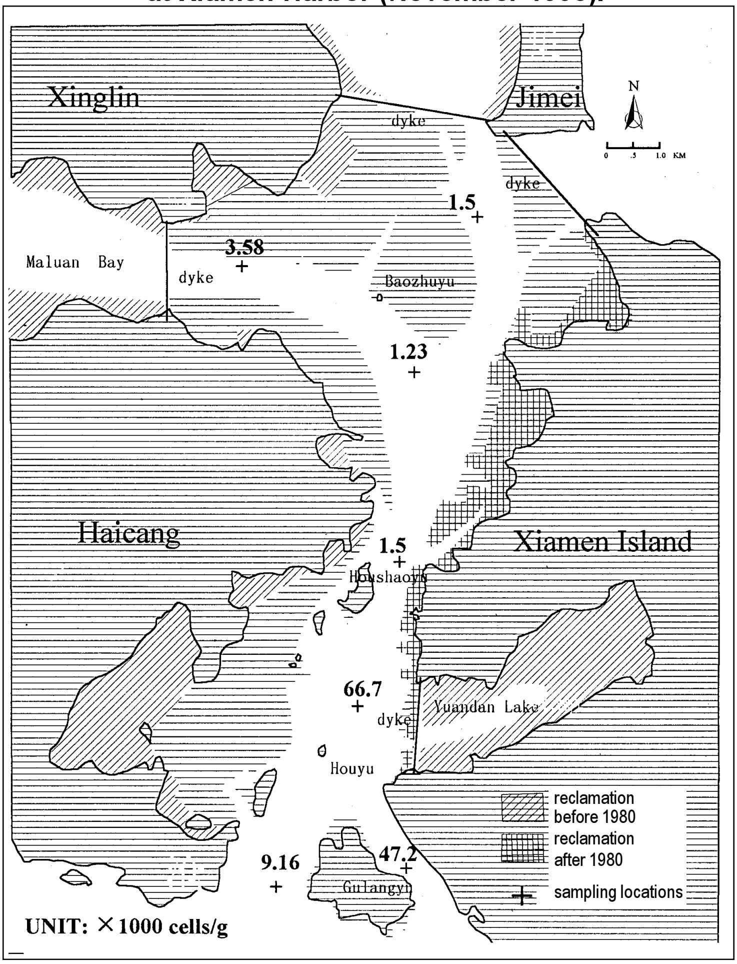
Another environmental issue of the West Sea is the impact of urbanization. The West Sea receives about 80% of the total land-based wastes, largely sewage. The amount of domestic waste being discharged is increasing. Although the water quality of the West Sea still meets the requirement of the class II seawater quality standard of China, the reduction in the tidal flushing capacity may lead to an increase in the concentration of organic matter and its retention time in the West Sea. Already the levels of COD, nutrients and total suspended particles are increasing, thus, threatening the quality of the water.

Marine sediment has been considered as sink for pollutants and could provide a record of pollution history. Contaminated sediments could act as non-point source of pollutant in releasing substances adsorbed in the silt particles, thus, affecting the chemistry of the overlying water. A study in 1993 showed that the general distribution pattern of organic pollutants in the sediments in the West Sea reflected the levels of pollutant discharges from industrial and urban sources. The highest concentration of DDT in the sediment was found in the channel between Xiamen and Gulangyu Island where population density is high. The highest concentration of polychlorinated biphenyls (PCBs) on the other hand is near the discharge point of the municipal sewage at the Yuandang Lake. The highest concentration of polycyclic aromatic hydrocarbons (PAHs) in the sediment was found near Dongdu Harbor and the navigation channel. Results show that the concentration of PAHs in the sediment is relatively low but tends to increase resulting from port activities and from the increasing number of vessels in the area.

Bacterial pollution by coliform (*Escherichia coli*) is serious in the West Sea despite efforts in sewage treatment and regulation of waste discharges. Although there was a reduction in the total coliform in the water, the coliform bacteria counts still exceeded the standard value for coastal waters. The highest count of total coliform was recorded in sediment samples taken close to sewage discharge points (Figure 2).

Deterioration of water and sediment quality could upset the ecological balance of the coastal ecosystem, in particular the species composition. As deposition of silt increased in the West Sea, the bottom configuration changed as more coarse sand grains were replaced by fine mud which was enriched with organic matter. The composition of the benthic species changed from *Saccella cuspidata* and *Dentalium kiaochowwanence* to *Naoxenophthalmus obscurus, Nucula hawamural* and *Trigononothracia jinxingael;* and the species composition was predominantly polychaetes. Results from the 1980, 1985 and 1994 surveys show that the benthic species at Baozhuyu Island in the West Sea were dominated by the polychaetes, *Poecilochaotus paratropicus* and *Paralacydonia paradora*. High

Figure 2. Concentration of Total Coliform in Sediments at Xiamen Harbor (November 1993).



organic matter content in the water and the abundance of polychaete worms are usually indicative of organic pollution.

Another obvious impact of human activities recorded in Xiamen is the large-scale destruction of mangroves. Historically, Xiamen had a vast mangrove forest. By comparing the remote-sensing images of 1987 and 1995, an estimated 88% of mangrove forest were lost in eight years. In 1987, mangroves covered an area of 179.3 km^2 and this area was reduced to 20.8 km^2 in 1995. In some locations such as Dongdu, 100% of the mangrove forest were destroyed to give way for the construction of the harbor. The situation is the same in the Yuandang Lake area, where mangroves were removed for human settlement. Species such as *Acanthus ilicifolius* and *Acanthus xiamenenses* are endemic in the Xiamen area.

Functional Zoning Scheme

The various environmental impacts briefly described above can only be resolved through a holistic planning and management approach. 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 area (see Ruan and Yu, this vol.). In the process of defining the zones, the current and potential cumulative environmental impacts of the marine areas in Xiamen were assessed, thus, providing the scientific basis for the establishment of the zonation scheme.

As a result of the ecological and socioeconomic study of economic development in the West Sea, its primary and accessory functions were determined. Based on the recommended functions, the West Sea is to be used primarily for port development but also serves as a nature reserve for endangered species including the Chinese dolphin, egret and lancelet. It also has the potential for tourism development. Land reclamation will be stopped so that the deep parts of the West Sea will be utilized.

The study also provides valuable information with respect to mitigating measures to be taken in addressing the above-mentioned environmental problems. A notable recommendation is the opening of the Maluan dike. Based on physical modelling experiments and analysis, opening Maluan dike will increase the capacity of tidal influx, improve the water circulation, reduce siltation and reduce the threat of flooding of the inner bay. If Maluan Bay will be opened, the tidal flushing volume of the West Sea will increase by 20 million m^3, thus, increasing the flow speed. It will also reduce siltation in the navigational lanes and promote the development of the shipping industry, help enhance the purification process of the water and improve the scenic quality of the West Sea. The study also recommends the rehabilitation of the mangroves.

REFERENCE

Hong Huasheng et al. 1996. The ecological and socioeconomic impact of economic development in Xiamen Demonstration Site with emphasis on marine pollution. Xiamen University, China.

Session II

Environmental Investments

Opportunities for Investment: Creating Public-Private Partnerships

Hugh Faulkner

Sustainable Project Management
Geneva Executive Center
11-13 Chemin des Anemoues
1219 Chatelaine, Geneva, Switzerland

FAULKNER, HUGH. 1999. Opportunities for investment: Creating public-private partnerships, p. 151-163. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper discusses the features of the public-private partnership process developed by the Sustainable Project Management (SPM). Eligible project types and optimum investment sizes in addressing environmental issues in the fields of water, waste and energy; project selection criteria; and criteria for selecting private sector partners are mentioned. SPM's partnership dynamic focuses on notions of ownership of the project; commitment to the project; and governance of the project.

Introduction

Sustainable Project Management (SPM) is the executing agency for an initiative called Public-Private Partnerships for the Urban Environment (PPPUE). PPPUE was created because the public sector cannot alone meet the expanding demand for urban infrastructure services, especially in developing countries. In addition to pioneering new approaches to the ownership and financing of environmental infrastructure services, the PPPUE is focused on the more efficient use of infrastructure—both existing as well as proposed—through increased productivity in the use of resources while reducing pollution impact. The objective is a convergence of economic and ecological benefits. These concepts are captured in the term, "eco-efficiency".

SPM is an independent, nonprofit association, based in Geneva, Switzerland. It has links to, and was spun-off from, the World Business Council for Sustainable Development (WBCSD)—a global network of top corporate executives committed to more "eco-efficient" business practices.

The term public-private partnership (PPP) is used today as a general heading for a variety of schemes which involve the two sectors in some form of collaboration as varied as wetlands management to build-operate-transfers (BOTs). The SPM/United Nations Development Programme (UNDP) use of the term PPP applies specifically to the formation of mixed capital companies or joint ventures where the private sector and public sector are co-investors, who together share the risks and the rewards of the enterprise.

The SPM/UNDP Public-Private Partnership has been designed to draw on the skills, experience and resources of both sectors to achieve a common goal. To date, these PPPs have been focused on urban infrastructure problems associated with waste collection, recycling and disposal, water use and reuse and energy efficiency. Recently, SPM has begun an initiative to take the PPP concept to create eco-industrial parks (EIPs) and capacity building centers (CBCs).

The Problem

The major challenge facing municipalities is that they are being overwhelmed by demographic forces and are unable to finance the need for infrastructure services. On the other hand, there is no market for water, waste and energy efficient services in the medium-/small-size communities. Larger projects attract attention, smaller projects are often ignored. Attention should be focused on the following key trends as noted by Worldwatch:

- Since 1948, the global population has doubled and real income has increased by a factor of six.
- In the next 50 years, the global population will grow by at least 60%. Therefore, global gross domestic product must also increase by 60%.
- Urbanization in developing countries has been accompanied by an alarming growth in the incidence of poverty. Today, one out of four urban dwellers lives in absolute poverty; another one in four is classified as relatively poor.

- Social progress rests on economic progress which, in turn, depends on energy. Energy demand continues to grow at least 2-3% a year.

- Most urban infrastructure services in developing countries are provided by the public sector. But SPM and UNDP experience demonstrates that municipalities alone cannot meet the continually expanding demand for services.

This leads to several questions with perhaps the most important being, how much is society willing to pay to fuel economic growth? The mounting problems that are identified today, such as pollution of land and marine resources, poor air quality, loss of habitat can be traced to the desire to develop. Development is not a bad thing, but done without regard for the consequences is a dangerous practice. On the basis of current trends, our lifestyle does indeed look unsustainable. So, the future requirement is clear—to provide economic progress without negative environmental or social impact.

Solutions

There is lack of information at the municipal level on technology options available and there is a need to design new ways to finance these projects. Public policy issues of user fees/polluter pays have to be addressed. In short, these problems have to be turned into investment opportunities—bankable documents—if the private sector is to become involved. There are many possible solutions, but certain elements are clear. The response must be integrated, it must be global and it must be balanced in terms of social, economic and environmental solutions.

Historically, it has been the practice of governments to adopt various environmental regulations to protect the quality of the environment. However, experience shows that reliance upon these regulations does not always work at creating successful, long-term solutions. This regulatory approach ignores many of the underlying realities of the contemporary world. It ignores the reality that social progress is driven by economic growth. It does not consider the interdependence of many human activities. It has little regard for wider issues such as levels of education, living standards and employment.

The formation of partnerships between the public and private sectors is one of the most promising of the newly emerging forms of cooperation that truly goes to the heart of sustainability. Through public-private partnerships, cities and companies can pool their resources, expertise and approaches to problem solving to tackle urban challenges in a comprehensive way.

PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnerships are a form of privatization in which government and private companies assume co-responsibility and co-ownership for the delivery of city services. Through these novel partnerships, the advantages of the private sector—dynamism, access to finance, knowledge of technologies, managerial efficiency, entrepreneurial spirit—are combined with the social responsibility, environmental awareness, local knowledge and job generation concerns for the public sector.

The PPP instrument allows the two partners to come together with SPM as an intermediary and resolve the problems that have traditionally prevented effective long-term solutions from being implemented. Once the partnership is initially formed, after a transparent selection process involving all interested potential partners, the private sector finances a large part of the feasibility study and has the first right to invest in the new company. The public sector, too, invests in the process, often in kind, and is a member of the new company.

Shared Risk = Shared Reward

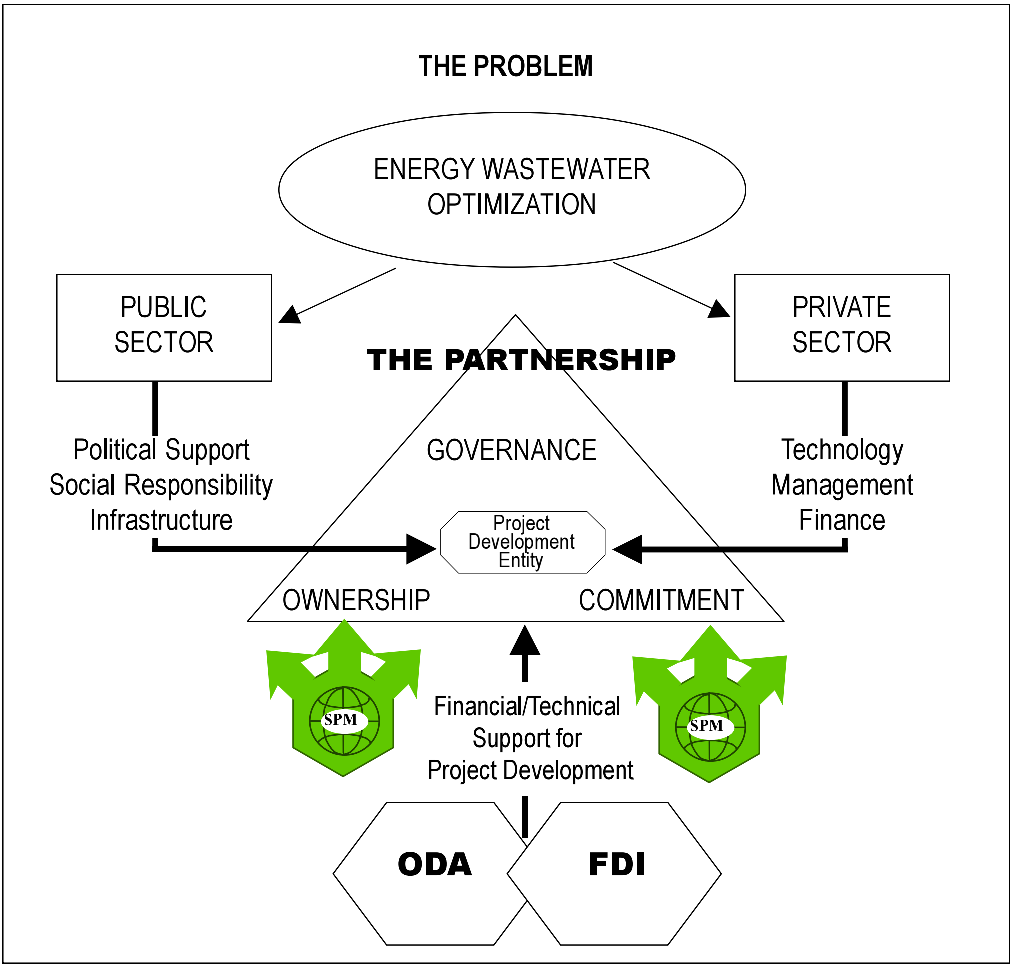
A true PPP is not merely a semblance of dialogue and consultation between the public and private sectors, but a concrete exercise in joint problem solving and burden sharing, leading to the establishment of a jointly-owned enterprise. The PPP methodology and project development process, as applied by SPM in each project, rests on a number of fundamental principles, which are graphically illustrated in Figure 1.

Project Types and Size

Target projects are intended to be in the US$5-$30 million investment range. Eligible project types include:

- Energy-Environment Service Companies for Industry;
- Operating Companies for Urban or Industrial Energy Management;
- Operating Companies for Urban Water Management;
- Operating Companies for Urban Waste Management; and
- Industrial Estate Management Companies.

Figure 1. SPM's Public-Private Partnership Dynamic.



The PPP program, as implemented by SPM, seeks to identify, develop and put in place economically viable, mixed capital companies to address environmental issues in the fields of water, waste and energy. Concurrently, SPM works to maximize the benefits of institutional strengthening and capacity building which the PPP process of project development offers.

SPM has concluded that the optimum investment size is between US$5 and $50 million. The reasons for these selection criteria include but are not limited to the following:

- Projects in this range usually have lower local investor appeal;
- Undertaking these projects in the traditional methods places a greater burden on national debt service capacity;
- Emerging markets can only sustain a limited number of infrastructure projects (particularly when external factors increasingly impact individual countries);[1] and
- Smaller projects have a higher replicability potential.

Features of the PPP Program

The PPP process developed by SPM reduces sharply the transaction times for implementing these projects. This results in real cost savings for both the public sector (which often bears much of these costs) and the private sector (which is more frequently choosing to avoid such high development costs). For a PPP to be successful, SPM must have:

- Full engagement, from the earliest possible moment, of both public and private sector partners;
- The acceptance, by all parties from the outset, of the notion of "shared risk/ shared reward", whereby each side will make visible and quantifiable contributions to the project development process (no one should be paid to develop a profitable project!);
- The maximization of institutional strengthening, intersectoral confidence building and executive capacity building at every stage of the project development process;
- The development of project skills inside the public sector facilitating subsequent project replication elsewhere in the country or region;
- The minimization of the public sector's economic contribution to the project, by mobilizing the maximum economic and technical contribution of the private sector; and

[1] *Impact of Russian crisis on Argentina and Brazil.*

- The ongoing contribution of SPM's specific skills in the fields of "eco-efficiency", project structuring and financing and private sector coordination to ensure that any gaps, which the two sides cannot easily fill, will receive appropriate support. This may include the mobilization of additional resources to contribute to the cost of essential studies (legal, market, prefeasibility, etc.) from outside the program, or the deployment of capacity building programs.

Joint Working Groups

Because much of the project development design is done collaboratively between the private and public sectors, which are both committed as long-term investors in the project, the results are optimal and cost-effective. The most concrete and effective expression of the above process resides in the establishment, at the earliest possible opportunity, of an institutional vehicle that will directly be responsible for developing the final project.

In its simplest form, this can take the form of a joint working group, but has, in certain cases, included the early formation of a jointly capitalized company registered specifically to develop the project (e.g., Agua Pura SA in Colombia). The formation of a working group is most conveniently enshrined in a Memorandum of Understanding (MOU) or similar document signed by all interested parties, including SPM.

It is the view of SPM that **only** in this manner can the following fundamental notions be realized:

- "**Ownership**" of the project by both sectors;

- Economic (and political) **commitment** to the project by all parties; and

- Operational/administrative management ("**governance**") of the project (see Figure 1).

This will provide confidence to all sides (including external partners such as bilateral or multilateral aid agencies) that all parties are prepared to accept the risk of designing the project. The "ownership" of the project and a quantifiable economic commitment to its cost-effective realization serve to ensure that, if the ultimate viability of the project is demonstrated by a shared effort, the project's chances of being finally executed are much higher.

Innovation

The PPP business model allows for certain invaluable innovations to be introduced to the project development process. These reflect a private sector, entrepreneurial approach to project design, financing and execution which include:

- Minimization of project development costs. Ongoing effort to keep the transaction costs lower by involving the private sector as an investor early on. SPM experience demonstrates that PPPs can be implemented with lower transaction costs than alternative approaches, e.g., BOT, build-operate-own (BOO) and in much less time;

- Time and pace of work are essential, if private sector interest in the process is to be maintained. If a greater share of the economic burden of developing the project falls on the private sector, it is reasonable to move at the pace of the private sector; and

- Optimization of the ultimate financing package for the project. The technical, economic and financial parameters of the project are designed jointly by the public and private sectors, with the direct support of SPM.

Project Selection Criteria

The project selection criteria are briefly discussed below. SPM works with donors and other nongovernment organizations (NGOs) to select projects that:

- Address a problem that is a priority for local authorities and the central government, and also a common concern shared by other cities in the region;

- Establish a functioning public-private partnership, not simply privatization of city services. Public administration must have an active interest and participation in the project;

- Demonstrate a strong potential for success including the possibility of reasonable profitability for attracting the private sector;

- Provide an opportunity for improving local social conditions through job generation, improvement of city services and enhanced urban living conditions;

- Respect local cultural values and established labor traditions;

- Embody opportunities for technology transfer and capacity building; and

- Involve local stakeholders, NGOs and community-based organizations in project development.

Project Finance

The last 18 months have been a rough year for the "global economy". As a wave of currency depreciations, stock market collapses and bank closures swept through the world, economists who just a year ago were singing the praises of the "Asian miracle" were suddenly disparaging the region's weak economic foundations.

As investors search for high returns, they are often drawn to countries with vast natural resources and weak environmental laws. This is a potentially disastrous combination says Hilary F. French, Vice President for Research at Worldwatch. Manufacturing largely fueled the spectacular growth of East Asia in the early 1990s. This strategy of utilizing manufacturing to launch into the 21st century is both a blessing and a curse. While on the one hand this type of investment can help countries to leapfrog over the most damaging phases of industrialization it can also end up by bringing in the highly polluting industries that will jeopardize human and ecological health.

Concurrent with this change in attitude toward investment in East Asian projects, the private sector project delivery companies (contractors) are also experiencing a changing attitude toward undertaking work in the region. Among these changing attitudes are:

- Perceptions that project margins are too low when weighed against the project risk;

- The emerging market stability is too low to merit the risk of traditional project tendering (bidding); and

- Payback periods of traditional contracts are too long.

The ultimate consequences of these attitudes are that International Contractors are increasingly avoiding traditional lead contractor roles on projects. Furthermore, what they seem to seek more frequently are "financial operation and maintenance (O&M)" contracts that run over the medium to long term.

Currency Considerations

When considering project finance for large infrastructure projects, what is usually observed is that the bigger the project the larger the Forex content. It is just this relationship that is making project financing more and more difficult. Therefore, SPM advises that for the PPP to succeed, one must maximize the local content, minimize the Forex exposure and lower the acceptable internal rate of return (IRR). To accomplish this one needs to:

- Create a greater role for the national contractors and suppliers who can accept lower and longer payback periods;
- Use proven domestic project management and business expertise; and
- Increase reliance on internal capital and financial markets.

There is still a need to attract foreign participants who bring technology, experience and additional resources. The PPP seeks to do this by use of an alternative contracting methodology. This alternative contracting methodology accomplishes several things. Most importantly, it substantially reduces the transaction costs to undertake these projects, and secondly, this reduces transaction time and cost and creates a more manageable risk profile for the private sector. Once the private sector is involved as a cost-sharing partner the financial risks become far less and the project is more attractive to the investment community.

Role of SPM

SPM has several roles in the project development process which change as the development effort moves from one phase to the next. It is in the project financing phase, where SPM's collective expertise is really put to work. In brief, it is SPM's job to facilitate the developing bond between the private sector and the public sector essentially acting as an "honest broker". By providing this service, one can be more assured and confident in the outcome of the new business enterprise. Furthermore, a common ground between the public and private sectors is identified and known. This foundation is critical for the project financing phase to transpire smoothly and without major problems.

SPM also strengthens the perception of the private sector and the banking sector regarding the PPP process by having a track record of bringing pre-screened projects to the tables. This pre-screening or reality check ensures a higher hit rate on successful projects. Furthermore, SPM supports the finance efforts by providing legal, financial and economic advice to the partnership in the preparation of the bankable documents. SPM assists the private sector in identifying potential investors and in making a financial presentation to secure project funding. Finally, SPM's goal is to turn municipal service problems into profitable business ventures by ensuring that the fee collection systems are either in place or arrangements are being made to establish a fee collection system. Simply put, a business without a fee collection system has no cash flow and without cash flow there is no business, hence no project finance.

THE BENEFITS OF INVOLVING PRIVATE SECTOR PARTNERS IN THE DELIVERY OF URBAN SERVICES

The experience of privatization in developing countries to date indicates that private corporations, NGOs and informal sector enterprises have potential advantages over government agencies in providing many municipal services. The private sector:

- Can provide lower production costs;
- Can deliver more efficiency in service;
- Has greater capacity to maintain capital equipment;
- Can make decisions faster and more efficiently than public bureaucracies;
- Has access to the latest technological advancements; and
- Can undertake research.

Furthermore, the private sector can also reduce financial burdens on governments for wages, operating costs, debt servicing and investment.

Criteria for Selecting Private Sector Partners

In identifying private sector partners to participate with the public sector in mixed capital companies, SPM uses a transparent process based on clearly defined criteria. At the same time, SPM is not interested in protracted tender schedules. To be eligible for selection, the private partner must:

- Be willing to contribute to the cost of the project's feasibility studies;
- Be prepared to invest in the new company when it is formed;
- Have experienced operating the eco-efficient technologies to be used by the new company;
- Preferably have experienced operating in the country where the new company will be established;
- Have the support of its own government's development agency; and
- Strongly support and advocate eco-efficiency and local participation.

For example, currently in the Philippines SPM is working with the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas to bring to market four environmental and energy projects in the Province of Batangas. The process of bringing these projects to this stage has involved significant effort on the part of SPM's regional partner. Much time has been invested to gather data, develop the political commitment and understand the problem. Most of this is work that both the public sector and the private sector are not able to perform. These programs in Batangas provide an excellent opportunity for demonstrating the benefits of the PPP methodology. Some additional reasons for this include:

- SPM, with the New Zealand Official Development Assistance (NZODA) support, has worked at identifying and engaging a number of key private sector companies that have shown considerable interest in participating in the project as an active partner; and
- Draft MOUs have been prepared and signed by the public sector, SPM and the GEF/UNDP/IMO Regional Programme. These clearly memorialize the

parties' commitment to the PPP process as the best method for delivering solution.

Time, cost-effectiveness and a visible and quantifiable engagement of all parties are essential to the PPP process. The proper and timely mobilization of the private sector (one of the particular roles of SPM) is essential from the start. It is the view of SPM that any significant departure from the approach outlined above will eliminate not only the inherent capacity building benefits of the PPP process, but also the vital process of fully engaging the private sector on a risk-sharing basis from the outset. It is this private sector involvement that will break new grounds in the identification, development and implementation of environmental infrastructure projects in countries of the Asia-Pacific region.

Conclusion

In summary, it is believed that public-private partnerships are very effective toward achieving growth that can be sustained, thereby protecting the ecosystem from further damage. SPM regards the greater efficiency and accountability associated with the PPP program as an opportunity for leadership and innovation. Finally, there is only one planet earth to live on. It is huge but it is fragile. If people continue to build parking lots and pollute the air and water, what will be left for the future. People must be stewards of this fragile blue island and think carefully about how to utilize resources responsibly.

Implementation of Public-Private Partnerships: Batangas Bay Case Study

S. Adrian Ross

GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas P.O. Box 2502, Quezon City 1165, Philippines

ROSS, S. ADRIAN. 1999. Implementation of public-private partnerships: Batangas Bay case study, p. 164-172. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The GEF/UNDP/IMO Regional Programme, in conjunction with local stakeholders and Sustainable Project Management, an international nongovernment organization promoting public-private partnerships to solve urban environment problems, has implemented an initiative in Batangas, Philippines, which is aimed at providing improved waste management facilities and services throughout the Province. The initiative is innovative for the Philippines and for the East Asian Region in general, in that it attempts to combine the interests and strengths of the public and private sectors into an efficient and functional operating facility. In the end, the idea is to establish a mixed-ownership (public and private sector) operating company that is responsible for designing, building, financing, operating and maintaining a Province-wide integrated waste management service for Batangas.

The Batangas experience is examined in this paper. Although the project has received considerable interests from both sectors, at the local, national and international levels, the benefits and constraints of the process are still unfolding. The paper identifies the progress that has been made and outlines the steps that still need to be achieved in Batangas. Background activities leading to the promotion of investment opportunities in an integrated waste management system are outlined, as well as the process of selecting a private sector partner from a list of prospective private partners.

An intriguing aspect of the public-private partnership process is the required change in the mindset of the two sectors. In Batangas, the social, economic, financial and environmental considerations of this new scheme for managing wastes were evaluated with local decision-makers and stakeholders from both sectors. The outcome was a consensus and a formal agreement to proceed with the development of required facilities and services within the public-private partnership framework. The practical aspects of building confidence and trust between the two sectors are examined.

Introduction

The Province of Batangas, Philippines, is located some 100 km south of Manila (Figure 1). Economic growth, including the development of an international port for transshipment of raw and finished products, the influx of industry to the coastal area and the intensification of commerce, is occurring at a rapid rate. Along with economic growth, the population of the province is also increasing at a rate of 2.38% annually. As a consequence, the generation of waste is also on the rise. At present, available facilities and services for the management and disposal of both hazardous and non-hazardous waste materials are inadequate. The technical and financial capacity of local government units to address the growing problem is also limited. It was, therefore, essential to develop and apply an alternative delivery system which would: a) meet the public need for environmentally sound waste management; and b) be financially viable for local government units, as a capital investment and operating service.

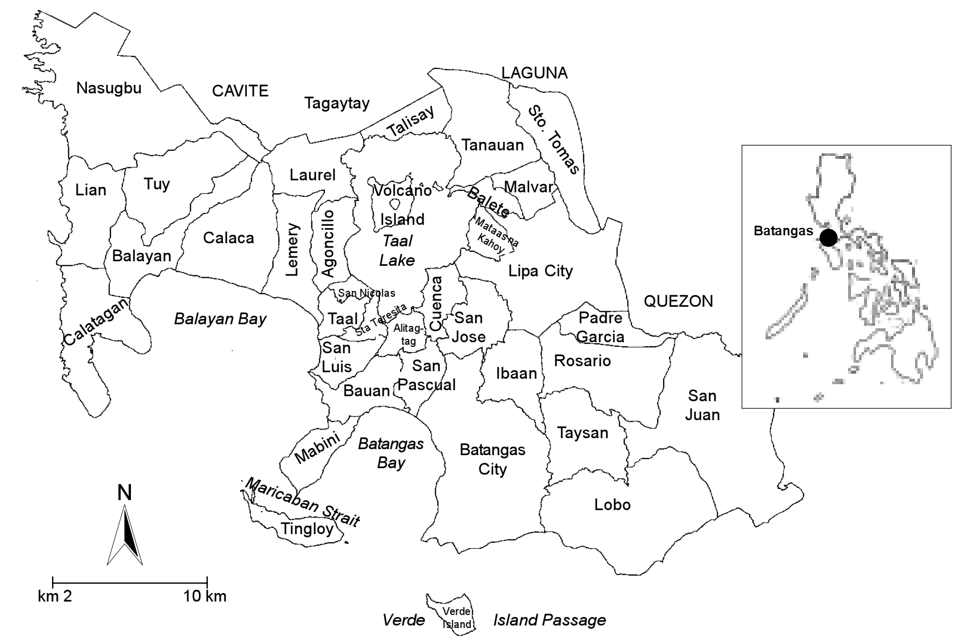
Public-Private Partnership Process in Batangas

There are numerous definitions of public-private partnerships (PPP), depending on the particular reference or application, ranging from informal, voluntary agreements to joint ventures and mixed-ownership operating companies. The following definition, which seems most consistent with the ideal of integrated coastal management, has been adopted from the Canadian Council for Public-Private Partnerships (Carr, 1998):

> *"A cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of risks, rewards and responsibilities."*

Figure 1. Map and Profile of the Province of Batangas, 1997.

- Area: 3,165.81 km^2
- 32 municipalities; 2 chartered cities
- Population: 1.77 million (1997); 30% urban, 70% rural
- Population growth rate: 2.58% per year
- >100 industrial facilities; 45 hazardous waste generators
- 33 hospitals; >400 health clinics, medical and pharmaceutical facilities



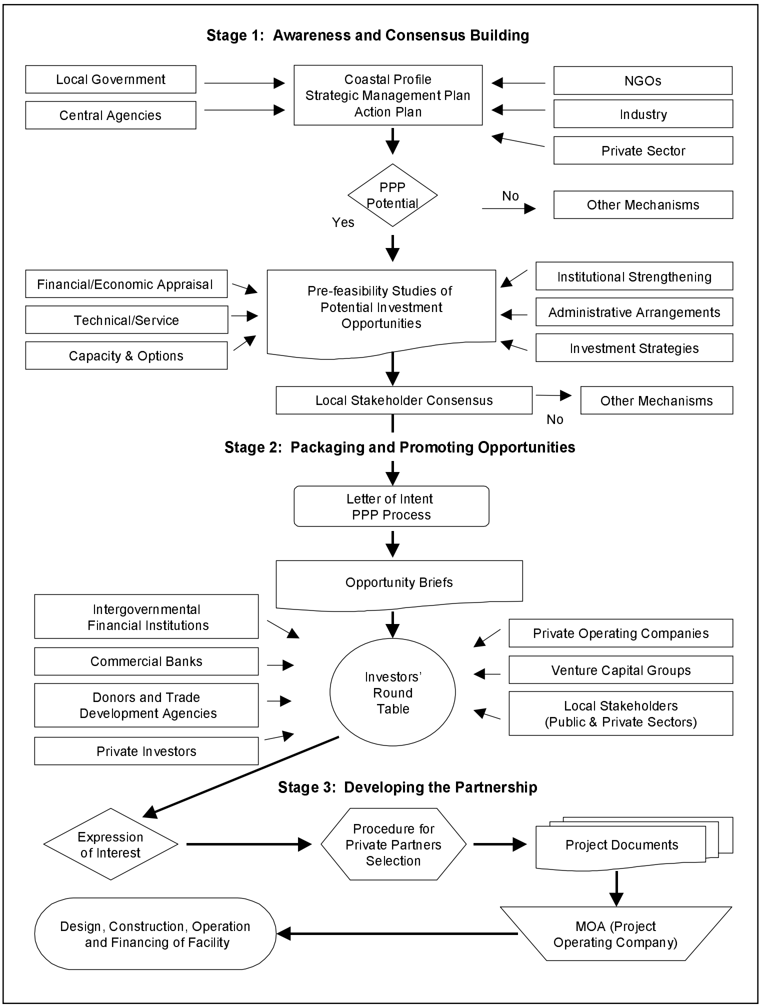
The public-private partnership process (Figure 2), as applied in Batangas, Philippines, consisted of three evolutionary stages, namely:

- Awareness, consensus building and establishing partnerships among local stakeholders;
- Packaging and promoting opportunities for private sector partners and investors from outside the Batangas region; and
- Selecting a private partner and establishing a mixed-ownership operating company.

Stage 1: Building Awareness and Consensus among Local Stakeholders

Engagement of public and private sector stakeholders within the Province of Batangas, along with interested central government agencies of the Philippines, began in early 1994, with the startup of an integrated coastal management (ICM)

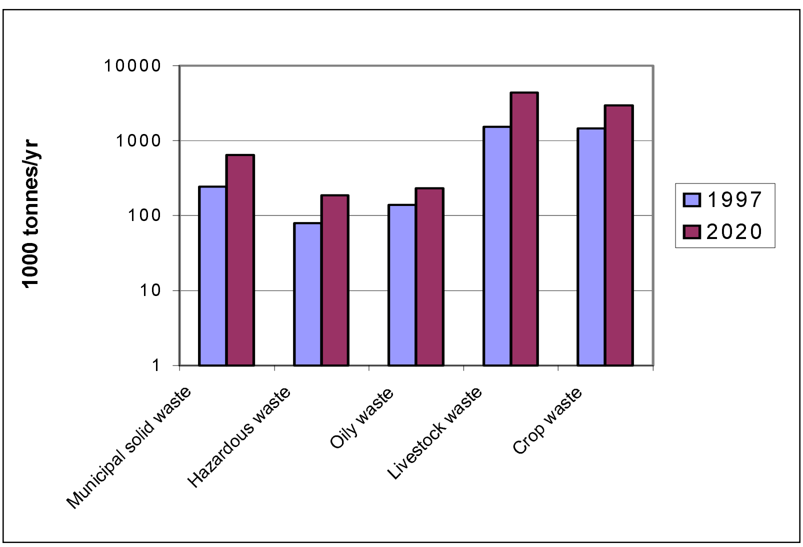
Figure 2. Public-Private Partnership Process.



project. Important early outputs generated over the first two years of the project, through the cooperative efforts of the local government, industry and scientific and technical institutions, included an environmental and socioeconomic profile of the coastal area (MTE, 1996), a strategic environmental management plan (PG-ENRO, 1996) and an action plan on integrated waste management (MPP-EAS, 1996). These joint activities accomplished two objectives. First, the products themselves served as the building blocks for the ICM program in Batangas. Major environmental problems and management issues were identified. Institutional, technical and economic interventions to tackle identified issues were formulated. Short-term action oriented initiatives were developed and agreed to by local stakeholders as a first step toward the long-term vision for the bay development and management. Second, interaction between the sectors provided a better understanding of the respective concerns, capacities and limitations with respect to the current 'command-and-control' relationship between the local public and private stakeholders. Trust and confidence took seed between the sectors. Commitments were made by both sectors under 'voluntary agreements'. Responsibilities were taken on to reduce the quantities of waste being generated to negotiated target levels, as well as to eliminate illegal dumping and waste disposal practices within a two-year period. Finally, the parties agreed to jointly develop a long-term waste management solution for both hazardous and non-hazardous wastes. The voluntary agreements were signed in September 1996.

Over the next 18 months, prefeasibility studies were completed in four priority areas in Batangas, namely hazardous waste, municipal solid waste, ship and port waste and agricultural waste. The studies were implemented under the direction and coordination of the local multisectoral technical working groups. Technical options and financial and economic analyses were completed and promoted among the sectors. The estimated costs of waste management facilities and services were developed for each sector. Individual entities, including the 32 municipalities of the province, soon recognized that they could not afford the required waste management services. Collectively, however, it was demonstrated that the quantities and types of waste available across the province could be of commercial interest (see Figure 3). It was also confirmed among the local government units that privatization of services was not an acceptable alternative. A joint undertaking, which would keep the public sector involved as a facilitator, regulator and part owner, was preferred. In October 1998, an agreement was reached among local stakeholders in the public and private sectors to proceed to the next stage of the public-private partnership development process.

Figure 3. Waste Generation in the Province of Batangas.



1 tonne = 1 metric ton

Stage 2: Packaging and Promoting Opportunities

Two key actions were implemented during Stage 2. The first involved the development of an information package on the Batangas situation that would be attractive to investment groups, private operating companies, venture capital groups and commercial banks. The second required identifying which of these groups were interested in environmental projects in the Philippines, and public-private partnership as an alternative to the traditional tendering and contractual relationship with the public sector. Box 1 presents the profile of a private sector partner.

Box 1. Profile of a Private Sector Partner (generic).

1. Good business track record
2. Regional history/experience
3. Technical/scientific capability in project area
4. Financial backing/access to financing
5. Project startup and delivery experience
6. Demonstrated willingness to work within the PPP process
7. Technology transfer and capacity building capability
8. Evidence of proven technology and/or services

Four investment opportunity briefs were prepared by the GEF/UNDP/IMO Regional Programme in conjunction with the local public and private sectors, focused on the four priority waste areas. The briefs were a consolidation of information on the quantities and nature of wastes being generated, 20-year projections on economic and population growth and predicted waste volumes, cost estimates of alternative technologies and servicing options, current market prices for recycled materials within the Philippines, and an analysis of the *Integrated Coastal Management Contingent Valuation Survey in Batangas Bay* (Tejam and Ross, 1997). This last component reviewed the general public's willingness to pay for improved waste management services in Batangas.

Sustainable Project Management (SPM), an international NGO working in collaboration with the United Nations Development Programme, addressed the second action. Through a global network of investors, venture capital groups and operating companies, SPM was able to secure interest from parties in North America, Europe, Asia, Australia and New Zealand. Commitments were made by these parties to participate in an Investors' Round Table, to receive a briefing on the investment opportunities, to discuss the opportunities with the local partners, and to learn more about the terms and conditions of the PPP process. Thirty-two representatives from private investment groups and companies attended the Investors' Round Table held in Manila in November 1998.

The Investors' Round Table provided the private sector with a clear indication of the available opportunities. Two other issues were affirmed during the event as well, namely: a) political will and commitment of local stakeholders; and b) transparency of the PPP process. The public sector's consideration of key requirements for prospective private partners was outlined to all participants, as was the process to be followed for the selection of partners. It was further emphasized that the Regional Programme would serve as focal point between the public and private sectors throughout the selection process, and that both SPM and the Regional Programme would oversee the process to its completion. A time schedule was delineated for each stage of application and review. The entire process was to be completed in four months.

Stage 3: Selecting a Private Partner and Establishing a Mixed-Ownership Operating Company

In March 1999, a consortium of four New Zealand companies was identified as the successful candidate among a total of six companies submitting expressions of interest on the individual projects. The New Zealand group satisfied the selection committee's prerequisites for a private partner. Second, the consortium's proposal encompassed all four waste streams, presenting a strategy for leveraging revenues generated from one stream to offset the cost of another less lucrative stream. In addition, the New Zealand submission made in-roads with the selection committee by acknowledging the political and social sensitivities that arise with the introduction of a new scheme or system affecting the general public. Issues such as location of facilities, displacement of people, disruption of informal waste recycling enterprises, traffic congestion, employment of local firms and labor and provision of affordable services were given high consideration by the local stakeholders. The New Zealand consortium proposal indicated awareness of the issues and an openness to inclusion of these points as part of the feasibility study for the project.

Initial negotiations between the public and private sectors, prior to the signing of a Memorandum of Agreement, are currently focusing on several points of clarification and confirmation. From the private sector's viewpoint, the role, responsibility and *modus operandi* of the public sector during the feasibility study, leading to the formation of a mixed-ownership operating company, required definition. On its part, the public sector wanted further assurances regarding the consortium's member companies, the proposed technologies and the coverage to be provided by the new waste management service.

Undoubtedly, there will be future lessons for both parties to this partnership as Stage 3 of the PPP process unfolds. Each party is looking for benchmarks that will satisfy their respective constituents. The mindset of the public and private sector players, however, is clearly one of confidence, in terms of the partnership and the integrated waste management system and their viability in Batangas. Box 2 details the steps in selecting a private sector partner.

Box 2. Procedure for Selecting a Private Sector Partner.

1. Establish a multisectoral selection committee, comprised of appropriate local stakeholders from the public and private sectors.
2. Invite interested companies to submit company profiles in line with the stated private partner criteria.
3. Review company profiles and shortlist potential partners.
4. Invite shortlisted companies to submit formal proposal, based on a descriptive outline provided by the selection committee.
5. Review proposals submitted by companies, and screen potential partners.
6. Invite screened potential partners to make an oral presentation to the selection committee.
7. Committee assessment and consensus on the selection of a private partner, based on written and oral presentations.

Conclusion

Waste management is a critical issue in the Province of Batangas. The application of an alternative delivery system, through a public-private partnership process, is an innovative concept for the Philippines and for other East Asian countries. Although the process is still evolving in Batangas, significant progress has been made. Stakeholders on both sides are committed to the successful conclusion of the initiative. It is hoped that the accumulated knowledge and experience from the PPP as applied in Batangas will serve as practical lessons for others, particularly for those local government units in similar circumstances elsewhere in the East Asian Seas region.

REFERENCES

Carr, G. 1998. Public-private partnerships: The Canadian experience. Presentation to the Oxford School of Project Finance, 9-11 July 1998, Oxford, England.

MPP-EAS. 1996. Integrated waste management action plan for the Batangas Bay Region. MPP-EAS Technical Report No. 9, 66 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

MTE (Multidisciplinary Team of Experts). 1996. Coastal environmental profile of the Batangas Bay Region. MPP-EAS Technical Report No. 5, 148 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

PG-ENRO (Provincial Government of Batangas-Environment and Natural Resources Office). 1996. Strategic environmental management plan for the Batangas Bay Region. MPP-EAS Technical Report No. 3, 71 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Tejam, C.S. and S.A. Ross. 1997. Integrated coastal management (ICM) contingent valuation survey in Batangas Bay, Philippines. MPP-EAS Technical Report No. 13, 52 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Small and Medium Enterprises in Ship and Port Waste Management: Challenges and Opportunities

Lex Hemelaar

WASTE - Advisers on Urban Environment and Development
Nieuwehaven 201, 2801 CW Gouda, The Netherlands

HEMELAAR, LEX. 1999. Small and medium enterprises in ship and port waste management: Challenges and opportunities, p. 173-177. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

In developing countries, the port authorities are preparing for the establishment of an environmentally sound ship and port waste management system, as required by MARPOL. More and more, the private sector is regarded and approached as a partner to participate in this.

The Urban Waste Expertise Programme (UWEP) is funded by the Netherlands Development Assistance and executed by WASTE. UWEP's objective is to examine, analyze and document the existing ship and port waste management system in developing countries, focusing on the role of small and medium enterprises (SMEs). Research by UWEP has revealed that SMEs are very active in the port environment. However, they are often not acknowledged as a serious partner when it comes to the establishment of public-private partnerships in waste management. The tendency is to approach large enterprises.

UWEP has the opinion that the participation of SMEs in the port and ship waste management system is an opportunity which the port authorities should seriously consider. The main contribution of SMEs stems from the fact that they are well-established in the market for recycled products simply because they are part and parcel of the resource recovery sector and maintain close links with others in this network. The port authorities could take advantage of that, since capturing the value of recyclable waste materials could lead to a reduction in the port waste management cost.

THE LEGAL FRAMEWORK

The International Maritime Organization (IMO) is a United Nations body mandated to ensure navigational safety and prevent marine pollution from shipping related activities. The IMO drafts and promotes the adoption of rules, regulations and conventions. The legal framework for ship and port waste management is internationally regulated by the MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978) regulations.

Ship and port waste management refers to the on-board generated waste of vessels and the waste generated by activities in the port area. The MARPOL regulations stipulate that ports have to cater for environmentally sound port reception facilities at which vessels can dispose of various kinds of waste. Nations are encouraged to ratify these regulations and to modify the national legal framework accordingly. National port authorities are, therefore, under international pressure to upgrade port operations to meet the MARPOL standards.

However, the reality is that many ports in developing countries have not yet lived up to this standard, because of technical, financial and institutional impediments. In improving the prevailing system, one of the first steps is the development of a waste management strategy, including options for prevention, storage, collection, recycling and disposal. Although the MARPOL regulations prescribe the establishment of an environmentally sound system, it leaves the system choice open and dependent on local conditions as well as on the nation's waste management policies. IMO provides assistance to port authorities by issuing guidelines and providing training for people responsible for waste management in the port and on ships.

SHIP AND PORT WASTE IN UWEP

WASTE decided to include ship and port waste management in UWEP, because:

- Ports are places where large volumes of waste are generated and landed in a relatively small area;
- The economic value of the waste materials is relatively high, including oil residuals, plastics, paper, dunnage, etc., and therefore offers opportunities for income generation and employment;

- Being a planned and delineated area, a port environment offers good possibilities to arrange for reception facilities allowing for onsite separation and, possibly, further processing; and

- The port environment offers a good institutional setting for establishing public-private partnerships in waste handling, thereby recognizing the contribution that SMEs already have or could have.

Of special interest for UWEP is to examine how the basic informal waste management activities of SMEs can be attuned to the international legal framework set by the MARPOL regulations. UWEP initiated case studies in the port of Medan, Indonesia; the port of Karachi, Pakistan; and the ports of Vacamonte and San Cristobal, Panama. All the case studies were executed by local researchers.

Conclusions from the UWEP Case Studies

The UWEP case studies, discussions with resource persons and a review of literature indicated that:

- Community-based organizations and NGOs seldom participate in the port waste management system;

- The SME private sector is quite active in the port environment in Africa and Asia, but seems to be marginal in Latin America;

- SMEs are often not authorized to operate in the port environment, but are tolerated as long as it does not hinder crucial port operations;

- Not many port authorities and hardly any of the SMEs have established environmentally sustainable waste management practices, the absence of which results in the deterioration of the coastal zone environment;

- SMEs are seldom considered serious partners in the establishment of an environmentally sound waste management system in the ports; and

- There is a clear link between the informal waste recovery activities in the port area and the recycling sector outside the port area. However, the link between the port waste management system and the adjacent city waste management system is often vague.

The case studies showed that SMEs operate in three areas. First, the entrepreneurs who collect waste oil and oily bilge water using tank trucks. The waste oil is recovered and sold at considerable profits as lubricating oil or fuel oil, or refined into a higher grade. However, separation of oil and water is seldom done in a responsible way, resulting in large amounts of oil disposed into water and land bodies.

Second, SMEs are engaged in the collection of recyclable solid waste fractions. These are mainly individuals, often laborers taking residuals like packing materials with them when leaving the port area. While this is not permitted formally, it is often tolerated by port officials. Subsequently, the recyclables enter the resource recovery sector when sold to intermediate buyers.

Third, in a number of instances the collection of solid waste is contracted out to small-scale cleaning services that employ laborers and simple equipment for the operation of the service.

Small and Medium Enterprises: A Forgotten Partner?

As mentioned above, one of the most important challenges that ports in developing countries face nowadays is the protection of the marine environment. In many countries, the responsible authorities are preparing themselves for the establishment of an environmentally sound ship and port waste management system, as required by MARPOL. More and more, the private sector is regarded and approached as a partner to participate in this. UWEP's research has revealed that SMEs are very active in the port environment. However, they are often not acknowledged as a serious partner when it comes to the establishment of public-private partnerships in waste management. The tendency is to approach large enterprises to manage the ship and port waste, in some cases even to introduce foreign companies.

UWEP believes that the participation of SMEs in the port and ship waste management system is an opportunity which the port authorities should seriously consider. The main contribution of SMEs stems from the fact that they are well-established in the market for recycled products, simply because they are part and parcel of the resource recovery sector and maintain close links with others in this network. The port authorities could take advantage of that, since capturing the value of recyclable waste materials could lead to a reduction in the port waste management cost. In an urban economy perspective, the participation of SMEs means the generation of income and employment inside as well as outside the port.

Policies and Strategies

At present, the survival of SME activities in ports in developing countries is at stake. There is an imminent threat that SMEs will be ousted from port areas and will be overwhelmed by large private companies. This would result in depriving small entrepreneurs and their staff of their current business, while there is an international recognition that the SME sector is often the motor and the main employment generator in urban economies in developing countries. Moreover, neglecting SMEs will forego the opportunity of an optimal resource recovery and thus a reduction of system cost.

Policies and strategies that promote and facilitate SME participation in the ship and port waste management system are needed. It should be stressed, however, that the involvement of SMEs should not be pursued at the expense of the environment. Therefore, investment and capacity building programs are required to improve the environmental performance of SMEs.

UWEP's thrust will be to further advocate the case of SMEs in ship and port waste management and to support activities that consider SME participation.

Catalyzing and Sustaining an Industry Contribution in Integrated Coastal Zone Management Programs

John Lemlin[1]
Richard Bavister[2]
John Kearns[3]
John Fricker[4]
Mario Camarsa[5]

Environmental Management International Limited (E.M.I.L)
7 Orchard Gardens
West Challow, Wantage Oxfordshire OX12 9TL
United Kingdom

LEMLIN, JOHN, RICHARD BAVISTER, JOHN KEARNS, JOHN FRICKER and MARIO CAMARSA. 1999. Catalyzing and sustaining an industry contribution in integrated coastal zone management programs, p. 178-192. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The leaders of the industrial revolution in Europe and the United States cared little for the environmental impact of their industrial enterprises. Perhaps they knew even less about the short- and long-term impact of their activities. Certainly, they will have had no appreciation of the capacity limitations of the global environment to sustain an ever-expanding level of industrial and commercial activity. Times, awareness and attitudes have changed. What has not changed, however, is the continuing escalation of worldwide industrial activity to satisfy demands created by the huge growth in human population worldwide in the last half of the 20th century.

1 *7 Orchard Gardens, West Challow, Wantage Oxfordshire OX12 9TL, United Kingdom*
2 *Wildwood House, Buckers Hard, Beaulieu, Hants SO42 7XD, United Kingdom*
3 *Ordhead, Inverurie, Aberdeenshire AB51 7RD, United Kingdom*
4 *Coachman's Cottage, Berghers Hill, Wooburn Common, Bucks P10 0JP, United Kingdom*
5 *1 Meadow Close, Goring-on-Thames, Berks RG8 OAP, United Kingdom*

Much of the industry's operation and its development now takes place with a genuine care and regard for environmental concerns and issues. Nevertheless, its activities and performance still appear to represent a battlefield between environmentalists, government environmental agencies and the industries concerned. Industry credibility on environmental issues remains very low.

This paper explores the reason for this ongoing, unproductive confrontation. It takes the concept of partnership in coastal zone management programs to illustrate a pathway towards a more harmonious relationship between all stakeholders. It demonstrates the benefits that can flow in terms of cost-effectiveness, environmental improvement and sustainable economic growth.

COASTAL ZONE MANAGEMENT: A MAJOR CHALLENGE FOR THE 21ST CENTURY

Integrated coastal zone management (ICZM), sometimes termed integrated coastal area management (ICAM), or integrated coastal management (ICM), is a process of managing coastal environments in a sustainable way.

Many view ICM as the best process for managing the coastal environment. The Convention on Biological Diversity (CBD) in Jakarta mandates that: "integrated marine and coastal area management is the most suitable framework for addressing human impacts on marine and coastal biological diversity and for promoting conservation and sustainable use of this biological diversity."

Many recognize that, within the ICM processes, there is the need to involve a wide range of stakeholders, including industry. One of the CBD subsidiary bodies has defined integrated marine and coastal area management as follows: "Integrated marine and coastal area management is a participatory process for decision-making to prevent, control or mitigate adverse impacts from human activities in the marine and coastal environments and to contribute to the restoration of degraded coastal areas. It involves all stakeholders, including: decision-makers in the public and private sectors; resource owners, managers and users; non-government organizations; and the general public."

Much has been written about how best to carry out ICM processes. Many guidelines exist, just a few of which are included in this paper as references (Clark, 1992; World Bank, 1993; Pernetta and Elder, 1993; Post and Lundin, 1996).

Normally, the initial step in the ICM process is to inventory coastal and marine resources, list their uses and identify the effects of such uses. Having completed this work, various stakeholders can then negotiate towards a management plan along with the associated monitoring.

Deciding on the details of the management plan (i.e., exactly what should be done and where) in order to manage the coastal environment is generally recognized as the hardest part of the process. The question of what needs to be done involves some degree of trade-off between environmental, social and economic issues. One such issue may be the need to protect ecologically critical habitats to ensure that resources remain available for continued sustainable use. A second may be the need to assess the extent and relative importance of various threats, including, for example, all land-based sources of degradation such as sewage runoff or inherently destructive processes such as dynamite fishing. The key question of where action should be taken often involves identifying specific geographical areas for the creation of marine protected areas. The criteria for pinpointing these areas will generally include estimates of ecological importance (species richness, productivity and the degree to which important ecological processes are concentrated in an area) as well as quantification of direct and indirect threats.

Whatever plan is eventually agreed upon, the process for priority setting should bring together all stakeholders. These may include biological and social scientists, citizen's groups, nongovernment organizations, resource conservation and use managers, local and indigenous communities and user groups such as industry.

Unfortunately, it is often the case that ICM processes proceed without the involvement of industry. Even in cases where industry is involved, it is often not perceived as an equal partner. Many industry fears about ICM stem from a suspicion that it will be used to support some pre-judged outcomes. Many see ICM as inevitably leading to more 'no go' areas even when other tools (cleaner production targets, risk reduction plans, etc.) could achieve comparable ends.

Having said this, some ICM processes are highly effective. The work of Dr. Chua Thia-Eng and his team, under the auspices of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, has made a major contribution to the development of a structured approach to ICM, along with the constructive involvement of industry.

This paper does not intend to suggest that existing and extensive methodologies should be challenged. Rather, it aims to encourage critical discussion on the means by which industry can become more constructively engaged in integrated coastal management.

A Background to Coastal Development

Why is concern for the coastal zone of such global importance as one moves into the 21st century? It was not the case a century ago when similar pressures on the coastal zones of the now developed economies were taking place—industrialization on a massive scale and shifts of population to the new centers of industry which for strategic and economic reasons were frequently situated along the coast. Pollution discharges to the aquatic environment were damaging to the beaches and other marine-related coastal zone features and natural resources, but did not appear to raise public concern.

There are perhaps four key reasons:

- In global terms, industrialization in the North American East Coast and Northern Europe in the late 19th and early 20th centuries was limited geographically and small in size compared with the global economy of today's world;

- The magnitude of population pressure was far removed from the multibillion population pressure the 21st century will have to manage especially on developing economies;

- Scientific appreciation of the environmental and health effects of polluting discharges was extremely limited and there was little or no historical experience to draw upon; and

- Economic growth and development was the priority for government, industry and society at large—environmental concern was not an issue.

Today, the global coastal zone is under huge pressure. Nearly 4 billion people in the developing world now live within 60 km of the coastal zone, and an even greater percentage of the 8-10 billion people estimated to populate the globe by 2020 will live, work, play and die within the narrow coastal belt of virtually every country in the world. Many of them will be concentrated in the megacities that are expected to characterize the 21st century world.

The coastal zone will also be host to the massive growth of public and private sector industry, commercial activity and related transportation systems needed to sustain the growing demands for better quality goods and services. The fact that this escalation of coastal zone pressure is taking place at a time when environmental issues are moving towards the top of social priorities, provides one explanation for the increasing focus on integrated coastal zone management. At the same time, scientific development has provided the capacity to measure and interpret the effect of polluting emissions over an ever-increasing global reach. Moreover, the role of the sea in affecting the world's climate as well as in food production is being given greater recognition. Finally, societal pressures have created a level of political will to encourage and support action which was clearly not present 100 years ago.

WHAT IS INDUSTRY'S INVOLVEMENT?

What of industry? How has industry's position changed? Perhaps, more importantly how had society's perception of industry changed—if at all? Why indeed is there a need for a paper to a Conference on Integrated Coastal Management on "Catalyzing and Sustaining an Industry Contribution?"

Why, in December 1998, did a World Bank International Workshop on Clean Air for Latin American Cities and the Phasing out of Lead from Petrol not seek the participation of the Latin American Petroleum Industry—an oversight or failure to recognize a key stakeholder?

Why, in an otherwise excellent World Bank paper on Guidelines for Integrated Coastal Zone Management, edited by Post and Lundin (1996), does the reader fail to find the word 'industry'? Indeed the following text appears in the paper, "in many cases long-term planning and sustainability is not in the primary interest of the private sector!"

Why, in the work that International Petroleum Industry Environmental Conservation Association (IPIECA) carried out with IMO during 1990-1996 (Lemlin, 1997) on Oil Spill Response Contingency Planning—surely an issue of coastal zone significance—did we discover that in the majority of the 100 countries involved, studies which had been done were without reference to the involvement of industry, in this case, the petroleum and shipping industry?

Why, during discussions in more than 20 countries in Southeast Asia and Latin America on the topic of Urban Air Quality Management, was scant evidence found in many UN Agencies, World Bank and other donor agencies studies of the inclusion of industry in their fact finding and analyses?

Why, when the evidence of national and international legislative negotiations on environmental issues highlights the capacity of industry to develop and present scientific studies of a scope and depth equivalent to the best academic work, and to contribute to discussions regarding the development for new regulations, is industry not welcomed at the table with other stakeholders on environmental issues, particularly integrated coastal zone management?

These facts are replicated around the world. They are a serious source of concern to industry and should be to government agencies. They are the reason why the topic of catalyzing and sustaining an industry contribution to national, regional and local environmental issues is important. The conference presents a unique opportunity to examine these issues within the context of ICM.

Although this paper draws on the collective experience of the petroleum industry, it could equally apply to the chemical, plastics, iron and steel, mining or agricultural industries and much other science and technology-based fields.

The Evolution of Environmental Concern and Industry's Involvement

Serious public awareness and debate on environmental issues can possibly be linked to Rachel Carson's (1962) powerful essay "Silent Spring", which reinforced a very negative, if not wholly justified, public perception of the industry's environmental track record.

The debate has continued to evolve. It was reflected in the formation of the United Nations Environment Programme in 1972 and took a dramatic step with the 1992 United Nations Conference on Environment and Development in Rio de Janeiro. The conference, with its emphasis on sustainable development, captured the attention of governments worldwide and its output continues to provide encouragement for sustainable environmental development as the foundation for economic and social growth.

So, has not the petroleum and other industry's position changed in the context of these developments? The experience is that, industry has often been at the forefront of changes in environmental management for the very good reason that it recognized many years ago that sound environmental management made sound business sense.

As early as 1959, the World Petroleum Congress was dedicating time to environmental presentations. In the context of today's debates on environmental issues, the industry could, with justification, be seen to have taken an early lead. A Shell UK executive W.W. Kirby, presented a paper to the 1959 Congress entitled, "Pollution Prevention through Design and Operation". Forty years on, when "cleaner production" has become an international buzzword, it is worth quoting his paper:

> *"Pollution control is not merely a matter of devising methods and equipment for solving pollution problems as they arise, but it is more properly a subject in the design of 'refineries and refining plans'" and further "when new plans are being developed, it is of the greatest importance to foresee the sort of problems that are likely to arise. Then, by careful selection of processes, by the correct selection of equipment, and methods of operation, to eliminate pollution at source."*

Farsighted thinking indeed in 1959. But perhaps, this example provides one of the first clues as to why industry is perceived to have a negative attitude towards environmental issues. We can only speculate. The paper was presented by an industrial specialist, to the industry's most prestigious international forum for the petroleum industry. It was unlikely that the paper or the management philosophy behind it was ever drawn to the attention of the public. Environment was not a media issue in 1959. *Torrey Canyon* in 1968, the world's first major marine oil pollution incident had yet to happen.

A paper by IPIECA, E & P Forum and Oil Companies International Marine Forum (OCIMF) to the 1997 World Petroleum Congress in Beijing (Lemlin et al., 1998) presented an extensive portfolio of the petroleum industry's achievements since 1959 to mitigate the impact of its operations on the environment.

In recent years, the industry has made substantial efforts to communicate its work on environmental impact management. But predominantly for 'in house' publications, less frequently at open international conferences. Rarely is its work on "cleaner production" technology development exposed to the rigors of academic scrutiny and review. The reason is the commercial value/competitive advantage associated with such development work often involves millions of dollars of research and development effort.

Nevertheless, in the same time period industrial operations have experienced accidents which resulted in significant impact on the local environment. The most visible are the marine pollution incidents resulting from oil tanker accidents.

Thanks to media, the public sees marine pollution incidents as the unacceptable face of the petroleum industry. Sadly, people are all victims of the media view that "bad news" is good news and "good news" is no news. Thus, all the successful environmental developments flowing from the application of industry science go unnoticed and unreported.

A similar story could be told for each facet of the industry's operations from oil and gas exploration to retail marketing of gasoline, diesel fuels and lubricants. The industry is justifiably proud of its scientific, technological and engineering achievements. Why then, on those occasions, when it deploys that expertise in the public domain, is it overlooked by the media, governments, environmental groups and through them, the public at large. It is rejected as biased, unsound and unworthy of inclusion in the public debate. That is why industry is not automatically invited to participate in international and national programs addressing environmental issues.

So What has Contributed to the Public's Negative Perception of Industry's Environmental Role?

Before exploring how best to change this negative attitude, it is first necessary to try to understand why industry's scientific capability to contribute is often rejected at the outset. The reasons are explained why in many countries the general public, other than shareholders, are likely to be unaware of how high the quality of scientific research and development has simultaneously contributed to commercial success and reduced operational and product environmental impact. There are three kinds of occasion when the industry's scientific capabilities are typically placed on public display.

- To justify an activity which the industry wishes to undertake but which government agencies, the environmentalists and the public do not support (i.e., oil/gas exploration activities in sensitive areas of the environment).

- To provide an interpretation of the short-, medium- and long-term environmental impacts of an operational accident (i.e., small portfolio of major oil pollution incidents since the *Torrey Canyon* accident in 1968).

- To promote an industry view of the implications for the environment and for its commercial operations of proposed health and environment and safety legislation (i.e., on product quality issues such as removal of lead and benzene from petrol).

The industry position in each situation is based on two platforms where it feels most secure—sound science and rigorous analysis of data and careful in-depth economic analysis.

From the environmentalist, the media and public perspective, the industry position is not scientifically or economically based, but draws upon a sense of outrage from their own value judgments. Economic distress arguments from an industry perceived to be so gigantic and economically successful are also unlikely to be given little credence.

According to the general public, the industry's presentation of its scientific strengths is only apparent when it wishes to undertake a new activity or to sustain an existing operation or product in the face of public fears, concerns and potential outrage. Again, from the public perception, the industry's arguments are seen as confrontational and presented as a challenge to government or environmentalists.

Thus, the industry is seen to have made little effort to either understand or respond to public outrage. The industry's use of highly technical argument is itself perceived as threatening to the public which is for the greater part scientifically naive.

Opinion polls repeatedly demonstrate that on environment and environmental health issues, industry's credibility has the lowest ratings in contrast to the environmentalists who are frequently rated very high. The industry's reaction to such negative, or even hostile responses, has been a puzzle, a sense of being unfairly challenged when their careful objective-scientific analysis is rejected as a basis for decision-making.

The Elements of the Credibility Gap

If our analysis of the situation is correct, then here are some of the elements that contribute to the 'credibility gap':

- The industry is scientifically based. It owes much of its commercial success to the application of science to improve its processes and operations. There has been a coincidental environmental benefit, although the environment *per se* was not the main driving force. Indeed, there was a recognition, many years ago, that introducing environmental performance factors could make sound economic sense;

- As environmental issues have assumed a higher public profile, the environmental benefits of industry's scientific/technological developments have been communicated, but only to in-house captive audiences;

- The industry has only deployed its scientific capacity in a reactive rather than a proactive way to respond to challenges to its current and proposed operations;

- Since the 'good environmental' performance stories have gone unremarked by the media, the public perception of industry's methods is a tool only used to respond to environmental issues which totally ignore their own sense of outrage; and

- The industry's 'valuations' on environmental issues are wildly different from public views and the public sees no obvious efforts to respond. Indeed, the industry's insistence on its use of science in presenting its own side of the case is sometimes perceived as an additional threat.

Criteria for Bringing About Change

If this analysis is correct, it is little wonder that there are few examples of invitations for the industry to participate in environmental projects. In the context of ICM, the criteria that might have to be satisfied to initiate and sustain industry participation are as follows.

From a non-industry perspective:

- It is essential that representation is invited from the industries and activities are discussed that contribute to the quality of the marine environment and who will be affected by the development of new or more restrictive regulation;

- Industry should be viewed as a resource as well as a regulated activity;

- Industry representation should come from within the community, which is to be the focus of the ICZM, but with access to company-wide expertise and experience;

- Industry participation should not be conditional on acceptance of any predefined, non-negotiable aspects of the coastal zone environment;

- Industry should not expect to be funded for its ongoing contribution by donor agency monies;
- Industry should be prepared to consider providing resources to assist in non-industry related aspects of the coastal zone management study; and
- Industry should be committed to support the implementation of study findings even when they suggest that important remedial actions to be undertaken by the industry are necessary.

From an industry perspective:

- Industry should be considered as an equal partner with all the other stakeholders involved in developing the management plan;
- There should be defined common visions regarding the plan in terms of ultimate environmental goals and standards to which the community aspires—but unrestrained by time targets until cost implications are revealed by the plan;
- Industry should be prepared to consider providing resources to assist in non-industry related aspects of the coastal zone management study;
- Industry should not expect to be funded for its ongoing contribution by donor agency monies;
- The plan should be based on rigorous application of good science and data collection and analysis subjected to standard scientific principles and criteria;
- Industry should participate in the background work (identification of resource inventories and descriptions of resource uses and effects);
- Industry should commit its scientific/technical resources to the planning processes—and accept the cost associated with its contribution; and
- The solutions identified relevant to the problem should be rigorously tested for cost-effectiveness and presented as 'least cost' solutions for the community as a whole.

If these criteria can be agreed upon, there is every reason to assume that industry would be more willing to be a proactive and committed participant: (1) in ICM; (2) in urban air quality management studies; (3) in oil spill preparedness and response studies; and (4) in other environmental issues that raise concern for the involved community at large.

Catalyzing and Sustaining an Industry Involvement

What are the concrete steps needed so as to change the situation today? With industry frequently uninvolved in community environmental studies; with industry presented with solutions required to implement without either being aware of the study or the data upon which the conclusions are based; and with industry using its science and technology reactively to challenge or resist the proposals. Industry itself must take the initiative in bringing this change.

Working Together: The Way Forward

Taking guidance from the academic world and donor agencies and international bodies such as World Bank, UNEP, UNDP, etc., a positive, realistic and proactive starting point could be for industry to convene a Stakeholders' Workshop, with industry demonstrating its commitment to the process by funding the workshop. Ideally, the workshop would be sponsored by industry at large and not just by one industry sector. The purpose of such a workshop would be to provide a sound basis for the subsequent ICM process, and in particular to achieve the following:

- To enable representatives of the various stakeholders to meet in a non-confrontational situation;

- To help all the stakeholders understand the needs, aspirations, concerns and values of the various community groups within the context of environment and environmental health issues;

- To provide all the stakeholders an opportunity to become aware of studies completed, underway or planned as a result of which their own activities might be enhanced;

- To begin a process of confidence building and of breaking down the barriers that exist between industry and the community at large; and

- To begin the process of negotiating a sustainable involvement in, e.g., integrated coastal zone management plans.

Such an event may sound very simple to organize, but will require much effort, time and the involvement of facilitators with professional skills in catalyzing constructive interactions between the wide range of interests that such a workshop would successfully bring together. There is no doubt that the effort is worthwhile. Experience of such a meeting in Asia was captured in the words of a fairly aggressive environmentalist participant who said as his closing comment:

> *"Why have we never done this before—it is clear that so much more can be achieved if we can work together as this workshop has so clearly demonstrated."*

The same sentiment, if not the words, has been repeated at many other workshops in Asia, Africa, Europe and South America.

One should take a look in more detail at the methodology for setting up such a workshop and some of the development work that is interesting and potentially valuable.

The Workshop Process and Methodology

The objective of the Integrated Coastal Management Workshop would be to provide the basis for a comprehensive ICM process; particularly from the standpoint of data acquisition and identification of major issues that any management plan needs to address. It intends to identify the key players and stakeholders and invite them to contribute their views on the following three issues:

- Identification of resources that they can make available to the ICM process. These resources may be information (i.e., research reports, surveys, etc.), financial resources, or possibly expertise. The expertise may not necessarily be technical or scientific. Community groups are often the best source of 'on the ground' validation of the results of scientific studies;

- Identification of the range of concerns that exist with regard to ICM. Some of these concerns may relate to the consequences of the loss of species or ecosystem degradation, others may be associated with perceptions about specific industrial activities. Community groups may be concerned about jobs. Industry may be concerned about the economic implications of possible regulatory actions; and

- Identification of any underlying objectives that participants wish to achieve. These may include needs and aspirations of community groups. Industry groups may have economic hurdles that must be achieved for a project to go ahead. NGOs may have commitments that they have made to their members in terms of ecological protection. Government agencies may have goals implicit in international agreements to which they are signatory.

The intent would not be to try and solve these issues at the first meeting, or indeed to provide extensive justification for particular concerns and criticisms. Rather, to use the information gathered in order to provide a sound basis for the subsequent data gathering and negotiation process. The key to the success of this process is the need to identify those key individuals and organizations that are most involved and affected by any eventual coastal management program. It is obvious that the appropriate government regulatory agency is intimately involved in this decision. Equally, it is essential that the regulated industries as well as the academe be properly represented. Other interest groups (e.g., conservation bodies, fisheries, consumer groups, tourist agencies, port users) and other similar organizations should be invited to participate where their input and opinions are necessary to the decision-making process. Once an understanding of the key issues and the resources available has been gathered then the group can be enlarged as necessary and can move forward on a more detailed workplan.

Finally, it is evident that this process will not work without a little help. A properly designed and conducted workshop can produce the stakeholders' desired results. However, it does require professional input to explain the process, to engender the necessary atmosphere of trust and respect and to guide participants in a way that maximizes their contribution and sense of ownership. In many situations, it will seem strange and unusual for government agency personnel, ministers even, to sit alongside individuals from industry, the private sector as well as local community interest groups. With guidance from professional facilitators, it is possible to overcome this natural sense of uneasiness. With goodwill from participants, it is possible to achieve considerable success in this important field of marine management.

This paper ends with a conclusion from several oil spill contingency planning seminars referred to earlier:

"Effective environmental programs comprise a cooperative process involving government, industry and all others who share the risk and responsibility. It requires:

- An assessment of the risks and economic, social and ecological impacts;
- The development of credible, cost-effective response strategies;
- A clear definition and allocation of responsibilities; and
- A joint commitment by all parties to accept the responsibilities revealed as a result of working together.

References

Carson, R. 1962. Silent spring. Houghton Mifflin Co., Boston.

Clark, J.R. 1992. Integrated management of coastal zones. FAO Fish. Tech. Pap. No. 327. FAO, Rome.

Lemlin, J.S. 1997. IMO/Industry global oil spill planning initiative: An IPIECA perspective, p. 135-147. *In* S. Adrian Ross, C. Tejam and R. Rosales (eds.) Sustainable financing mechanisms: Public sector-private sector partnership. MPP-EAS Conference Proceedings No. 6, 352 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Lemlin, J.S., M. Cloughley and R. Oldham. 1998. Facing the future with confidence, p. 251-259. *In* Proceedings of the 15th World Petroleum Congress. John Wiley and Sons.

Pernetta, J. and D.L. Elder. 1993. Cross-Sectoral, Integrated Coastal Area Planning (CICAP): Guidelines and principles in coastal area development. A Marine Conservation and Development Report. IUCN, Gland, Switzerland.

Post, J.C. and C.G. Lundin, Editors. 1996. Guidelines for integrated coastal zone management. Environmentally Sustainable Development Studies and Monographs Series No. 9. World Bank, Washington, D.C.

World Bank. 1993. Noordwijk guidelines for integrated coastal zone management. Paper presented at the World Coast Conference, 1-5 November 1993. Noordwijk, The Netherlands. World Bank, Environmental Department, Washington, D.C. 21 p.

Public-Private Partnership for Animal Waste Management in Batangas Province

S. West Stewart

Philippine Bio-Sciences & Engineering Co., Inc.
Strata 100 Building, 10th Floor, Ortigas Center
Pasig City, Philippines

STEWART, S. WEST. 1999. Public-private partnership for animal waste management in Batangas Province, p. 193-200. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper highlights the benefits of public-private partnerships in the treatment and management of animal waste streams in Batangas, Philippines. Animal waste has been alleged to contaminate water and soil, causing serious public health concerns. The partnership supports the quality of life needs of Batangas citizens while safeguarding business opportunities for farmers and workers.

In November 1997, the Batangas Provincial Government joined with LIMCOMA (Lipa Multipurpose Cooperative and Marketing Association) livestock cooperative and Philippine Bio-Sciences & Engineering (PhilBIO) to establish viable animal waste treatment systems. PhilBIO will design, engineer and construct a central processing unit (CPU) demonstration site to accept LIMCOMA members' animal waste stream. In the process, PhilBIO's cost-effective treatment technology produces by-products such as methane gas, compost and feed supplements. Biological treatment of the waste will kill all pathogens, assuring improvements in public health.

The partners will form a joint venture to build and operate the CPU and sell and distribute the by-products.

INTRODUCTION

Agriculture is the traditional economic force of the Batangas Province, providing livelihood for a substantial number of residents. The climate and topography of the province have proven highly favorable for livestock and poultry production. Hog production alone is estimated at more than 325,000 heads.

The waste treatment and disposal options are varied and largely inadequate. According to agricultural experts, the carrying capacity of the land in terms of nitrogen loading from animal manure exceeds international standards in more than 25 cities and towns in Batangas.

The Department of Environment and Natural Resources (DENR) and third party analytical groups concluded that a considerable amount of the nitrite, nitrate and coliform bacteria contamination in the provincial creeks, streams and rivers is directly a result of improper waste management on swine and poultry farms. While legislation exists and is enforced in some municipalities, strict enforcement of the environmental laws would threaten the operations of hundreds of small- and medium-size swine and poultry operations.

An integrated waste management approach must be established in the area to preserve the natural environment. It is also important to maintain and enhance current and future job creation. Project studies advocate the establishment of new business opportunities for animal waste management by-products such as organic fertilizers, supplemental feeds for swine and fuel production, and the electrical, thermal and cold storage applications for animal manure biogas production.

Biogas from animal waste is usually rated at 60% methane (CH_4) and 38% carbon dioxide (CO_2). These two gases are the most invidious greenhouse gases said to be responsible for global warming.

The Provincial Government recognizes that there are significant direct economic benefits to raisers, their workers and families from the implementation of an integrated waste management system. A successful waste program should include:

- Support services from the government and cooperatives;
- Education and training in better waste and water management on the farms;

- Collection, transport and recycling of animal waste; and
- A marketing plan for by-products.

Philippine Bio-Sciences & Engineering Company

Philippine Bio-Sciences & Engineering Company (PhilBIO) is one of the leading firms in the Philippines in the design, engineering and operation of waste-to-energy systems. It operates in three basic markets: animal waste, municipal waste and food and beverage processing waste. The firm has technical and licensing agreements with several firms in the United States, Canada and the United Kingdom. One of the technologies that PhilBIO staff have executed in the past is a central processing unit (CPU) for animal waste. Animal farm owners contract the waste manager to collect and process waste streams. These are almost always liquid manure, and are taken by truck to a destination no more than 7 km from the site. At a central processing site, the liquid manure is ground and mixed to a uniform slurry stream and pumped into bioconversion vessels. The core technology for the CPU is thermophilic biological treatment in anaerobic reactors.

PhilBIO approached LIMCOMA, the largest cooperative in Batangas Province to encourage its interest in a joint venture activity to build and operate the CPU. In October 1997, the LIMCOMA Board of Directors agreed to execute a prefeasibility study to determine the viability of a CPU for animal waste. A demonstration site for the technology is the objective of the first phase study and proposal.

The Provincial Government of Batangas and the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas were approached by PhilBIO to join in the creation of a public-private partnership to carry out the CPU development. Local municipalities such as San Jose, with a high concentration of animal farms (whose owners are also LIMCOMA members) indicated their interest in developing the project.

PhilBIO intends to contract at least 15 farm owners in the San Jose area to develop the demonstration site. The waste-to-energy project envisions a total manure processing capacity of 10 tons* /day. Annual gas production is estimated to be 1 million m^3/yr. Total investment is estimated to be around $250,000. The CPU system consists of mixing tanks, at least two anaerobic digesters (tanks with plastic film as a medium) and a gas engine generator set.

* *1 ton = 0.907 tonnes*

Electric power and process heat will be available for customers, including the animal farm owners at a greatly reduced cost per kWh. Organic fertilizers for agriculture will also be processed for sale to fertilizer companies for further processing and packaging. The CPU will be a zero discharge facility. All wastewater from the processing of waste will be recycled. PhilBIO intends to have some high nutrient liquid fertilizer available for neighboring croplands. No wastewater will be discharged to the waterways.

Merits of the Technical Approach to Animal Waste

Animal Waste Generation in Batangas Province

Livestock and poultry in Batangas Province number more than 19 million total heads. About 90% of the population are found in the Fourth District including Lipa City and the municipalities of San Jose and Rosario. Ninety-six percent of the total population are chicken broilers and layers and 3.3% are swine. Of the major livestock groups, the swine population has increased the fastest, although the cattle population (somewhat smaller) is growing at twice the national average (Table 1).

Table 1. National Average Growth Rate for Animal Population in Batangas and the Philippines (1978-1993, Bureau of Agricultural Statistics).

Animal	Growth Rate for Batangas (%)	Growth Rate for the Philippines (%)
Chicken	2.45	2.80
Swine	6.96	2.28
Cattle	2.07	0.76
Carabao	(0.76)	(0.72)
Duck	30.58	4.78
Goat	(0.37)	5.19

Source: Department of Agriculture.

In terms of absolute numbers, chicken (broilers, layers and some free-range) in the province numbered 19,100,000 in 1996 and swine totaled 677,000 heads. Using historical growth rates, the total animal population in Batangas could reach 38 million heads (mostly chicken and swine) if waste and water management practices are improved.

In terms of animal waste generation, the following conversion factors can be used as benchmarks:

For Chicken:	0.1 kg/head/day
For Swine:	2.0 kg/head/day
For Cattle:	10 kg/head/day
For Carabao:	12 kg/head/day
For Goat:	1 kg/head/day

This translates into the 1997 estimates for annual waste generation by animal type (Table 2).

Table 2. Annual Waste Generation (in metric tons) for Animal Population in Batangas Province, 1997.

Animal	Total Waste by Animal Type (metric tons)	Percentage of Total
Chicken		34.90
• Broiler	325,137	
• Layers	193,637	
• Free-range	19,586	
Swine		
• Commercial	169,670	32.05
• Backyard	324,844	
Cattle		22.34
• Commercial	22,068	
• Backyard	322,551	
Carabao	111,234	7.21
Duck	N/A	N/A
Goat	23,418	1.52

Source: MADECOR (1997).

Biogas Production from Animal Waste Biological Treatment

Animal manure is a major natural resource for methane gas production. As most hogs are housed in feedpens in commercial operations in Batangas, swine is the most readily adaptable animal population for a biogas system. On swine and dairy farms in the United States, China and Europe, anaerobic digesters, so-called bioreactors, are used for both waste management and electric power generation. Other benefits of bioreactors include odor and pathogen control, environmental protection and thermal and refrigeration uses.

The biogas production is largely methane (CH_4). This gas has a British Thermal Unit (BTU) value similar to natural gas and can fire a natural gas fired engine or turbine. Biogas production can be utilized for the farm's electric, thermal and refrigeration needs. Table 3 shows an estimate for gas production from animal manure.

Table 3. Biogas Production by Animal Feedstock.

Animal Feedstock	Gas Production [1]	Electric Energy Production [2]	Thermal Energy Production [3]
Dairy cows (1,650 kg each)	1.75	100	40
Beef steer (400 kg each, fresh manure)	1.38	80	32
Beef steer (400 kg each, aged manure)	0.69	40	16
Poultry (100 layers, fresh manure)	0.85	50	20
Poultry (100 layers, aged manure)	0.43	25	10
Hogs (1 sow unit, 9 piglets)	1.2	80	28
Hogs (45 kg each)	0.1	6	2.5

[1] m^3/unit/day.

[2] kW/hour/1,000 units. Assume conversion efficiency of 25% via internal combustion engine; waste heat from engine used to heat generator.

[3] 1,000 mJ/day/1,000 units. Gross biogas energy production at 23 mJ/m^3.

Production is 80% with remaining 20% used to heat digester.

Market Potential for Organic Fertilizers

Composting of animal manure solids is a traditional method of waste recycling. Prior to World War II, most farming communities utilized organic fertilizer produced via composting. Today, inorganic processed fertilizers dominate the fertilizer markets. Still, organic fertilizer production is reviving through farmer and consumer education programs and gradual increases in production worldwide of reliable, standardized products for specific agricultural products.

In Batangas, many farms have been gradually converted to a manure system. Feed millers have diversified their products to include organic fertilizer products (from a combination of animal manure and crop residues). The products generated need to be developed as brand name products, with sales infrastructure support and service. Economies of scale in production and delivery of organic fertilizers are required to boost the production of quality, standard products while driving down the price per 20 kg bag.

The market for organic fertilizer production in Batangas Province should focus on the local markets of the province and nearby provinces of Quezon, Cavite, Rizal and the island of Mindoro (Table 4). However, the largest market for organic fertilizer is the vegetable bowl of the Cordillera Region in Benguet Province in the north. Benguet already purchases raw chicken manure from Batangas farmers. PhilBIO wants to promote a higher value-added approach to organic fertilizer production through the upgrading of the processing of the raw materials for easier handling by organic fertilizer companies.

Table 4. Target Markets for Organic Fertilizer Production from Animal Waste.

Commodity Market	Target Locations in the Philippines	1996 Estimated Planted Area in the Target Locations (in hectares)
Vegetable	Southern Luzon Provinces including Batangas, Quezon, Laguna	83,018
Fishponds	Central Luzon	9,197
Rice, corn, sugarcane and other major crops	Southern Luzon Provinces including Batangas, Quezon, Laguna	751,000
Total		**843,215**

Source: MADECOR (1997).

Agricultural growers of major crops should also be a major target group. In the local Southern Luzon Region, these growers include rice, corn, sugarcane, coconut and fruit orchards (Table 4). The cutflower market growers are also occupying a larger percentage of agricultural areas. These growers pay premium prices for existing inorganic fertilizers specifically engineered for individual flower species.

Fishponds (mostly milkfish and tilapia) use chicken manure for feed. A more concentrated and controlled production of chicken manure would enhance the product and make it more available to the fish farm population for protein conversion.

Public-Private Partnership

The Benefits

The public sector, the municipality of San Jose and the Provincial Government of Batangas work constantly with the local farmers and farming cooperatives to ensure that this important agricultural sector is supported. Animal farming is one of the top four employment groups employing over 35,000 people in various positions.

Public hygiene and water quality are also frequently addressed by the local governments. With limited funds, outbreaks of disease or water quality issues cannot often be addressed in real time. While the Department of Health (DOH) and the DENR maintain local offices, there is rarely enough money and man-power to respond to health or environmental problems.

In a private sector venture, the municipalities and/or the Provincial Government can act in real time to set up a company with responsibility for engaging in commerce that addresses the key economic, health and environmental concerns of the communities. For private sector entities such as LIMCOMA and PhilBIO, the public-private partnership with the local government(s) enables the establishment of a viable waste management enterprise. Waste material, off the farm, is a fundamentally public concern. To address this problem, given the huge number of farms and the scale of the manure issue, it is important to involve the public sector.

The CPU will go across municipal and barangay district lines. It will necessarily require a level of cooperation from the public sector. This cooperative spirit is needed to move the demonstration project towards completion. Once proven at the microeconomic level, the CPU will be expanded to take in more than 50 tons of manure slurry each day from local farmers. It is expected that achieving these economies of scale will permit the new venture firm to reach above average returns on investment. In other words, the public-private partnership assures bankability of the project, and expansion of the market for the technology throughout the province and possibly into other provinces in the Philippines and in the South China Sea Region.

Reference

MADECOR. 1997. Establishment of an agricultural waste management system for the Batangas Bay Region. Final Report to the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas. MADECOR Environment Management Systems, Inc., Los Baños, Laguna, Philippines.

A Contingent Valuation Survey on Willingness to Pay: Case Studies in Batangas, Philippines and Xiamen, China

Corazon L. Abansi

Batangas Bay Demonstration Project
PG-ENRO, Capitol Site, Batangas City, Philippines

ABANSI, CORAZON L. 1999. A contingent valuation survey on willingness to pay: Case studies in Batangas, Philippines and Xiamen, China, p. 201-207. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

A random survey of residents of the Batangas Bay Region, Philippines and Xiamen, People's Republic of China was conducted to determine the residents' support and willingness to pay (WTP) for environmental management programs that address key issues facing the two demonstration sites. The survey was also designed to assess the degree of public awareness and concern for environmental issues and disseminate information on the status of environmental resources in the two sites. The contingent valuation (CV) method was used which allowed for valuation of non-market environmental services by eliciting monetary values contingent upon a hypothetical market.

Results show that respondents in both sites are willing to participate in and pay for environmental programs that will benefit themselves and future generations. In Batangas, priority was given to fishery resources, garbage, coral reefs and sewage. For each program addressing these issues, the expressed WTP values vary. Prioritization of issues and the choice of WTP are significantly affected by socioeconomic characteristics, notably age, educational attainment and income.

In Xiamen, respondents attached utmost importance to sewage and solid waste, endangered species, fish resources and beaches. A large variation in WTP values was observed for each program addressing these issues. In general, educational

attainment, income and place of residence are the main factors affecting WTP for environmental services.

In both sites, the survey manifests a high degree of environmental consciousness among residents. As a research activity and management tool, the CV survey has proven to be a useful instrument to measure public support and general WTP for environmental management projects in Batangas and Xiamen.

Background Information

A contingent valuation survey was conducted by the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas in Batangas, Philippines and Xiamen, China (Figures 1 and 2). The survey was aimed at: (i) determining the people's support, priorities and WTP for environmental management programs that would address key resource issues facing the two sites; (ii) assessing their degree of awareness and concern for environmental issues; and (iii) disseminating information regarding the status of environmental resources in Batangas and Xiamen.

The survey was carried out in collaboration with the De La Salle University in Batangas and the Xiamen University in Xiamen. Respondents were strategically located through stratified random sampling and totaled to 1,902 and 1,496 in Batangas and Xiamen, respectively.

Profile of Respondents

The characteristics of respondents in Batangas and Xiamen generally correspond to the demographic features described in the Coastal Environmental Profiles of the two sites (Table 1; ITTXDP, 1996; MTE, 1996). In Batangas, respondents were almost equally divided between the male and female groups. Almost the same proportion was observed for single and married respondents. Majority (89.8%) were below 50 years, mostly in their teens or in their 20s. More than half were college graduates, implying a high literacy level. Average household size was six, with most of the respondents owning their homes and residing about 30 minutes away from Batangas Bay.

In Xiamen, males were dominant (63.7%) as well as married respondents (67.2%). The dominant age group was 25-34 years. Literacy was high with 35.6%

Table 1. Profile of Respondents in Batangas and Xiamen.

Profile	Batangas	Xiamen
Gender (%)		
Male	50.7	63.7
Female	48.6	36.3
Civil status (%)		
Single	47.6	32.8
Married	57.4	67.2
Dominant age group (years)	20-29	25-34
Educational attainment	College	College
Average income per month*	10,000 pesos	1,500 yuan
Average household size	6	3
Average length of residence (years)	26	21
Distance from water body (minutes)	30	15

* US$1 = ₱26 in 1997 = 8.07 yuan in 1998.

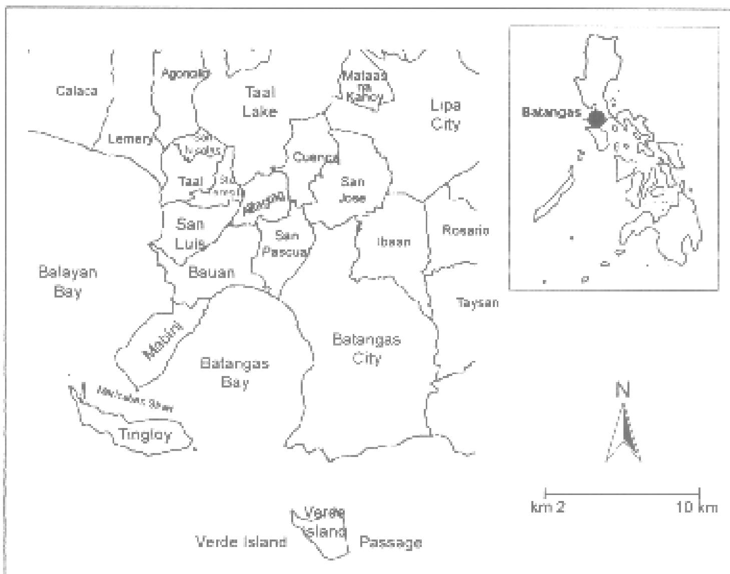
of the respondents being college graduates. Average household size was three, with 65.4% of the respondents owning their homes and residing at a distance not more than 15 minutes away from Xiamen waters.

CONTINGENT VALUATION SURVEY IN BATANGAS, PHILIPPINES

Environmental Awareness

As an indicator of environmental awareness and concern, respondents in Batangas were asked how important the issue of solid waste was to them, and whether they extend recycling activities outside those typically engaged in by their families. Results show that 91.7%

Figure 1. Map of Batangas, Philippines.



believed that the issue of solid waste was important with 62.3% recycling beyond the typical newspapers, used bottles and metals.

Respondents were also shown a picture of landfill, described as an alternative method of disposing of garbage using a more efficient sanitary procedure. Then, they were asked if they would be willing to support such a project, assuming that this would require a fee higher than the amount that they currently pay for garbage collection. Respondents were inclined to support a project that will collect 100% of their garbage for disposal in a sanitary landfill outside the barangay where they reside.

Which Environmental Program Should Come First?

Given a situation where they could influence which environmental programs would be implemented, respondents were asked to rank environmental programs according to the importance of specific resources and issues to them.

In Batangas, fish defined as food and source of livelihood for fishermen was ranked as the most important, suggesting food security as of the utmost priority. This was followed by garbage, which is a nagging concern especially for residents close to dump sites. Coral reefs came as third priority, described as the habitat and breeding ground for fish but associated by respondents with beaches, tourism and recreation. Finally, there is sewage, which is associated with problems concerning effluents from households and industries. Prioritization of issues is affected by the respondents' socioeconomic characteristics notably age, educational attainment and income.

Willingness to Pay for Environmental Management

Respondents were presented with four hypothetical environmental management programs, which should affect the condition of Batangas Bay in the year 2020. Respondents were asked to decide which type of program they would choose for implementation in relation to a specific natural resource or environmental concern, which includes fishery resources, coral reefs, garbage and sewage. Three scenarios were given: A, B and C; with A representing the status quo or no additional cost for implementation and B & C representing two scenarios with different costs. The weighted mean WTP of respondents were:

- ₱1,109.88 per year for a program that will conserve fishery resources;

- ₱1,069.40 per year for a program that will solve the garbage problem;
- ₱968.19 per year for a program that will conserve coral reefs; and
- ₱1,278.76 per year for a program that will treat sewage.

For fisheries, garbage and sewage, the choice of amount is affected by educational attainment, monthly income and place of residence. For coral reefs, age, education and income are the significant variables.

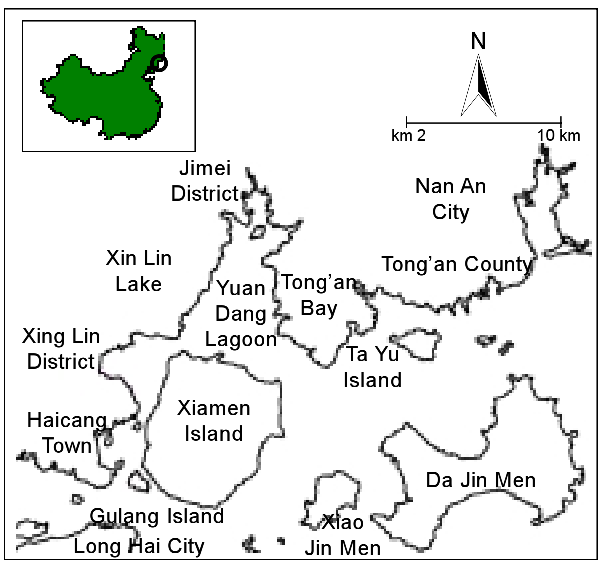
It is obvious that educational attainment and monthly income appear to be the overriding factors affecting respondents' WTP for environmental programs that protect resources and provide services. Educational attainment understandably contributes to environmental awareness and concern; while monthly income affects the respondents' willingness to shell out extra funds for a good cause.

Contingent Valuation Survey in Xiamen, China

Environmental Awareness

The residents of Xiamen exhibited a high degree of awareness and concern for endangered species, specifically the egret, dolphin and lancelet. There was overwhelming support from more than 90% of the respondents to set up preservation zones for the egret and dolphin. Respondents expressed their WTP for programs that would ensure the preservation of endangered species. They recognize the high cost of extinction of the egret, dolphin and lancelet in view of their significance to national heritage.

Figure 2. Map of Xiamen, China.



A similar concern for recreation sites was put forward by an overwhelming majority (91.4%) of the respondents.

Most of them expressed that they have taken part in activities designed to protect beaches and recreation sites and are willing to pay for programs that will attain this objective.

Which Environmental Program Should Come First?

In Xiamen, utmost importance was attached to sewage. Respondents hope to cling to the honor and distinction of having Xiamen as the model city for national environmental protection and cleanliness. Second priority was given to preservation of endangered species while fish resources was ranked as third priority. Beaches and water quality ranked last among the four programs prioritized for implementation. Prioritization of issues is affected by the respondents' socioeconomic characteristics notably educational attainment, income and place of residence.

Willingness to Pay for Environmental Management

The same scenario described in the Batangas survey was applied in the Xiamen survey of WTP for environmental programs. However, in Xiamen, the issues of interest were sewage, endangered species, fish resources and beaches.

The weighted mean WTP of respondents were:

- 59.5 yuan per year for a program that will conserve fishery resources;
- 47 yuan per year for a program that will preserve the endangered species;
- 77 yuan per year for a program that will conserve the beaches; and
- 101 yuan per year for a program that will treat sewage.

For all programs considered, the choice of amount is affected by educational attainment, monthly income and place of residence.

CONCLUSION

The survey reveals several views about waste management, fishery resources and coral reefs, endangered species and water quality, which are important for the successful implementation of the Batangas and Xiamen Demonstration Projects and other environmental management projects in the two sites. At the same time, the survey manifests a high degree of environmental protection awareness of the residents, and their participation and WTP for environmental programs that will benefit themselves and future generations.

The WTP figures should be considered with caution. It may be an indication of general openness to an increase in fees. However, a larger sample is required to get a stable WTP figure before upgrading an existing fee scheme or adapting a new scheme. The implementation of a new fee scheme structure should consider the change in income and educational attainment of the population.

References

ITTXDP (Integrated Task Team of the Xiamen Demonstration Project). 1996. Strategic management plan for marine pollution prevention and management in Xiamen. MPP-EAS Technical Report No. 7, 60 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

MTE (Multidisciplinary Team of Experts). 1996. The coastal environment profile of the Batangas Bay Region. MPP-EAS Technical Report No. 5, 148 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Voluntary Agreement on Waste Reduction: A Pilot Effort in Batangas Bay by the Private Sector

Frederick R. Contreras

Tabangao Refinery, Pilipinas Shell Petroleum Corporation
Tabangao, Batangas City, Philippines

CONTRERAS, FREDERICK R. 1999. Voluntary agreement on waste reduction: A pilot effort in Batangas Bay by the private sector, p. 208-215. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper summarizes the role of the private sector in the implementation of the Voluntary Agreement on the Integrated Waste Management Action Plan (IWMAP) in Batangas Bay, Philippines. The private sector, led by the Batangas Coastal Resources Management Foundation, Inc. (BCRMF), joined efforts with the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Department of Environment and Natural Resources (DENR), Provincial Government-Environment and Natural Resources Office (PG-ENRO) of Batangas, local government units (LGUs) and other stakeholders in addressing the growing concern on waste management and minimization in the Batangas Bay Region.

A brief summary of the accomplishments and status of the different provisions of the Voluntary Agreement on the IWMAP is presented, with particular attention on the waste reduction initiatives of the BCRMF member-companies.

Also included is an overview of the pollution management appraisal (PMA) process and the results of the pilot PMAs done on two BCRMF member-companies. The summary of the learning points during the implementation of the IWMAP and the pilot application of the PMA process is also presented in this paper. Lastly, an outline highlighting the future plans of the BCRMF in addressing issues on waste management and reduction is also presented.

Background

In 1993, Batangas Bay was chosen as one of the three demonstration sites of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas. The other demonstration sites are Xiamen, China and the Malacca Straits.

The GEF/UNDP/IMO Regional Programme developed a strategy on integrated coastal management which provides the framework involving major stakeholders in the coastal and marine resources management. With the GEF/UNDP/IMO Regional Programme's support, the Provincial Government of Batangas created the Batangas Bay Council for Integrated Coastal Management (BBCICM), later renamed the Batangas Bay Region Environmental Protection Council. The Council is composed of representatives from the GEF/UNDP/IMO Regional Programme, PG-ENRO, LGUs, BCRMF and other stakeholders in the Batangas Bay Region (BBR).

One of the accomplishments of the Council is the development of an IWMAP for the BBR. After a series of consultations, the major stakeholders arrived at a Voluntary Agreement aiming at reducing waste generation and improving waste management. In the case of the private sector, represented in the Council through the Batangas Coastal Resources Management Foundation, Inc. (BCRMF), the main responsibilities are the inventory of current hazardous waste generation, treatment, storage and disposal methods, and the implementation of waste minimization initiatives.

One of the waste reduction initiatives is the conduct of PMA at the facilities of the signatory firms. The PMA is an assessment tool that helps industrial firms identify cost-effective measures to substantially reduce waste generation, thereby increasing operational efficiency.

Integrated Waste Management Action Plan (IWMAP)

The Voluntary Agreement on the IWMAP is a result of the adaptation of the integrated coastal management (ICM) approach in the Batangas Bay Demonstration Project (BBDP). The ICM approach promotes sustainable development by addressing the environmental issues associated with the rapid industrial growth in the BBR.

The Voluntary Agreement on the IWMAP aims to strengthen the government and private sector's partnership in sustaining the rapid industrial growth by addressing land-based pollution sources. The said agreement was inked in September 1996 by the Provincial Government of Batangas, the DENR and the following BCRMF member-companies:

1. Babcock-Hitachi Philippines, Inc.;
2. Caltex Philippines, Inc. - Caltex Refinery;
3. ChemPhil Albright & Wilson Corp.;
4. Engineering Equipment, Inc.;
5. Petron Corporation - Batangas Depot;
6. Pilipinas Shell Petroleum Corp. - Tabangao Refinery;
7. Purefoods Corp. - Flour Division; and
8. Stepan Philippines, Inc.

The signatories have volunteered and committed to the implementation of the different provisions of the IWMAP. Among other provisions, those which concern the BCRMF member-companies are outlined in Table 1.

Pollution Management Appraisal (PMA)

The main provision of the IWMAP is the conduct of onsite PMA at the BCRMF member-industries that signed the Voluntary Agreement. The PMA process is a tool that identifies opportunities for reducing waste at source followed by possible reuse or recycling of whatever waste generated at the end-of-pipe. It also aims to identify cost-effective measures that would reduce waste and increase operational efficiency. It was designed with the support of the United States Agency for International Development (USAID) under the Industrial Environment Management Project of the DENR.

Table 1. IWMAP Provisions Concerning BCRMF Member-Companies.

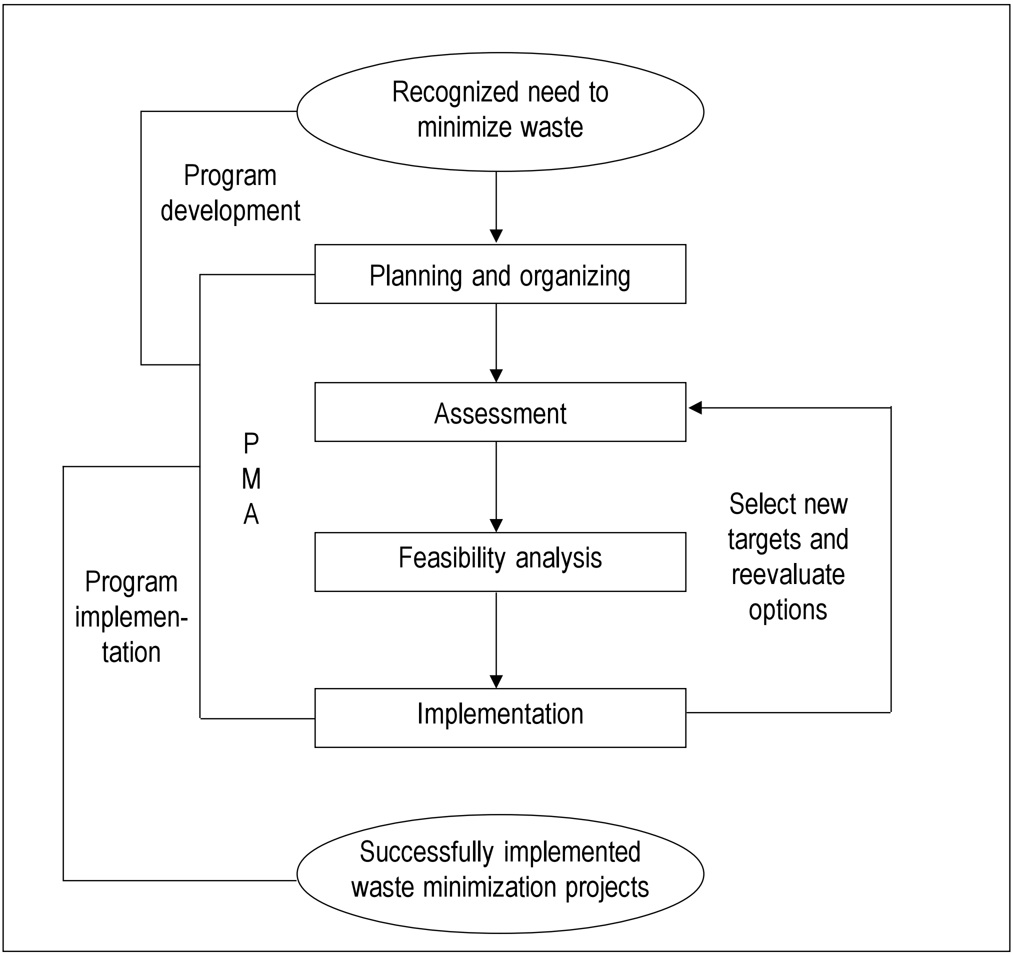
IWMAP Provision	Objectives	Status
A. Inventory of hazardous waste generators, transporters, storage, treatment, recycling and disposal facilities in the BBR	To identify common waste streams and their quantities. To identify existing treatment, storage and disposal facilities. To utilize only DENR-EMB accredited waste handlers/transporters.	Fourteen BCRMF member-companies have already submitted their existing waste inventory or database to the PG-ENRO. The other members are currently being followed up by the BCRMF Coordinator
B. Formation of a pool of experts in waste management among industries in the BBR	To have focal persons to tap for waste management initiatives.	Representatives from five BCRMF member-companies were trained and became members of the Council-PMA Team PMA & other environmental awareness courses are currently being arranged by BCRMF
C. Implementation of an industrial hazardous waste minimization program	To identify and optimize waste reduction opportunities and practices in industries in the BBR .	Onsite PMA facilitation done on two industries (EEI and ChemPhil) Ongoing monitoring and implementation of waste management options
D. Identification and technical and economic assessment of transitional technologies, practices and facilities for offsite hazardous waste processing and disposal in the BBR	To develop a series of practical options which may be implemented as interim measures for offsite processing and disposal of hazardous waste in the BBR.	Prefeasibility study undertaken by Tetra Tech EM Inc.
E. Preparation of a proposal concerning hazardous waste storage, treatment and disposal facility for the BBR	To identify common hazardous waste facilities for the industries in the BBR.	A selection committee was formed which evaluated possible partner for the common waste facility for BBR
F. Organization of a joint venture for hazardous waste facilities and services in the BBR	To develop and implement a centralized hazardous waste treatment facility.	Ongoing use of the public-private partnership model

PMA Methodology

The whole PMA methodology involves several stages (Figure 1). The first is to convince the management of an industry in recognizing that *waste is a measure of operational efficiency* that the more waste a company generates, the lower the operational efficiency of the plant. Also, *waste could be considered as a resource,* because the waste of one company may be a viable raw material for another.

The second stage is the organization of a PMA team that will do all the planning and preassessment work. This step usually involves review of the facility process and operations, waste management data, financial data and all other related information which can help in identifying waste reduction options.

Figure 1. The Pollution Management Appraisal Process.



An actual visit to the facility should be the third stage. This involves walk-through surveys and inspection of the plant to gain a complete understanding of the actual operations. Interviews and discussions of possible waste reduction options with all levels of management and labor should also be conducted in this step.

In the fourth stage of the PMA process, the suggested actions and improvements are screened to identify the viable ones. The final list of feasible options are presented to management in the fifth stage. After prioritization, a timetable for implementation is agreed upon.

Finally, a PMA monitoring schedule is prepared to facilitate followups on the status of action items. If the review reveals new action points that can still be pursued, the PMA team can go back to the assessment step.

Council-PMA Team

As part of the IWMAP, the Batangas Bay Environmental Protection Council formed and trained its own PMA team composed of the following stakeholders:

- Four representatives from PG-ENRO;
- Five representatives from the BCRMF;
- One representative from the DENR-CENRO; and
- Other representatives from the different LGUs within the BBR.

This Council-PMA team was trained by Tetra Tech EM Inc. and conducted pilot PMAs at two facilities in Batangas, namely EEI Corp. and ChemPhil Albright and Wilson. A Memorandum of Agreement was signed between the Council and the two companies outlining the roles and responsibilities of each party.

Pilot PMAs

The two pilot PMAs both showed positive results. The recommendations made were acceptable to the management and were indeed helpful in improving operational efficiency of both plants. Since the complete results of the PMA studies are confidential, presented here are some of the general findings and recommendations of the Council-PMA team:

- Reduction of production losses by increasing equipment reliability through preventive maintenance program;
- Reduction of raw material consumption during plant startups;
- Reduction of fuel use by eliminating/minimizing leaks and spillage;
- Reduction of effluent volume by minimizing dilution at the water treatment plant;

- Reduction of labor costs by minimizing reworks/reruns;
- Use of transparent roofing and light-colored walls to reduce lighting costs;
- Improvement of management control on material issuance and withdrawal;
- Replacement of mercury vapor lamps with halide lamps;
- Conduct of regular refresher courses to improve workers' efficiency; and
- Installation of power capacitor to optimize electrical consumption.

Most of the recommendations were low-cost or no-cost options although some involved capital expenditures. The potential savings of both plants based on the computation of the PMA team amounted to approximately ₱8.7 million per year.

Learning Points

Summarized below are the encountered problems, suggested approaches, successes and failures in the administration of the IWMAP and in the conduct of PMAs at the two sites:

- The Voluntary Agreement and continuous consultation during the development of the Action Plan were effective in getting the commitment of the BCRMF member-industries. However, only half of the original members of the BCRMF signed the Voluntary Agreement on the IWMAP;
- The diversity in the membership of the Council-PMA team, coupled with the support of the experienced staff of the participating industries, contributed to the overall success of the pilot PMAs;
- Vis-à-vis an onsite PMA, an environmental awareness campaign should also be conducted, not only within the management but more importantly among the workers who oversee the actual day-to-day operations;
- The documentation of the pilot PMA results took a considerable amount of time. Both the presentation of the action plan of the participating firms and

the schedule of PMA monitoring were also postponed several times due to lack of common schedule among Council-PMA team members; and

- The conduct of two pilot PMAs generated positive feedback from the participating firms. However, the public copy/version of the PMA reports still has to be finalized. This will be issued to the other BCRMF member-companies to encourage them to conduct their own PMAs or similar waste minimization studies.

Future Plans

The potential of the PMA process will be maximized by the BCRMF member-industries through a programmed application in their own sites using cross-functional teams consisting either of their own staff or representatives from the other companies. In parallel, the BCRMF will be offering other training courses on environment and waste management systems (e.g., ISO 14001, Industrial Air Pollution and Control, etc.).

The members of the Council-PMA team will be invited to participate in future PMAs as observers and advisors. There are already member-industries who have expressed their willingness to volunteer for the second batch of PMAs. Consequently, BCRMF will conduct the future PMA training and the actual onsite PMA in the facilities of the participating industries.

Lastly, other waste management and minimization techniques will be introduced to the BCRMF members such as the hazards and effects management process (HEMP) as an alternative to the PMA process.

Ports Environmental Improvement Project in Indonesia

Mattheus F. Sturm

DHV Consultants
P.O. Box 1399, 3800 BJ Amersfoort, The Netherlands

STURM, MATTHEUS F. 1999. Ports Environmental Improvement Project in Indonesia, p. 216-226. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Indonesia has long recognized the importance of protecting and conserving the marine environment of its coastal and adjacent international waters. In 1995, the Ports Environmental Improvement Project was initiated to extend existing initiatives of the government.

The project comprises three main components:

- *Ship wastes: Preparation of a program to equip all important ports in Indonesia with adequate facilities for the reception, treatment and disposal of ship-generated wastes;*

- *Disposal of dredged materials: Preparation of a program for assessment and monitoring of sediment contamination, identification of sound dredging techniques, disposal systems and selection of disposal sites; and*

- *Oil spill prevention: Upgrading of the existing capabilities and facilities to prevent and to combat oil spills in all Indonesian waters.*

In addition, all institutional measures and training, and all relevant regulations required for the implementation of the project should be detailed. The project resulted in a master plan for maritime environmental policy for Indonesia in 1996 and the related action plan will be finalized by the end of April 1999.

Background

Indonesia is the world's largest archipelagic state with far more marine resources than its Asian neighbors. Indonesia has extensive marine ecosystems such as seagrass beds, coral reefs, mudflats and mangrove forests that are vulnerable to pollution. Seventy percent of Indonesia's population live within the coastal zone. Much of the oil industry is located in this zone, along which there are major oil tanker routes in the Straits of Malacca, Makassar, Sunda and Lombok. Any damage to the existing ecosystems is a significant threat as majority of the natural resources are of high socioeconomic importance to people living in the coastal communities.

In Indonesia, the Directorate General of Sea Communications (DGSC) is responsible for all aspects of maritime transport. Efficient maritime transport is crucial for the country as more than 90% of its foreign trade and a substantial part of its domestic trade is seabound. Moreover, exports and imports each represent about a quarter of the gross domestic product (GDP). The share of foreign trade in GDP is expected to increase further. In line with the thrust of the Government of Indonesia's (GOI's) overall economic policies relying on deregulation and increased private sector participation, the DGSC has to transform itself from an implementation and control orientation to one focusing on strategic planning, creating the enabling environment for efficiency and private sector participation and promoting safety and sound environmental practices in the sector.

In Indonesia, there is great concern over the potential of marine pollution from maritime transport activities. The environmental impacts arise in three main areas: (i) the disposal at sea of ship wastes; (ii) the environmental degradation caused by oil spills; and (iii) dredging and the disposal of contaminated dredged material. At the highest levels, GOI is strongly committed to protect the environment, particularly the marine environment, and to build up an appropriate institutional capacity. Until a few years ago, however, implementation of these policies has received low priority in the maritime sector.

In order to further develop sound environmental maritime practices, the Ports Environmental Improvement Project (PEIP) has been set up, the preparation of which began in 1995, when a contract was signed between the Research and Development Agency of the Ministry of Communications (MOC) of Indonesia and DHV Consultants of The Netherlands to provide the associated consulting services. The preparation of the project has been funded by a grant from the Japanese Government through the International Bank for Reconstruction and Development.

Objectives

The project addresses the issues of marine and coastal environment pollution resulting from maritime transport activities and aims to assist the government in implementing sound environmental practices. The objective is to reduce pollution in the marine environment resulting from port and shipping activities. The project will also enable Indonesia to harmonize with initiatives in other countries along the East Asian main shipping routes.

Description

The project comprises three main components:

- Ship and port waste management (MARPOL): Upgrading of the capability of the maritime sector agencies for environmentally sound disposal of ship and port wastes, through technical assistance (TA), training and investment in facilities;

- Environmentally sound dredging: Upgrading of the capability for environmentally sound management of dredging and disposal of dredged material, through TA, training and investment in facilities; and

- Oil spill prevention and response: Upgrading of the capability to respond to oil spills in individual ports and at regional and national levels, through TA, training and investment in facilities.

Project Preparation

The crucial aspect of the project preparation is to define the overall coordination and management arrangements. GOI has expressed preference for working within the framework of existing agencies and organizational structures. Each of the three components will have a different set of agencies or units, which in turn are either within these agencies with primary or secondary responsibilities for implementation including:

- Ship and port wastes: The four existing Port Corporations will be the principal agency responsible for establishing and operating the facilities. DGSC will be responsible for the development of regulations, standards and guidelines and also training;

- Oil spill response: DGSC will assume overall responsibility. The precise roles and responsibilities of the Port Corporations, the state oil company PERTAMINA, DGSC, the MOC and the Environmental Impact Agency (BAPEDAL) for developing the preparedness and response capability need to be defined; and

- Dredged material management: DGSC will assume overall responsibility. The exact roles and responsibilities of RUKINDO, the dredging corporation, DGSC, and LIPI, the oceanographic laboratory for upgrading the capability of the sector need to be defined.

The project will put into practice the lessons learned from initiatives already taken in Indonesia and in other countries, including:

- Establishment of environmentally sound practices requires a comprehensive package of measures, including, *inter alia*, an appropriate legal framework, new operating procedures and guidelines, staffing, awareness campaigns, monitoring, enforcement authority and capability and operating budgets;

- In addition, many agencies are involved and success will depend on careful identification of a lead agency and design of coordination arrangements; and

- Establishing cooperation between neighboring countries is important, especially for successful implementation of MARPOL and oil spill contingency management.

Execution and Phasing

The preparation of the project has been divided in two phases—the preparation of the master plan and the action plan. In 1995, a master plan was drafted for an improved maritime environmental policy, addressing the three issues mentioned above. The final report was submitted in 1996 after a lengthy review process by GOI during which environmental policy matters were further elaborated.

The second phase of the project (PEIP 2), which aims at the preparation of an action plan, started in the beginning of October 1998. The final report and action plan will be submitted by the end of April 1999. Project implementation is foreseen in April 2000-April 2003.

There are hundreds of ports in Indonesia, including the 25 so-called "strategic" ports and 110 commercial ports, managed by the four Port Corporations. At the start of the project preparation, 11 ports spread throughout the archipelago were selected for implementation of the recommendations. This selection includes from West to East: Belawan, Dumai, Palembang, Tanjung Priok, Cilacap, Tanjung Perak, Benoa, Makassar, Balikpapan, Samarinda and Ambon. The ports chosen represent the major characteristics of ports in Indonesia, including the four main ports (Belawan, Tanjung Priok, Tanjung Perak, Makassar), river ports (Palembang, Samarinda), an ocean port (Cilacap), refinery ports (Dumai, Palembang, Cilacap, Balikpapan), vulnerable environment (Benoa on the island of Bali) and important regional and supply center (Ambon).

The master plan provided an inventory of the three project components with regard to concerned agencies, institutional settings, laws and regulations and facilities. In addition, broad recommendations for policy development and improvement have been formulated.

Action and Implementation Plan

The action plan follows from the master planning efforts of 1995-1996. Below, the major elements of the proposed action plan are summarized. The experience to be gained with implementation of the action plan in the 11 ports will provide a sound basis for extending the plan to other main ports in the country in the future.

Ports and Shipping Waste Management

A crucial element in the proposed plan is the role of the private sector. The four Port Corporations (already partly privatized) will bear the responsibility of investing in waste reception facilities, to be built in the 11 selected ports. The background of the recommendations is the "polluter pays" principle. An environmental fee will be levied on all ships entering ports where waste reception facilities are located, as part of the port dues. This fee, to be paid by shipping companies and owners, will cover both capital and operation/maintenance cost of the reception facilities. Running of the facility will be contracted out to private operators.

Another role of the private sector is in the collection of oily waste from ships, to be carried out by barges and/or trucks. The reception facilities will provide a three step treatment of the oily water received: (i) settlement by gravity, (ii) additional gravity separation in an API separator, and (iii) chemical treatment in a dissolved air flotation unit. The effluent water will be discharged to the surface water. The waste oil recovered is a valuable and tradable commodity. It can be sold to brick or limestone factories as fuel oil or to a refining plant for spent lubrication oil, in accordance with the present practice.

The project will also comprise improved control and enforcement systems and an incentive/penalty system.

The main elements of the action plan are summarized below.

Institutional

- Establish new MARPOL unit within the Marine Safety Sub-directorate which is responsible for policy and planning, coordination of activities, institutional development, initiating of new laws and regulations and technical issues.

- Train DGSC/Port Administrations/Port Corporations/private sector.

- Establish a multidisciplinary project committee.

- Provide training and awareness-building programs.

Rules and Regulations

- Define (Joint) Ministerial Decrees for: (i) waste reception facilities and (ii) environmental fee.

- Provide government regulation for sanction scheme.

- Provide operational, administrative and monitoring procedures.

- Provide enforcement and compliance procedures.

Performance Indicators and Benchmarking

Public-Private Partnership Arrangements and Protocols

Investments: Construction of Waste Reception Facilities

Dredging and Disposal Management

Capital and maintenance dredging takes place in all major ports in Indonesia. At present, there are no formalized procedures for the application of environmentally acceptable dredging and disposal techniques. There is a great need for such procedures, since for instance sediments dredged in the basins of the ports of Jakarta (Tanjung Priok) and Surabaya (Tanjung Perak) are (heavily) polluted.

The main elements of the action plan are as follows:

Institutional

- Define new tasks for Sub-directorate of Dredging and Reclamation (technical and environmental evaluation, and monitoring).
- Provide training and awareness-building programs.
- Define law amendments to provide a legal base for environmentally sound dredging operations.

Rules and Regulations

- Provide environmental management guideline for dredging works.
- Provide sediment assessment system guideline.
- Provide guidelines for evaluation and monitoring of dredging and reclamation activities.
- Provide overview of environmental issues regarding dredging works.

- Provide guidelines for design of disposal sites.
- Provide guidelines for at-source pollution control assessment program.
- Provide disposal options for the ports of Jakarta and Surabaya as pilot project.

Oil Spill Management

Oil spills may occur nearly anywhere in the extended Indonesian archipelago. In Indonesia, a start has been made to formalize oil spill management within the National Contingency Plan (NCP) which had undergone approximately 20 revisions. The latest revision has been within the offices of the Secretary of the State Cabinet since 1994. The existence of such plan is a major requirement for membership in various United Nations and IMO-sponsored International Conventions. The most important issue for the action plan is the updating and formal approval of the NCP.

With respect to the larger oil spills, localized contingency plans within the framework of the ASEAN regional cooperation for Malacca and Singapore Straits, and to some extent for the Lombok and Makassar Straits, already exist. These plans need updating and expansion. In addition, contingency plans to cater for small oil spills in the ports are required. In the past, Port Administrators in some of the 11 selected ports (Dumai, Tanjung Priok, Cilacap) have developed their own port contingency plans.

The main elements of the action plan are summarized below.

Institutional and Training

- Clarify the roles of DGSC and BAPEDAL with respect to marine pollution control.
- Establish a Duty Officer Corps consisting of trained oil spill response professionals.
- Develop a training curriculum for oil spill management.

Rules and Regulations

- Update and approve the NCP.
- Develop Memoranda of Understanding to formalize informal arrangements.
- Review International Conventions and Laws (Sulawesi Sea Oil Spill Network Action Plan, Malacca Straits Agreement, Indonesia—Australia Agreement) and provisions of linking laws.
- Establish operational protocols with Singapore and Malaysia concerning mutual alerting of oil spills.

Contingency Plans for Tier 1-3

- Review existing standard operating procedures (SOPs) for the 11 project ports. Assist ports lacking SOPs in their development.
- Negotiate rates for equipment and services at each port/regional office or location.
- Review existing communication systems and procedures and recommend improvements.
- Develop a clear operational strategy for the disposal of oily waters.
- Implement a schedule of maintenance and tests for oil spill equipment.
- Initiate monthly practice sessions on the operation of oil spill equipment.
- Review standard operating procedures of response agencies.

Investments

- Establish four regional Tier 2 bases.
- Upgrade the national emergency center into a fully operational oil spill reporting and response center.

IMPLEMENTATION

It is very important to maintain the present momentum of the project. Elaboration of the many activities to be undertaken has shown that after submission of the final action plan in April of this year, a large number of pre-implementation activities should be carried out, as a precondition for successful implementation starting in the budget year of April 2000.

Three phases are distinguished.

Phase 1. 1999-2000 Pre-implementation Phase

Preliminary Decisions

Discussion and formal agreement by all concerned authorities on the results of the project and the implementation of the recommended measures. Appointment of an experienced Project Manager to provide the necessary push. Necessary preliminary actions and decisions of a general, financial, legal or institutional character being preconditional for the full implementation of the implementation program.

Crash Action Program

Implementation of GOI decisions, start of top priority training, reaching agreements with donor organizations, finalization of the Terms of Reference for the various projects identified, of tendering documents and procedures, preselection of contractors and tendering of contracts, establishment of project steering committee and project management unit.

Objectives

1. To communicate the results of the PEIP 2 project to the key stakeholders (recommendations and action plan).
2. To speed up all decisions necessary to start the implementation process.
3. To immediately start improvements of the performance of the sector.

4. To coordinate and facilitate preparatory activities for project implementation and investments.

Phase 2. 2000-2003 Project Implementation Phase

Establishing of project implementation unit. Execution of major investments, implementation of programs for technical assistance, training, awareness and monitoring, adaptation of regulatory framework, improvement of institutional performances at all levels.

Phase 3. 2003-2010 Sustainable Development Phase

Consolidation and institutionalization of project activities without the need for additional technical assistance, further improvement of institutional performance, full dissolution of project management unit within DGSC and transformation of project steering committee into Clean Seas Advisory Board, GOI decision to expand project activities to other ports and provinces.

Funding Sustainable Development: Trends in the Financial Sector

Magnus Pettersson

Sycon Energikonsult AB, S-205 09 Malmø, Sweden

PETTERSSON, MAGNUS. 1999. Funding sustainable development: Trends in the financial sector, p. 227-235. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

In the East Asian Region, the fast economic development was to a great extent built on a "grow now, clean up later" policy. This resulted in unacceptable environmental costs in the region.

During the last five years, the environmental investments in Europe have rapidly increased and are steadily increasing. This study looks at this recent economic development, focusing on the trends in the financial community operating in the region. Green policies for general investments, environmental funds, environmental loan initiatives and environmental insurance are some of the trends investigated in the study. What mechanisms control this development and what can be learned from this when restoring the economies in the East Asian Region?

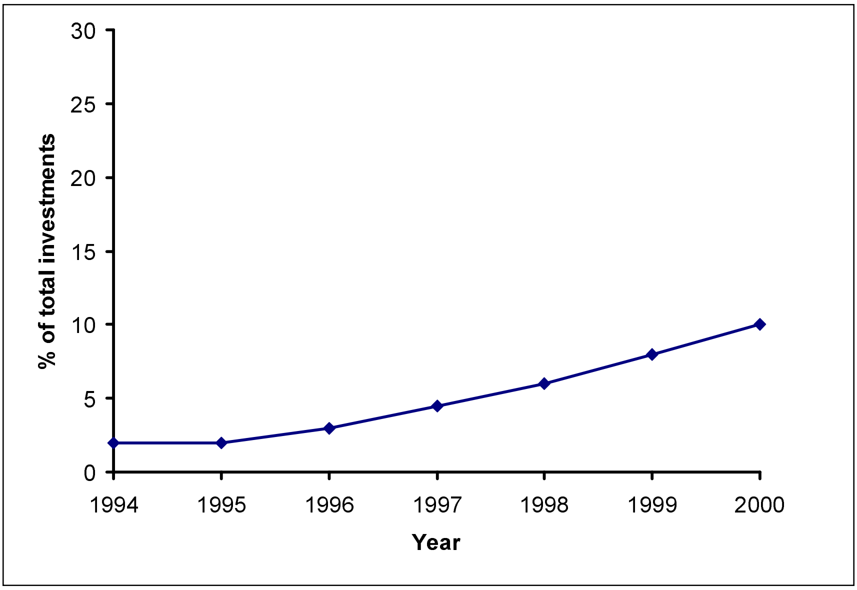
The recent financial crisis has made it crucial to restore a high level of investments in the East Asian Region. Investors want to see opportunities for long-term stability in the region, something that can only happen if environmental issues are taken into account. In order to achieve this, the governments in the region must establish a long-term economic and environmental framework that supports a sustainable development.

If proper long-term environmental and economic rules are set, control is effective and market demand for environmental protection is high, then the interplay between government, business, the financial sector and the market should have the opportunity to promote a sustainable development in the East Asian Region.

Introduction

The environmental investments in Europe have rapidly increased during the last five years and are steadily increasing (Figure 1). Green policies for general investments, environmental funds, environmental loan initiatives and environmental insurance are of growing importance in the financial market. Internal environmental investments made by companies are also increasing. What mechanisms control this development and what can be learned from this when restoring the economies in the East Asian Region?

Figure 1. An Estimate of the Development of Environmental Investments in Europe.



Environmental and Financial Crisis in East Asia

In East Asia, the fast economic development was to a great extent built on a “grow now, clean up later” policy. This has resulted in unacceptable environmental costs. After realizing the alarming development, large-scale efforts have been made by the countries in the region to improve environmental management. Institutions like the World Bank and the Asian Development Bank have supplied funding and expertise for environmental programs in the region. The recent economic crisis in the region has, however, changed the priority to restoring economic growth.

The critical question for the environment in the region is whether resumed growth will be "business as usual" or will reflect fundamental reforms.

The environmental damage, including water and air pollution, loss of forests and soil erosion, has severely affected the main sources of income and survival for the countries in the region. Sectors like agriculture, fisheries, the export industry and tourism have seen declined productivity and economic losses during the last years. Effects of environmental mismanagement have also damaged the health of the population. For example, the cost so far of the recent drought and the forest fires in the region has been estimated at US$12 to US$14 billion including health cost of air pollution caused by the fires. This amounts to about 2.5% of the total gross national product (GNP) of the main countries affected (World Bank, 1998). The full impact of environmental disasters like the drought and the forest fires will not be known for another decade or more.

The environmental problems and the recent financial crisis in the East Asian Region have similar roots:

- Growth without safeguards and proper policies;
- Lack of long-term environmental and economic framework;
- Lack of monitoring and control;
- Weak management;
- Lack of transparency; and
- Corruption.

The recent financial crisis has made it crucial to restore a high level of investments in the East Asian Region. Investors want to see opportunities for long-term stability in the region, something that can only happen if environmental issues are taken into account. In order to achieve this, the governments in the region need to establish a long-term economic and environmental framework that supports a sustainable development. A lower rate of growth than before may have to be accepted. Instead, it is important to ensure that the investments are used more productively than in the past.

The Financial Sector and the Environment

Financial institutions are aware that their sector has a long-term interest in sustainable development and in backing commercial and industrial practices that safeguard future resources. Quick profit with no thought for tomorrow is not in the interests of a sector that has to invest in the future. It is also becoming clear that there are short-term benefits in working with environmentally sound investments. It is good business to invest in companies that manage their environmental issues in a responsible way, dealing with changing legal obligations, taxes, fees and a growing demand for green business from customers. The critical drivers for the financial community funding a sustainable development are rules set by the governments and the demand from the customers in the global market.

The financial services sector has an important stake in promoting sustainable development. Investment in projects that take no heed of the future, that destroy or deplete natural resources needed for future development, does not make economic sense. For example, as governments continue negotiations on reducing greenhouse gas emissions, the demand for energy is increasing at a phenomenal rate requiring investment and rapid development of clean technologies.

Environmental degradation and man-made ecological catastrophes threaten the very basis of the insurance industry, which depends on being able to manage and reduce risks. Environmental catastrophes are not only expensive but the costs can spread far and unpredictably into the future. The major investors of the world have to take this into account. In the insurance industry, environmental risk is business risk. The increase of claims related to environmental disasters and extreme weather events has been causing serious concern.

Bankers and insurers are realizing that sound economic practice and concern for the future of the environment go hand in hand. Because of the crucial role they play in economic development throughout the world, they are uniquely placed to play an important role in greening other sectors and industries. This promotion of better environmental practice to the sector's millions of customers and clients is an important role for the financial services sector.

Green Trends in the Financial Sector

In Europe, environmental scandals, together with progressive environmental regulations and the rising environmental awareness of the market, have forced the financial sector to put environmental issues on the daily agenda. There are substantial financial and commercial risks connected to environmental issues for businesses. Lately, the financial community is also getting aware of the opportunities connected to environmental issues for the business community. Case studies show that higher environmental standards are linked to stronger economic performance. This has already resulted in environmental investments in the form of green policies for general investments, environmental funds, environmental loan initiatives and environmental insurance among others. A recent example is an initiative of the European Parliament to facilitate access by small- and medium-size companies to bank loans for new environmental investments.

General Investments

When analyzing business for investments, loans or insurance, the environment is becoming an important part of the evaluation process. Today, most of the European financial institutions include environmental issues in their policies and strategies. Especially, credit institutions and insurance companies have introduced environment in their daily working tools for evaluation.

Investment and general fund analysts analyze business sector-wise and, in sectors like the oil and gas sector, environment is a crucial component to evaluate the future for the company. The analysts want the companies to identify their main financial and commercial risks connected to the environment and describe how they deal with them. The companies analyzed are often very big and they provide a lot of environmental information. Investment and general fund analysts want to be able to compare companies with each other and information to be linked financially. Evaluation of opportunities connected to environmental issues is starting to be important.

Credit institutions and insurance companies often analyze smaller companies and separate projects. The business risks connected to environmental issues are very big in these cases because of poor ability to deal with financial setbacks and too small resources to properly take care of the environmental risks. The credit and insurance analysts have great problems getting the relevant information for evaluation of the environmental risks for small companies and separate projects. Instead, they do an overall environmental risk analysis and then use their own developed questionnaires to collect the relevant information. Credit and insurance analysts often use external consultants to help them with the environmental evaluation (Pettersson and Earl, 1998).

Ethical and Environmental Funds

About 10% of the total value of investment funds in the UK are ethical and environmental funds today and the interest from customers is rising. In terms of new sales, 15-20% are ethical and environmental funds. For Europe, the total figure is a bit lower. There are more than 100 ethical and environmental funds in the UK and the biggest are pension funds like the ones run by Friends Provident (FP) and National Provident Institution (NPI).

There are basically three types of ethical and environmental funds:

- Funds with investment strategies that use negative screening excluding companies that cannot meet certain ethical criteria. Investment should be in companies that actively try to improve their environmental performance;
- Funds that only invest in companies specializing in environmental technology; and
- Funds that contribute a part of their investments to environmental organizations.

Environmental Loan Initiatives

Many of the European banks have developed special environmental loan initiatives. Companies that want funds for new environmental investments are given bank loans with reduced interest rates and other benefits. To be eligible for the loans, the environmental investments must satisfy certain criteria.

Following an initiative of the European Parliament, the European Commission and the European Investment Fund are working together to facilitate access by small- and medium-size companies to bank loans for new environmental investments. This scheme provides guarantees on investment loans granted by financial institutions (mainly banks) in the Member States. The European Commission is providing budgetary support to pay for the guarantees as well as to help finance technical assistance. The scheme is directed at smaller companies (less than 100 employees), with a special focus on those with less than 50 employees.

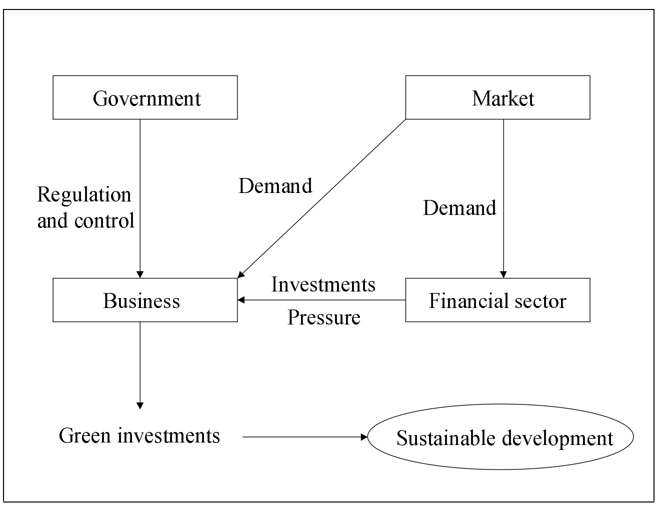
Environmental Insurance

The European insurance sector is now starting to offer specific environmental insurance to companies, for example, future costs for remediation of contaminated land when taking over another company.

Mechanisms Behind the Environmental Development in Europe

In Europe, there is a long tradition of environmental and economic regulation. The control institutions have the right basis—knowledge, authority, respect from the business and proper framework to work with—to be able to manage development. Governments are trying to establish a long-term environmental and economic framework that supports a sustainable development. In many areas, the framework is still changing too fast to provide the right conditions for environmental investments by the business. The companies hesitate to invest if they cannot be sure that the rules will be the same for at least two to three years. To have the right development, the interplay between government, business, the financial sector and the market needs to be open and competitive (see Figure 2).

Figure 2. Illustration of the Interplay between Government, Business, the Financial Sector and the Market.



Governments in Europe set the environmental regulation tough enough to force companies to invest in the latest environmental technology in order to keep permission to operate. New economic disincentives like carbon tax and landfill tax are used to try to move away from the dependence on fossil fuel and to decrease the production of waste.

Why has the green investment boom not started earlier? The driver for the recent development in green investments is the awareness and demands from the market. People are starting to act on their fear for an environmental catastrophe.

Future Environmental Development in East Asia

In East Asia, it is first of all important to establish a development built on openness and democracy. Institutions that have the ability and the real authority to control the environmental and economic development must be established. A lot of efforts have already been made to improve environmental management in the region. The financial crisis will probably slow down the development but should be seen as an opportunity to follow a better path in the future.

The immediate effects of the financial crisis have been beneficial for the environment. Sharp declines in income and industrial output have substantially reduced air and water pollution caused by vehicles and industry. However, a concern is that a prolonged recession will increase pressure on natural resources. Unemployment and lower real wages in urban areas have encouraged people to move to rural areas increasing the pressure on rural resources. Therefore, restoring economic growth in the region is essential in order to establish a balance between people and the environment. In the mean time, public expenditures on water supplies and sanitation, planting of trees and soil conservation can create substantial employment and produce lasting environmental benefits.

In order to attract investments to the region and at the same time make sure that the investments are made in a sustainable way, the environmental and economic framework must be long term and must support a sustainable development path.

An example of a critical framework issue is adjustment of the level and structure of user fees for exploiting natural resources. An increase in user fees would discourage short-term tendencies to harvest stocks of natural resources and enable the East Asian governments to capture a more reasonable share of the income generated by logging, fishing, mining and other natural resource activities.

Such an adjustment would provide an opportunity to establish a more appropriate structure of incentives for the proper use of natural resources (World Bank, 1998). More effort must be devoted to enforce compliance with such user fees. On the whole, it is essential to decentralize much of the responsibility for environmental regulation. Enough resources must be provided to build up and sustain local administrative capacity.

Another framework issue is distorted price incentives that result in significant environmental costs. Examples are the subsidies on certain types of transport fuels that contribute heavily to local air pollution. It is also important that there are incentives encouraging companies to improve their environmental performance, such as economic reward systems and awards for best environmental performances in different business sectors.

There will only be a high degree of environmental investments if the market demands it. The awareness and demand from the market for environmental protection in East Asia is already high after the latest environmental development in the region.

If proper long-term environmental and economic rules are set, control is effective and market demand for environmental protection is high, then the interplay between government, business, the financial sector and the market should have the opportunity to promote a sustainable development in the East Asian Region.

References

Pettersson, M. and G. Earl. 1998. Investigation of the environmental reporting requirements of the financial community. Swedish Office of Science and Technology.

World Bank. 1998. East Asia: The road to recovery. World Bank, Washington, D.C.

Economic Instruments and Other Policy Approaches for Integrated Coastal Management

Maria Corazon M. Ebarvia

GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas P.O. Box 2502, Quezon City 1165, Philippines

EBARVIA, MARIA CORAZON M. 1999. Economic instruments and other policy approaches for integrated coastal management, p. 236-254. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper presents a background on the current problems besetting the coastal and marine environments, and prevailing policies, as well as discusses the economic instruments (EIs) to help countries develop implementation strategies. Most environmental policy instruments utilized by governments are of the regulatory or 'command-and-control' (CAC) type, and seek to achieve mandated environmental standards through fines and legal sanctions. Environmental policy, to be effective however, needs to formulate a balance between the costs of pollution and resource depletion and the costs of mitigating these problems. Towards this end, the usual fines connected to legal sanctions have to be re-evaluated, and other policy instruments, such as EIs or market-based incentives (MBIs) are being implemented in many countries to complement the use of strong and effective environmental laws to achieve specific environmental objectives. They work through market signals, such as prices, which can motivate people toward conservation and production of less waste. In choosing between the CAC approach and the market-based approach, the information requirement for the enforcement of a particular policy instrument must be met, the costs involved to get this information, and the enforcement costs have to be weighed against the benefits of implementing such instrument. Moreover, it is necessary to know if these policies are cost-effective*, in terms of mitigating the overextraction of resources and getting the most pollution reduction possible for the money spent, and whether they are efficient, in terms of appropriately balancing the benefits and costs of resource and environmental improvement. In practice, however, both EIs/MBIs*

and CACs may be used together to achieve the desired environmental targets, with properly designed property rights system and monitoring and enforcement institutions in place.

Introduction

Although population growth and poverty are widely regarded as the dominant causes of overly rapid use of natural resources and environmental deterioration, misguided government policies and the failure of market systems to inform and account for external effects (on both current and future generations) have resulted in the loss of environmental assets, even in developed countries. Thus, the prevailing economic, political and social institutions shape the *incentives* that lead people to make decisions on consumption, production and disposal towards certain directions and outcomes. Due to increasing environmental problems, there is a need to introduce a system that would give people an incentive to search for ways to conserve resources and reduce waste.

Coastal development policies would involve strategies, such as conserving and enhancing the coastal environment, managing risk and coastal vulnerability, and merging coastal environmental considerations with economics in decision-making (Turner and Adger, 1997). Most environmental policy instruments utilized by governments are of the regulatory or 'command-and-control' (CAC) type, and seek to achieve mandated environmental standards through fines and legal sanctions. Environmental policy, to be effective however, needs to formulate a balance between the costs of pollution and resource depletion and the costs of mitigating these problems. Towards this end, the usual fines connected to legal sanctions have to be re-evaluated, and other policy instruments, such as economic instruments (EIs) or market-based incentives (MBIs) are being implemented in many countries to complement the use of strong and effective environmental laws to achieve specific environmental objectives.

Objective of the Paper

In designing policy strategies, the current status of the resources and the environmental quality are assessed first, and then the various pressures leading to this situation are determined. Different policy approaches will be discussed since EIs produce better results if they are implemented in tandem with other policies. This paper presents a background on the current problems besetting the coastal and marine environments and the prevailing policy approaches as well as shows examples where applications of EIs have been successful in controlling resource and environmental deterioration.

Economic Value of Ecosystems

The total economic value (TEV) of a natural system is the sum of all net benefits from all compatible uses, including non-use values. Conceptually, it is the amount of resources, expressed in common units of money, that society would be worse off if the natural resource or environmental amenities were lost. Collectively, coastal ecosystems provide food (major protein sources); economic development opportunities (e.g., tourism, commercial fishery, mariculture, transportation); building materials (sand and rocks); firewood; recreational opportunities; shoreline protection and buffering and important life-support functions. It is important to note, however, that there are immense difficulties involved in arriving at a monetary value to attach to a certain benefit or to a given degree of environmental destruction.

Valuation of natural resources and the environment necessitates the estimation of benefits and costs of using these natural assets. One rationale for resource valuation lies in the desire of policy-makers and managers to influence resource allocation by making those responsible pay for the environmental costs associated with their activities. For instance, standards and regulations would be effective if the fines are set at levels that consider the value of damages, which result from violations. Likewise, EIs, such as user charges, effluent tax and environmental bonds, should also be based on the value of using the environment as a waste repository.

The following section shows examples of the different problems that affect the sustainability of coastal ecosystems. Evidence already points to declining fish catches, depletion of mangrove areas and degradation of coral reefs. These problems, if not mitigated, would lead to the loss of economic values shown above.

Current Pressures

The health and productivity of an ecosystem depend on many factors, any of which may set a limit on its biological potential. Aside from natural forces, the current pressures in coastal areas are resource depletion and environmental degradation or pollution brought about by population growth, migration, land conversion and development. These problems affect the sustainability of coastal and marine resources, and can further aggravate the social and economic conditions. Understanding the limiting factors is valuable in environmental management, especially in identifying mitigating measures and formulating policies. Some of the factors affecting the dynamics of coastal ecosystems are enumerated in Box 1.

Box 1. Factors Affecting the Dynamics of Coastal Ecosystems.

Estuaries, Lagoons, Mangroves and Wetlands

- dredging, filling, construction
- upland and coastal erosion, sedimentation
- denudation of mangrove areas
- spills of chemicals and oil from land or ships and pollution from sewage
- excess nutrients from agriculture and aquaculture

Beaches

- coastal dredging of dune and beach sand mining
- recreational activities (e.g., boating, jet skis, etc.)
- loss of shoreline protection from dredged reefs
- placement of damaging property close to shoreline
- coastal engineering works (e.g., groins and seawalls) that alter wave flows
- modification of riverine discharges due to jetties and other deflecting structures

Coral Reefs

- excessive sedimentation reducing light availability and consequently decreasing primary productivity
- breakage by storms, boat anchors, trampling and blasting
- destructive fishing methods such as poison (cyanide) fishing and blast fishing
- shoreline and offshore dredging and filling
- toxic chemicals from land, industries and ships
- eutrophication and nutrient enrichment
- oil spills
- discharge of mine tailings
- heated water or thermal discharge
- sewage outfalls

Source: Carpenter and Maragos (1989).

Source of Problems

In general, there are two broad types of inefficiency in modern economies—market failure and failure of government's policy. *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). The full social costs consist of *private cost*, which is already reflected in the profit-and-loss statement of firms, and *external (environmental) costs*, which are not normally taken into account by firms when making output decisions. These external costs, however, are borne by people other than the firms, or by society as a whole. For example, users of chemicals discharge wastewater containing toxic substances that affect water quality, fish and the health of the people. Land developers may not consider the deterioration of the visual environment of the local inhabitants or the loss of unique species of animals or plants that may not have commercial value. Not only the firms are responsible for external costs. When individuals dispose of solid waste improperly, they may affect the quality of the local environment or when they indiscriminately cut mangroves for fuelwood.

Non-market or policy failure. Non-market failure is a breakdown of the system of taxation, transfers and expenditures, which results in the lack of progress toward stated goals (White, 1976). Government interventions, such as price controls, subsidies, exchange controls, ownership controls, land-use policies, etc., can distort market signals, resulting in inefficient outcomes, i.e., wasteful use of natural resources and environmental degradation. For example, subsidized credit and other policies designed to foster capital-intensive heavy industry development have encouraged the growth of heavily polluting sectors in Korea and Taiwan (O'Connor, 1992).

Institutional failure. Inadequate and ill-defined property rights are another type of policy and institutional failure. Coastal and marine resources are often publicly owned and open to uncontrolled access by individuals and firms that find it profitable to use them. These resources can be exploited on a first-come, first-served basis, and no one is encouraged to conserve because the benefits from conserving would be captured by other exploiters. Everyone behaves as if the resources are inexhaustible, i.e., a zero price is imputed on these resources. The government can, however, correct these market failures through appropriate interventions, such as defining property rights, land-use planning and coastal zoning and imposing user charges.

Information failure. Another source of problem in resource and environmental management is information failure. Although the availability of good information does not automatically lead to correct or good decisions, its unavailability will certainly contribute to bad decisions being made. For example, lack of data on the total economic value of, say, mangroves, has given rise to the misconception that mangroves are not worth much. Hence, their conversion to alternative uses would be the more profitable option. This has subsequently led to the rapid depletion of mangroves and the loss of important life-support functions provided by these resources.

Implementation/Enforcement failure. A number of environmental laws and regulations were instituted to make certain activities illegal, such as illegal fishing, accompanied by fines and penalties. Despite these measures, dynamite fishing, 'muro-ami', and the use of hazardous substances, such as cyanide, to capture tropical fishes still persist. Among the reasons given are: (1) the laws' provisions are sufficient, but the problem is the low level of awareness of the officials in charge of carrying them out; (2) government resources (personnel, equipment budget) are not sufficient to undertake effective monitoring and enforcement, forcing them to rely on license holders; and (3) there are problems with the laws themselves, including regulations and in particular subsidiary orders (Nomura and Sakumoto, 1997; Tolentino, 1997).

Policy Approaches

The process of regulating the market system has its own transaction cost, e.g., cost of reaching and enforcing agreements. In choosing among these policy approaches, the information and institutional requirements for the enforcement of a particular policy must be met. The costs involved in getting these requirements must be weighed against the benefits of implementing such policy. The prevailing environmental policy approaches fall under the following categories: (1) well-defined property rights system; (2) liability laws; (3) moral suasion; (4) command-and-control approach; and (5) economic or market-based instruments.

Property Rights System

Property rights refer to the bundle of entitlements defining the owner's rights, privileges and limitations for use of the resource (Tietenberg, 1992). When there is a small number of parties involved, which means lower transaction cost, property rights system will result in the optimal level of pollution, even without further outside intervention. In order for property rights system to work for the attainment of environmental goals, however, the following conditions have to be met: (1) property rights must be well-defined, enforceable and transferable; (2) the parties involved can come together to negotiate about how property rights will be used; and (3) negotiating costs as well as the cost of policing agreements must be fairly modest.

Liability Laws

When individual negotiation is not practical, affected parties can turn to courts to seek compensation. This system does not require any centralized control authorities to set standards for effluent levels, but rather a system of decentralized courts and liability laws that would permit those affected by environmental damages to seek compensation. Liability laws work by making polluters liable or responsible for the damages they cause.

Moral Suasion

This involves programs of persuasion that appeal to a person's sense of civic duty to get him/her to contribute to the preservation of natural resources, and to avoid undertaking activities that degrade the environment.

For consumers, this may involve educational and information campaigns to influence consumption of certain products and proper waste disposal. For firms, public access to information on their environmental performance can be a powerful stimulus to production changes, and for managers to be more concerned about improving their performance. For example, in the United States, national legislation was passed in 1986 wherein manufacturers are required to report their toxics release data, which are made available to the public through a database system (European Foundation for the Improvement of Living and Working Conditions, 1996).

Command-and-Control Approach

Command-and-control (CAC) approaches consist of relying on standards, in which political authorities mandate the behavior by law and enforce it through the courts, police and fines. To enforce this standard, however, the enforcement agencies must measure and detect any violation. If any infringement is found, the source is subjected to some form of penalty, such as fines and imprisonment.

There are three types of environmental standards: (1) *ambient standards*[1], which measure and set the quality of environmental media like water and air; (2) *performance standards*, which apply to the allowable emissions and effluents released to the environment by specific pollution sources; and (3) *technology standards*, which specify particular techniques, methods and devices to be used for pollution control. Ambient standards mirror the chosen target level of environmental quality while the performance and technology standards are the mechanisms by which this target may be attained.

The rationale for employing the CAC approach is the relative certainty of the environmental outcomes. A major advantage of the CAC approach is that, assuming effective enforcement, a given set of standards should result in the attainment of targeted environmental quality. The effectiveness of CACs to achieve

[1] *The existence of ambient standards is not limited to the CAC approach. An environmental management system based on a set of economic instruments would still need to make use of ambient standards to assess the effectiveness of the chosen EIs to meet environmental goals.*

environmental goals, however, depends on a combination of factors, such as the strength of government's political will to undertake vigorous enforcement, the technical competence of those charged with regulatory design and implementation, and the financial capacity of regulated sectors to invest in the requisite control technologies (O'Connor, 1992). The following issues have been raised against CACs: (1) they may not be cost-effective; (2) fines may be set too low; and (3) high monitoring costs could be incurred in enforcement.

Market-based Incentives/Economic Instruments

When regulatory approaches fail to achieve desired environmental quality, MBIs/EIs can be applied to enhance and complement environmental laws and standards. They work through market signals, such as prices, which can motivate decision-makers toward more environment-friendly activities. The different types of EIs are shown in Box 2. Some of the advantages of using EIs in environmental management are:

- *Cost-effectiveness.* Due to the flexibility inherent in market-based approaches, economic instruments allow polluters to meet a given degree of environmental protection at a lower cost. EIs are able to consider that the costs of controlling pollution may not be the same for all sources. Unlike regulations, which set technology standards that could be very expensive for some sectors, EIs allow agents to choose the least-cost technology that can reduce pollution up to the ambient level standards and even beyond.

- *Continuing incentive to go further.* Under regulation, firms have no incentive to go beyond the required standards. On the other hand, EIs provide continuing incentive for firms to reduce their waste and, therefore, apply pollution-control technologies and processes and develop new ones. With eco-taxes, firms would have to continue paying taxes on residual pollution, and with marketable permits, continued pollution has an opportunity cost—in terms of foregone revenue from selling the permit.

- *Revenue potential.* Tax instruments can raise government revenues. For acceptability, however, earmarking of these eco-taxes must be clearly defined. For example, revenues raised from effluent taxes can be allocated for the construction, operation and maintenance of wastewater treatment systems.

Even with these advantages of EIs over other policy tools, some caveats have to be noted. It is important to remember that incentive systems are also not costless because they involve monitoring, policing and regulation. Various economic

Box 2. Types of Economic Instruments.

Non-tax instruments
- tradable permits/market for wastes
- user charges
- deposit-refund schemes
- tradable resource shares/tradable quotas
- individual transferable rights
- transferable development rights
- risk-liability schemes/environmental bonds

Tax instruments
- charges for wastes (effluent tax, emission tax)
- product charges
- charges on inputs or raw materials
- tax incentives (investment incentives, financing incentives)
- tax reliefs or subsidies
- tax differentiation
- combined environmental tax and tax incentives or subsidies

instruments are suitable for dealing with different environmental problems. A particular economic instrument may, in theory, be appropriate for addressing a given problem, however, its success will depend on how it is designed, and on whether the necessary institutions for its implementation are in place or not. Moreover, it is the nature of the environmental damage and its causes that will most likely direct the type of market interventions, and which will be politically and administratively effective.

The main drawback is the ability of the market and/or the government to set prices for environmental resources correctly. Ideally, charges for the destructive use of natural resources and environment should be equal to the damage or external cost generated by such activities. This leads us to the problem of estimating marginal damage costs. An environmental policy should lead to an optimal level of pollution by imposing the social costs of external damage on those who cause the damage. In practice, the determination of the external social costs of environmental degradation is hampered by: (1) lack of information concerning the exact causality of the damage; and (2) precise monetary value corresponding to the damage.

The second problem is the limitation of applying MBIs to the management of marine resources since many of these resources are migratory or straddle international boundaries, making it difficult to assign property rights and enforce policies. Moreover, certain types of EIs, such as deposit-refund schemes and tradable permits, are not applicable to all types of pollutants. The third problem stems from the difficulty of defining a base for charges and tax incentives. Since environmental taxes deal directly with pollutants, which are discharged by various sources (land-based point and non-point sources and sea-based sources) in different quantities, it is hard to identify sources that are more liable for the overall ambient quality.

General Policy Lessons

The government can be a key to correcting market failures through appropriate interventions, such as reforming price and tax structures to encourage conservation and pollution abatement; strengthening public institutions charged with environmental policy-making and enforcement; and boosting public and media attention as a way of promoting informal regulation through informed public participation (Brandon, 1994). Some of the lessons learned from past experiences with various policy approaches in resource and environmental management are (International Institute for Sustainable Development, 1995; ADB, 1997a):

- A zoning plan provides the basis for different forms of management in different areas or zones.

- The principle of carrying capacity should be applied in setting allowable levels of use or extraction of resources and in the establishment of permitted levels of pollutants.

- EIs were effective in achieving environmental policy goals, were received by those regulated and did not harm international competitiveness.

- Development and commercialization of appropriate technology for the environment were accelerated with the implementation of EIs.

- EIs and CACs, implemented in tandem, produced better results than when either is implemented in isolation.

- Political considerations are a key to the success of EIs.

Implementation Requirements

One of the difficulties of coastal zone management has been the absence so far of a single jurisdiction over a particular coastal area due to the environmental linkages of the coastal zone with the hinterlands (ADB, 1997a). Various ADB reports have advocated a limited realignment of property structure within the coastal zone, together with land capability-based land-use planning, community-based conflict resolution, pollution abatement through effluent taxes and user charges, voluntary self-regulation and incentives for domestic waste collection. Among the key legal and institutional issues that need to be addressed in designing an environmental management system are: (1) the division of responsibilities and the mechanisms for coordination between the environmental agency and other government bodies; (2) the determination of legal liability for present and past environmental damages; (3) the appropriate role of the general public in the environmental management effort; and (4) the legal and institutional mechanisms for facilitating public involvement.

Examples of Economic Instruments

Transferable Quotas

To reduce overfishing, New Zealand and Australia instituted the tradable catch quotas on all fish harvested, which were allocated to individual fishermen according to historical catches. This is of particular relevance to developing countries with overexploited fishery resources. The scheme was able to accomplish: (1) protection of the resource; (2) increased efficiency in terms of maximizing fishery rents; (3) fairness; and (4) self-financing (Panayotou, 1993). The program was financed through the fees collected rather than from the government budget (Box 3). Moreover, this system can be combined with fee-financed retraining and relocation programs to encourage surplus fishermen to sell their quotas (to those who are more productive and efficient) and take up alternative occupations. A problem arises though when unemployment is widespread since few fishermen would be willing to sell their catch quotas if employment alternatives are not available (Panayotou, 1993).

Deposit-Refund Scheme

Under these schemes, a charge is imposed on the point of sale. A surcharge is added to the price of such products, and is refunded, or partly refunded, if the

Box 3. New Zealand's Transferable Fishing Quotas.

Inshore Fishery

- The total allowable catch, which is based on estimated sustainable and efficiency yields of the fish species considered in the program, was divided into individual transferable quotas.
- The quotas were allocated to existing firms/fishermen on the basis of investment in harvesting equipment, investment in onshore production equipment and other recent production.
- The rights to harvest were denominated in terms of specific amount of fish and were granted for a ten-year period.
- In the case of inshore fishery where there are many participants, it was also necessary to have fewer boats harvesting the stock. The economic incentive approach is to impose annual fees on fishermen for their catch quotas. The revenues derived from the collected fees were used to buy out fishermen who were willing to forego any future fishing for the species in jeopardy.

Source: Tietenberg (1992).

product is returned to a collection depot. Incentives, however, should be provided to encourage waste recovery and recycling. These instruments can be used for: (1) products that can be reused or recycled, take up landfill space and are costly to incinerate; and (2) products that create environmental problems and health risks if not disposed of properly. Some examples of products where this scheme has been successfully implemented include bottles, cans, paper, plastic cups, utensils, car batteries and used lubricant oils (Box 4).

Environmental Bonds

This type of EI falls under risk-liability schemes, which require firms to place dated monetary assurance bonds before operations begin. These bonds will be forfeited if the firm's activities result in excessive pollution levels or cause detrimental effects on the environment. The main problem with this instrument is in setting the value of the bond. Ideally, the bond should at least equal the potential value of environmental damage that may occur from the firm's production and waste disposal activities, and the cost of cleanup and restoration once damage has been done to resources and the environment. Earmarking of the fund should be well-defined so as not to create confusion about its purpose. This is one problem encountered in the environmental guarantee fund in the Philippines (Box 5).

Box 4. Examples of Deposit-Refund Systems.

Japan: The beer industry has been using a voluntary deposit-refund system since before World War II. Beer-makers levy a deposit fee on each case of beer, consisting of 20 bottles of 260 ml each, and a plastic container. As of September 1992, the fee was 300 yen, 100 of which are for the bottles, and the other 200 for the container. The deposit is passed on from manufacturers to wholesale dealers, and thence to retail shops, and ultimately to the consumers. When a new case of beer is delivered, the used package and bottles are collected and the refund is made at each distribution stage.

A number of local governments and consumer cooperatives have also organized deposit-refund schemes for beverage cans. A typical deposit is 10 yen per can and involves attaching deposit stickers by retail shops.

As of 1990, overall recycling rates for general waste were as follows: beer bottles, 92%; waste paper, 49.7%; aluminum cans, 42.6%; steel cans, 44.8%; and glass bottles, 47.9%.

South Korea: Under a 1991 amendment to the Solid Waste Management Act, a deposit-refund system was established for a number of products, such as food and beverage containers, pesticide containers, batteries, tires, lubricant oil, plastic products and certain domestic appliances (e.g., television and washing machines), but the deposit rates are quite low.

Indonesia: In a variation on the deposit-refund scheme, a reforestation fee is levied on concessionaires—equal to $4/m^3 of extracted timber—which was deposited into an escrow account for refund upon replanting of a logged concession. The fee per hectare was originally set at only a fraction of the estimated replanting costs, so loggers preferred to forfeit the fee by not replanting. The fee, however, has been raised twice in the last five years, and is likely to be increased again.

Box 5. Liability Issues.

In the Philippines, an environmental guarantee fund (EGF) was set up, and targeted sectors are required to post a certain amount into the fund as part of the conditions of the environmental compliance certificate (ECC). It combines in one fund a contingency amount and an amount for monitoring, information dissemination, etc., thereby, creating confusion (ADB, 1997b).

User Charge

These are charges that can be imposed on users of goods and services, which have an impact on the environment. They should be structured so as to reflect the full cost of supplying the service, and related directly to the amount of service consumed. These charges can close the information and price-signal gap by signalling to users the costs (or benefits) associated with their use of the service. One example of a successful user charge system is the one being applied in managing solid waste in Ireland (Box 6).

Box 6. Charging for Municipal Solid Waste by Volume in Ireland.

A scheme, based on paying for a tag attached to a bag, was introduced in two local authorities. Only bags with such tags would be collected. The tag scheme was later transferred from bags to bins with wheels – which were initially provided free to households. The tags can be purchased from retailers, who keep 5% of the sale value as commission.

	Charges for Solid Waste (in constant 1995 ECU)*		
An amount per tag attached to a uniform-sized bag	1988 0.38	1990 0.71	%Δ 187
A uniform amount per tag attached to a uniform-sized bin with wheels	1992 2.00	1995 2.50	%Δ 25
Landfill sites (per loaded truck)	1988 30	1995 88	%Δ 293

The results are as follows:

- A very high level of participation; hardly any resistance from householders was encountered, after an initial period of confusion and apprehension.
- Revenue comes close to covering collection costs, but charges are not sufficiently high yet to cover the costs of landfilling.
- Charges were kept low at first and later significantly increased. There was no significant resistance once household realized they were getting the service they were paying for.
- One of the concerns about introducing volume-related charges is that it would encourage illegal dumping. Paradoxically, the effect seems to be the opposite, for the following reason: households paying on a volume basis are not willing to see others simultaneously debase their environment and avoid payment.
- The volume of recycling in the areas had increased, as manifested in the increased recycling activity in transfer stations.
- The introduction of 'wheelie bins' generated economies of scale in collection. In the case of the first local authority, collection costs were reduced by 125,000 ECU per year. In the case of the second local authority, it was able to reduce the number of trucks operating from four to three (the value of this savings was not estimated).

Source: European Foundation for the Improvement of Living and Working Conditions (1996).

* ECU has been converted to Euro, the monetary unit used by the European Union.

Effluent Taxes

These are charges designed to modify behavior by imposing a charge on particular effluents or sources of an environmental problem. Effluent taxes for water pollution have been effective and acceptable in Europe (Box 7). Where charge rates have been set relatively high and increased over time (to incorporate inflationary effects), there has been continuing incentive for firms to minimize waste and to abate it. Charges are varied also according to source and type of pollutant.

Box 7. Effluent Taxes.

Netherlands

In order to finance the construction of water treatment facilities in compliance with the water quality requirements of the Surface Water Pollution Act of 1970, water effluent charges were introduced in addition to CAC regulations. The effluent charge system operates through two subsystems: (1) the State Water Authority levying charges on the pollution of state waters; and (2) Water Boards levying charges on industries and households discharging into other water bodies. In addition to fulfilling their declared primary financing function, the charges have proven to be effective in influencing the amount of industrial effluent discharges. A dramatic decrease in pollution took place despite the growth in economic activities (Lovei, 1995).

Germany

Effluent charges were introduced in Germany in 1976. As of 1986, the nominal charge was 19.20 ECU. Even if charges were low, they were shown to have noticeable effects when private abatement costs were lower than the effluent charge. The incentive aspect lies in the way charges are varied according to the degree of compliance with the standards (Panayotou, 1993).

Spain (Catalonia)

It applies to households (<6,000 m^3/yr and low pollution potential), and to industry (>6,000 m^3/yr and high pollution potential), in 14 zones. Agriculture (irrigation) is not included. For households, the tax rate is fixed at 1 PTA/m^3, and applied to a coefficient ranging from 0.6 to 1.2 depending on population concentration. For industries, the tax rate is based on contamination units, which are a combination of basic pollution parameters, such as suspended solids, biological oxygen demand (BOD), chemical oxygen demand (COD), salts and temperature increase. Hence, a relationship is established between the amount paid and the specific pollution effects of economic activity. The funds from the tax have been considerable, and have, since 1991, been spent on implementing provisions of the EU's Directive (91/271). From 1991 to 1994, 34 new treatment plants have been built, partly financed by revenues collected from the effluent charge (European Foundation for the Improvement of Living and Working Conditions, 1996).

Product Taxes

When the environmental problem is directly attributable to consumer demand for certain final products, product charges can raise the price of the product so as to reflect the total costs associated with the production, consumption and disposal of these products. The incentive effects, through the price change, allow consumers to respond and choose goods according to their own preferences. Product taxes are also being implemented in Europe (Box 8).

Box 8. Examples of Product Taxes in Denmark.

Pesticides: The retail sales of pesticides sold in containers less than 1 kg or 1 liter are subject to a tax at the rate of 1/6 of the wholesale value including the tax but excluding the value-added tax (VAT). The tax on imports is 20% of the producer price. Pesticides sold in large quantities are subject to a tax of 3% of the wholesale price excluding discounts and VAT.

Batteries: The tax rate is DKr 2 per single rechargeable nickel/cadmium battery, and DKr 8 per battery attached to a technical device or apparatus. The revenues from the tax are earmarked for covering the costs of a collection arrangement for used rechargeable batteries.

Lightbulbs: There is a tax on ordinary lightbulbs whereas energy-saving bulbs are exempted to encourage energy efficiency.

Plastic and paper cups, plates, cutlery, etc.: These are taxed at a rate of 1/3 of the wholesale value, including the tax rate, but excluding VAT. Imports face a tax rate of 50%.

Source: OECD (1995).

Combining Taxes and Tax Reliefs

This scheme combines taxes and tax reliefs or subsidies. Taxes are disincentives to continue with polluting activities while tax reliefs and subsidies are incentives to accelerate the adoption of pollution-control technologies. Examples of tax reliefs include accelerated depreciation, investment tax credits, partial expensing, tax exemptions, tax deductible funds and tax-free bonds. The main issue against tax reliefs and subsidies is that they may be in conflict with the polluter pays principle. Table 1 shows that the tax incentives given in some countries are connected to environmental objectives to avoid this conflict. It is important to note that firms invest in pollution control devices because they are required to do so by law. In other words, environment regulations are the primary incentives for pollution control, and the tax reliefs are designed to lessen the cost of those firms investing in such facilities. Tax reliefs are the carrot while the laws and taxes serve as the stick.

Table 1. Investment Tax Incentives for Pollution Control.

	Type of Incentive	Details
Japan	Special depreciation for pollution control equipment	25% initial allowance, the remainder of the investment cost is depreciated normally
Republic of Korea	Investment tax credit for pollution control equipment Accelerated depreciation for new technologies	3% for imported equipment 10% for domestic equipment 30% for imported equipment 50% for domestic equipment
Netherlands	Investment tax credit for any environmental protection investment	3%-15%, depending on the asset

Source: Jenkins and Lamech (1994).

Conclusion

The first basic requirement in developing a plan is to understand the coastal and reef areas so as to identify areas of particular ecological significance. The second basic need is to understand the pattern of human use and existing property rights regime. A third factor is the realistic assessment of the likely availability of resources for management, education and policing. Implementation of both CAC and market-based approaches involves administrative costs, particularly for monitoring and enforcement. Fourth, a combination of various policy options may be needed to address resource and environmental problems and the cooperation of key stakeholders is essential. Stakeholders, i.e., government, households and firms, should be aware of political and institutional requirements that are keys to the success of various policy strategies, including economic instruments. Fifth, EIs may complement CAC approaches, and may even be more efficient in achieving environmental targets. EIs can correct: (1) market failure by accounting for externalities and correcting prices; and (2) policy failure by making taxes and incentives compatible with environmental objectives and these EIs could result in less distortions in the economic system. To be effective, however, the following points have to considered:

- There has to be a direct and stable link between the EI and the environmental problem;

- EIs must be simple, understandable, transparent and enforceable to guarantee acceptance not only by the targeted sectors, but also by the public at large;
- EIs must be consistent with other government policies;
- Well-functioning markets, together with enforced legislation (standards and liability laws) support EIs; and
- The benefits from implementing an EI must be balanced with the cost of implementing it.

REFERENCES

ADB (Asian Development Bank). 1997a. Strategy for the use of market-based instruments in Indonesia's environmental management. ADB, Manila.

ADB (Asian Development Bank). 1997b. Potential uses of market-based instruments for environmental management in the Philippines: The essentials. ADB, Manila.

Brandon, C. 1994. Reversing pollution trends in Asia. Finance and Development, Vol. 31, No. 2. International Monetary Fund–World Bank, Washington, D.C.

Carpenter, R.A. and J.E. Maragos. 1989. How to assess environmental impacts on tropical islands and coastal areas. East-West Center–Asian Development Bank.

European Foundation for the Improvement of Living and Working Conditions. 1996. Environmental taxes and charges: National experiences and plans. Papers from the Dublin Workshop.

International Institute for Sustainable Development. 1995. Making budgets green: Leading practices in taxation and subsidy reform.

Jenkins, G. and R. Lamech. 1994. Green taxes and incentive policies: An international perspective. Institute for Contemporary Studies, San Francisco.

Lovei, M. 1995. Financing pollution abatement: Theory and practice. Environment Department Papers, No. 628. World Bank, Washington, D.C.

Nomura, Y. and N. Sakumoto, Editors. 1997. Environmental law and policy in Asia: Issues of enforcement. Development and the Environment Series, No. 4. Institute of Developing Studies, Tokyo.

O'Connor, D. 1992. Managing the environment with rapid industrialization: Lessons from the East Asian experience. Organization for Economic Cooperation and Development (OECD), Paris.

OECD (Organization for Economic Cooperation and Development). 1995. Environmental taxes in OECD countries. OECD, Paris.

Panayotou, T. 1993. Economic instruments for environmental management and sustainable development.

Pearce, D. and J.J. Warford. 1993. World without end: Economics, environment and sustainable development. World Bank, Washington, D.C.

Tietenberg, T. 1992. Environmental and natural resource economics. HarperCollins Publishers, Inc., New York.

Tolentino, A.S. 1997. Environmental law enforcement in the Philippines. *In* Y. Nomura and N. Sakumoto (eds.) Environmental law and policy in Asia: Issues of enforcement. Development and the Environment Series, No. 4. Institute of Developing Studies, Tokyo.

Turner, R.K. and N. Adger. 1997. Towards integrated assessment in the coastal zone: A draft discussion document.

White, R.D. 1976. The anatomy of non-market failure: An examination of environmental policies. Am. Econ. Assoc. 66(2): 454-458.

Session III

International Conventions

International Law and Funding of Specific Services in Straits Used for International Navigation: A Case Study of the Straits of Malacca and Singapore

B.A. Hamzah

Maritime Institute of Malaysia (MIMA)
Unit B-06-08 - B-06-11
Megan Phileo Avenue
12, Jalan Yap Kwan Seng
Kuala Lumpur 50450
Malaysia

HAMZAH, B.A. 1999. International law and funding of specific services in straits used for international navigation: A case study of the Straits of Malacca and Singapore, p. 257-275. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper examines the relevance of international law with regard to the provision of specific services in straits used for international navigation with special reference to the Straits of Malacca. The availability of specific services provided by the Straits States to facilitate navigational safety in the Straits are presented. The paper argues that 1) under international law, the Straits States are not obliged to pay for all costs of providing navigational services in the Straits; 2) the Straits States are not obliged to provide facilities or amenities beyond their means; 3) international law does not prohibit coastal states from levying charges on vessels which make use of specific services; and 4) under the polluter pays principle, the shipping community must pay for the common services which they use to protect the environment. The international community is urged to address the issues presented. Unless the stakeholders pay for the services or compensate the Straits States or agree on a recovery payment mechanism, there is a risk that some very critical navigational aids and services may not be provided in the future.

INTRODUCTION

Those who have sailed through the Straits of Malacca and Singapore can attest to the following:

- The Straits of Malacca and Singapore are one of the busiest in the world. In 1977, for example, 130,333 vessels of 75 gross tons and over arrived at the Port of Singapore. Between 30% and 35% of vessels that transit the Straits of Malacca and Singapore are tankers;

- The Straits form the shortest route to the Far East from Europe. A ship from Ras Tanura destined for Japan, for example, sailing at 20 knots could save up to 3.5 days by transiting the Straits of Malacca bypassing the Lombok-Makassar Straits. Translated into dollars and cents, it would mean a savings of US$340 million a year for the Japanese petroleum industry;

- The traffic congestion, the unpredictable heavy rain known as the *"sumatras"* have made the Straits prone to accidents. Between 1977 and 1997, the Lloyd's Maritime Information Services Ltd. (LMIS) based in London recorded 241 casualties[1]. Many accidents in the Straits are not reported and their statistics are not captured in the LMIS database; and

- The availability of specific services provided by Indonesia, Malaysia and Singapore (known as Straits States) to facilitate navigation and to minimize the impact of pollution from ship accidents has helped to promote navigational safety in the Straits. Without these facilities, navigational safety in the Straits of Malacca and Singapore could not have been guaranteed. Without constant vigilance and patrolling by the maritime forces of the three Straits States, it would not have been possible to weed out maritime violence in the Straits, e.g., sea robbery.

[1] *Reports on casualties vary between sources. A UNDP/IMO study puts the number at 476 between 1978 and 1994. See Proposal by UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas on GEF/PDF Block B Grant Request, October 1998 (Draft).*

Measures to Enhance Safety

Some of the measures undertaken by the Straits States to improve navigational safety in the Straits of Malacca include the following:

a. Provision of Navigational Aids

Over the years the Straits States have provided various types of navigational aids to improve navigational safety in the Straits of Malacca using their own limited resources. Among the first navigational aid to be introduced in the Straits was the lighthouse. In fact, the first lighthouse built by the British outside India was the Horsburgh Lighthouse (1854) to provide navigational aid to vessels approaching the Straits of Singapore. Interestingly, the fund to build the Horsburgh Lighthouse was collected mainly from British merchants in Canton, India, Singapore and the United Kingdom. This provides a strong evidence of funding for such common user facility from the shipping community itself. Excluding the Horsburgh Lighthouse, there are 15 other lighthouses in the Straits of Malacca and Singapore. According to a Malaysian report (Muhammad Razif bin Ahmad, 1997), there are 256 different types of navigational aids installed by Malaysia in the Straits of Malacca–10 lighthouses, 103 light beacons and 147 light buoys. These navigational aids are used by all vessels in transit or otherwise.

b. Surveys

Surveys of the Straits bottom are conducted on a regular basis by the Straits States at their own expense.

The first survey of the Straits of Malacca involving outside powers was done in 1971. Japan, a major user of the Straits of Malacca and Singapore sponsored a major survey initiative throughout the Straits of Malacca and Singapore as a preliminary to establishing a routeing scheme in the most critical areas of the Straits. This initiative was undertaken by the Malacca Strait Council in 1971 in consultation with the Intergovernmental Maritime Consultative Organization (IMCO) and the Straits States.

The data from the survey had been used to chart the International Maritime Organization (IMO) approved routeing system in the Straits of Malacca including the establishment of the present two traffic separation schemes (TSS) off Tg. Piai and One Fathom Bank.

The second multinational major survey of the Straits was conducted in 1996 and completed in 1998 (Kikuta, 1998). This four-nation joint resurvey of critical areas in the Straits of Malacca was undertaken with assistance from the Japan International Cooperation Agency (JICA). The data from this survey will become handy in formulating a new routeing system including the decision to extend the TSS from One Fathom Bank to Tg. Piai.

It is also very likely that the data will be used for electronic charting of the entire Straits of Malacca and Singapore. The Singapore Maritime and Port Authority has already released its electronic navigational charts (ENCs) for commercial use effective 17 March 1998 (Chua and Chiew, 1998).

c. Traffic Separation Scheme (TSS)

Following the successful completion of the surveys initiated by Straits States in conjunction with the Malacca Strait Council in 1973, the Oil Companies International Marine Forum (OCIMF)[2] together with the International Chamber of Shipping (ICS) initiated discussions with the littoral States concerning key navigational issues especially the need to accommodate the deep draught passing traffic. With consent from the Straits States, a *Navigation Routeing Guide for Deep Draught Ships* was published in 1976. In 1977, the OCIMF and ICS jointly published the first guide for deep draught vessels on routeing, general caution on navigation, shipborne equipment and communication. The emphasis of the *Guide* was primarily to guide transit for deep draught vessels to maintain a safe underkeel clearance through the critical areas.

The *Guide* was later endorsed by the IMO. In 1979, IMO formally adopted the routeing schemes for two critical areas–off One Fathom Bank and off Tg. Pisang–Tg. Piai at the western entrance to the Straits of Singapore. The IMO promulgated a *"Ship Routeing"* publication for the Straits of Malacca and published supplementary rules for vessels using the Straits of Singapore emphasizing the following:

- Which vessels should use the deep water route;
- Restrictions on overtaking in the deep water route;

[2] *See Submission to IMO—Improving Navigational Safety in the Malacca Straits by Enhancing Traffic Separation Schemes, submitted to General Purposes Committee, Navigation and Routeing Subcommittee, dated 29 June 1993.*

- Conduct of vessels using the traffic lanes;

- Actions to be taken in an emergency to avoid vessels constrained by draught in Singapore main strait;

- Maximum speed of approximately 12 knots for very large crude carrier (VLCC) and deep draught vessels; and

- Speed and maneuvering readiness of vessels navigating in the TSS.

The OCIMF in 1992 has submitted a list of recommendations to improve navigation in the Straits of Malacca. These recommendations which have been incorporated in the revised routeing guidelines included proposals to install light beacons with radar reflectors, and where necessary racons, and in some cases to replace existing buoys with light beacons fitted with radar reflectors. These measures are intended to augment IMO-approved regulations including the two IMO-approved TSS outside the Singapore Strait. Currently, there are no IMO-approved routeing schemes joining the two TSS at One Fathom Bank and off Tg. Piai–Pulau Pisang area. The IMO in May 1998 has approved the proposal to join the two TSS following the completion of a four-nation joint resurvey of critical areas and investigation of dangerous/unconfirmed shoals and wrecks in the Straits of Malacca and Singapore in June 1998. In July 1977, the Straits States submitted a revised proposal to NAV 43 (IMO Committee on Navigation) for an extension of the current routeing system in the Straits of Malacca. The proposal also included an amendment to the present routeing rules/guidelines to upgrade the navigational aids. In May 1998, the Maritime Safety Committee of IMO adopted *"the new and amended TSSs and the Rules to be implemented at 0000 hours (UTC), 1 December 1998. Also adopted by the IMO in May 1998 was the mandatory ship reporting system."*[3]

Malaysia has also agreed to install 10 new aids to navigation and upgrade eight existing ones. All light buoys will also be replaced with light beacons. In November 1998, the Malaysian authorities installed new light beacons.

---

[3] *See New and Amended Traffic Separation Scheme and Associated Routeing Measures, NAV 43/15, IMO, London, 1998.*

d. Vessel Traffic System

The Singapore Port Authority (SPA) has since 1990 successfully introduced a vessel traffic information system (VTIS) to promote navigational safety in the Strait of Singapore and within its port limits. Despite this, accidents still happen. The most recent major incident was in October 1997 when two vessels, the *Evoikos* and the *Orapin Global* collided in the traffic separation channel spilling some 25,000 tonnes[4] of heavy fuel. Nonetheless, the VTIS has proven to be effective in promoting navigational safety in Singapore waters.

The Government of Malaysia has also introduced in 1988 at a cost exceeding US$40 million a comprehensive radar-based VTS consisting of nine radar sites and three control centers, along the Straits of Malacca to promote navigational safety and to augment the existing navigational aids system. The VTS has combined the operating concept of both a coastal VTS and a port VTS. The coastal VTS is designed according to one report (Naipul, 1995) *"... to assist with the safe and expeditious passage of ships through the Straits while the port VTS is designed to increase efficiency, productivity and safety of vessels sailing in and out of ports."*

The major objective of the Malaysian VTS system is *"to provide for the safe navigation of vessels using the waters and ports of Malaysia, to regulate the prevention of pollution caused by vessels and to facilitate the implementation of contingency plans involving maritime disasters."* Within this general scope of objective, the VTS is intended to do the following (Osman, 1995):

- Provide surveillance to all types of shipping under all weather conditions to enhance safety and minimize marine pollution resulting from accidents;

- Monitor the movement of vessels within critical areas as well as monitor illegal dumping of waste by vessels; and

- Assist with search and rescue operations, management of marine pollution.

The VTS system is also intended to be integrated with the entire navigational system already in place in the Straits of Malacca. In other words, it provides another instrument or tool for ensuring navigational safety in the Straits and should be seen as additional to the IMO-approved TSS, the routeing guidelines and mandatory reporting system that has been approved in May 1998. In this sense, the VTS is not a stand-alone system.

---

[4] *1 tonne = 1 metric ton*

Cost

The cost to provide all services in the Straits of Malacca and Singapore is borne entirely by each individual Strait State. International law prohibits Straits States from levying charges *"upon foreign vessels by reason of their passage"* but it does not forbid charges as payment for specific services rendered to the ship.[5] While there is no intention on the part of Malaysia or other Straits States to impose a levy or toll on passing ships—especially those in transit—it is important to bear in mind that funds have to be raised by each Strait State to provide specific services.

Almost all tankers transiting the Straits of Malacca and Singapore are destined for the Far East—Taiwan, Hong Kong, Republic of Korea, China and Japan. As alluded to earlier, these tankers do make an economic savings by using the shorter route and yet they make use of specific services which the coastal states currently provide free of charge. In other words, the Straits States—especially Malaysia—are currently subsidizing the better-endowed economies of the world as those who transit the Straits do not have to make any contribution for installing and maintaining the facilities from which they benefit. This is an inequitable and unfair situation. The time has come for those in the Far East whose vessels have benefited from the specific services rendered to them in the Straits of Malacca to compensate in kind or cash or help alleviate the burden of those who have provided these specific services by contributing, for example, to a special fund (Hamzah and Basiron, 1995).

Malaysia has made it public that it wants to be compensated for the services that it has provided in the Straits of Malacca. The cost to Malaysia for providing these services is quite high. Muhammad Razif bin Ahmad (1997) has estimated it costs the Malaysian Government well over RM100 million a year to maintain various services in the Straits of Malacca. This RM100 million a year is just the operating cost. The capital cost to put up 10 lighthouses, various buoys, beacons and vessels to undertake patrols in the Straits of Malacca on a daily basis was very high. The cost to Malaysia since 1984 has been estimated at exceeding RM1 billion.

Malaysia openly calls for an equitable burden-sharing system in the Straits of Malacca (Hamzah, 1997). An appeal is made to all stakeholders (particularly those who directly benefit from the specific services in the Straits of Malacca) to contribute

[5] *Article 26 of the United Nations Convention on the Law of the Sea. Should be read together with Article 43.*

to the cost of installing and maintaining all navigational aids/system in the Straits of Malacca. The only foreign country which has compensated the Straits States or contributed in kind and cash to the Strait States is Japan. The Japanese contribution (1968-1993) has been estimated in 1995 at less than US$70 million. This figure is minuscule compared to the cost provided by coastal states for navigational safety programs in the Straits of Malacca and Singapore. Excluding the cost to resurvey the critical parts of the Straits which was completed in February 1998, the benefits which Japanese industries have accrued over the years for using the Straits far outweigh their contribution. However, this figure of US$70 million does not include a revolving fund of Yen 400 million which Japan set up in 1981 for oil spill cleanup in the Straits of Malacca (Ono, 1997).

Purpose

The purpose of this article is to establish the "sources" and "evidences" in international law on payment for specific services in straits used for international navigation, e.g., the Straits of Malacca and Singapore by those who use them either directly or indirectly. These services are specific in nature rendered in a non-discriminatory fashion for general use at a cost by Straits States in their respective waters. The "payment" for specific services, which can take different forms, is primarily towards alleviating, compensating or contributing to the cost of putting up and maintaining these services by the Straits States.

International Law

Policy planners who want to establish the rules and principles of international law that apply to a given situation have no universally recognized body of world statutes to which they can refer. They must search for the relevant law by making references to the diverse sources and evidences of international law. The term "sources" refers to the methods and procedures by which international law is created; the term "evidence" refers to the "documentary evidence" that supports the existence of a particular rule or principle.

The most authoritative statement of the sources and evidences of international law is Article 38 of the Statute of International Court of Justice, which reads:

1. "The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:

a) International conventions, whether general or particular, expressing rules recognized by the contesting states;

b) International custom, as evidence of general practice accepted as law;

c) The general principles of law recognized by civilized nations; and

d) Subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.

2. This provision shall not prejudice the power of the Court to decide a case *ex aequo et bono*, if the parties agree thereto."

The question of who should pay for specific services to facilitate navigation in the territorial sea and Straits used for international navigation has long been the concern of the international community. Apart from giving substance to the polluter pays principle and user pays principle, the matter has been codified in many international instruments. Article 26 (2) of the 1982 United Nations Convention on the Law of the Sea (UNCLOS) states that "charges may be levied upon a ship passing through the territorial sea as payment only for specific services rendered to the ship. These charges shall be levied without discrimination." This paragraph should be read together with 26(1) which states "no charge may be levied upon foreign ships by reason only of their passage through the territorial sea."[6]

In the 19th century, the Baltic States, in particular Denmark, used to levy charges on vessels passing through their straits. But the practice was discontinued following pressure from the United States vide the Treaty for the Redemption of the Sound Dues (4 March 1857) and the Convention for the Discontinuance of the Sound Dues between Denmark and the United States, 11 April 1857 (Roach and Smith, 1994).

In other words, the current practice only prohibits states from levying any toll on any vessel passing through its territorial sea or straits used for international navigation for mere passage. However, the law does not prohibit charges for specific services including light dues and use of navigational aids. In fact, it is

6 *The United Nations Convention on the Law of the Sea, New York, 1983.*

now part of international norm for users to pay for services rendered to them. Moreover, it is reasonable to expect beneficiaries of services to pay for goods or services especially public goods which when provided are available to all.

The issue here is, unlike the consumption of other public goods, i.e., sunlight and air, the specific services which are provided in the Straits of Malacca, for example, are not free. There is a cost to construct the facilities like lighthouses or dredging works. The costs are currently incurred by one party that provides the navigational aids, while another party enjoys the benefits. Making the issue more complex is a mistaken belief by some users that they are not under any obligation, moral, legal or otherwise, to share cost, compensate or pay the providers of these services.

Some are also under the false impression that it is incumbent upon coastal states or Straits States to provide these services regardless of cost and affordability. Yet, those who sail through the Suez or the Panama Canal do not complain for compensating the Suez Canal Authority and the Panama Canal Authority in the form of payments for specific services. There lies the irony. But the same people would protest to any kind of payment when they sail through the Straits of Malacca benefiting from the common facilities provided by the coastal states. It is true that the legal regimes for the waterways or straits used for international navigation are different. But the payment that users make to access the Suez or the Panama Canal has to do less with the legal status of the strait or waterway or whether it belongs to a particular nation or governed by a certain treaty or not. Rather, the dues are payment for specific services rendered by the states which benefit those who use the canals. These payments are intended to alleviate or compensate the states for providing and maintaining these services. This is just one way for providers of the services to recover partial cost.

In light of this practice, it is useful to examine the international law or state practice on this matter in detail. Contrary to general opinions, and notwithstanding Article 26(2) of the 1982 UNCLOS, the issue of who pays for navigational aids or services has been a subject of recurrent debates. There is no established legal authority making it mandatory for coastal states to provide and maintain services in straits used for international navigation. On the contrary, research demonstrates strong evidence of user states contribution funding these services in the past. Due to the complexity of navigational safety needs, such practice should continue. Irrespective of past practices it will be difficult for any rational person in this new millennium to even think, let alone justify, that he is entitled to make free use of specific services in Straits. Similarly it would be unreasonable, as it goes against the dictates of reason, to expect only coastal states to provide these services free-of-charge. The expenditure involved can be out of proportion to the traffic and benefits concerned. Not only is it common sense to expect the providers of these services to be compensated and recover some cost. Indeed, an obligation exists under the user pays principle of international law for all users to contribute their share of the benefits to those who provide these facilities.

PRECEDENTS

Evidence of general practice implies that it is in the interest of coastal states to provide navigational aids to facilitate passage. Yet, they are under no legal obligation to provide these facilities all by themselves especially in straits used for international navigation. The users of the waterway are equally responsible to share the cost. The mechanisms for cost sharing vary. Nevertheless, there were some precedents. Take the case of the lighthouse on Cape Spartel, built by the Sultan of Morocco in 1864. It was agreed by a convention (1865) that *"the expenses for upholding and managing the lighthouse shall be borne by the contracting powers..."* [emphasis by author] (Santos and Lennhoff, 1951).

Almost two decades before the Sultan of Morocco built the lighthouse on Cape Spartel using initially his own fund, the British Colonial Authorities in Malaya were faced with an almost identical problem, i.e., how to ensure the safety of vessels entering the Strait of Singapore from its eastern approach. As in the case of Morocco, the area off Tanjung Ramonia was not only prone to accidents but it was a graveyard for shipwrecks. It was also plagued with pirates. The issue of navigational safety became the rallying point for traders in the Far East, India and United Kingdom.

The Colonial Office in London in consultation with the Colonial Government of the Straits Settlements in Malaya agreed, following a spate of accidents between 1822 and 1851 and numerous petitions from the traders, to construct a lighthouse in 1847 on Pulau Batu Putih, a territory of the Sultanate of Johore (Thompson, 1852). The decision to construct the first lighthouse east of India was certainly an important milestone in the efforts to promote navigational safety, *albeit* in support of broader colonial trading interests. Of significant interest to this article is not the construction of the lighthouse per se, rather the manner in which the fund was raised from the private sector to realize this project.

According to one report (Thompson, 1852), Messrs. Jardine, Matheson and Co., a leading trading house in Canton with links in the British Empire, acted as treasurers to collect money for a memorial to Horsburgh, a British hydrographer. As it is well known, the lighthouse which still stands today, on Pulau Batu Putih bears his name and is popularly known as the Horsburgh Lighthouse. Money for the Horsburgh Lighthouse was also collected from trading houses in Bombay, British India and Penang Chamber of Commerce. The Chinese Security Merchants based in Canton also contributed. There were also philanthropists who contributed (e.g., Sir Charles Forbes).

The Government of the Straits Settlements contributed in kind, e.g., by providing the services of an engineer and other professionals, two gunboats, a steamer and other logistics. Incidentally, the Dutch Authorities of Rio also assisted by deploying gunboats as tenders to assist with the construction of the lighthouse. This demonstrates international support for the construction of the Horsburgh Lighthouse, an important facility to promote safe navigation. It is also interesting to note that the entire cost for the construction was borne by the users and not by the Colonial Government of Singapore.

The Government of the Straits Settlement advanced some fund to make up for the shortfall on the understanding that it would be recovered from light dues from shipping. This compensatory mechanism provides a precedent of payments by those who use the services of the lighthouse. Such payments can be conceived as a form of cost sharing, cost recovery or compensation to the Government for providing the services.

Another precedent of relevance was the 1898 treaty between Great Britain and the United States of America.[7] In 1930, the British Government exchanged notes with the United States of America Government as annexes to a Treaty imploring the latter "to give favorable consideration to the question of compensation... in respect of the capital expenditure incurred by the Company [British North Borneo Company] in connection with the lighthouse situated on [Taganak Island], and that the United States Government will provide for the future maintenance of the lighthouse." However, on assuming independence from the United States on 4 July 1946, the Philippine Government refused to abide by the *Exchange of Notes* with regard to compensating the British Government for the capital cost of the lighthouse at Taganak Island and provide for its future maintenance. The arguments put forth by Manila were based on the following:

- The services provided by the lighthouse did not benefit the Philippines. The assumption to be drawn from this is that Manila would not object to pay for these services if they had benefited from them;

[7] *The Treaty of Peace concluded in Paris between the United States and Spain on 10 December 1898 ending the Spanish-American War. See also terms of Treaty between the two countries on 7 November 1900.*

- The Philippine Government could not maintain a service that it did not need and "which would be difficult to justify to the people of the Philippines"; and

- The lighthouse was destroyed during the war with Japan and was not in working condition at the material time. Manila also claimed the lighthouse ought to be in working condition before it could assume responsibility.

Unhappy with the decision of the Philippines not to honor the earlier commitment made on its behalf by the administering power [USA], on 26 May 1948, the British Minister in Manila reminded the Philippines' Secretary of Foreign Affairs in a letter of specific obligations arising from the *Exchange of Notes* and that "to remind the Government of the Philippines that it is in any case an accepted obligation of sovereign states to ensure the safety of shipping about their coasts by assuming responsibility for the provision of lighthouse and other necessary navigational aids..."[8]

When pressed, Manila admitted, however, that it had a moral obligation to ensure the safety of navigation along its coast, but it would only provide necessary navigational aids "consistent with financial ability."[9] What is clear from the *Exchange of Notes* between Manila and London with regard to this case are the following:

- There exists only a moral obligation for coastal states to facilitate navigational safety measures in their water; and

- The provision of navigational aids must be consistent with financial capacity. In other words, the coastal states cannot be held responsible for not providing facilities if they cannot afford it and if they do not directly benefit from such facilities. On the contrary, it is incumbent upon all the users of the straits or waterways to share the expenses with those who provide these services.

Precedents have been cited in 1853 (Straits Settlements), 1857 (Denmark), 1865 (Morocco), 1930 and 1948 (UK-Philippines) to demonstrate that it was a common practice for states to share or contribute to the cost of constructing and maintaining navigational safety services e.g., lighthouses. While some of these

---

[8] *See the Exchange of Notes between Great Britain and United States dated 3 and 10 July 1907. Letter of the British Ambassador (Durand) to the Secretary of State, 29 September 1905. See also the terms of Convention between Great Britain and the United States dated 2 January 1930.*

[9] *Letter of the Philippines' Secretary of Foreign Affairs to the British Minister in Manila dated 24 September 1947.*

practices may have been discontinued, there is ample evidence that such practices are now continued to the present time, e.g., in the Straits of Malacca.

Following a spate of accidents in the Straits of Malacca in the 1980s, some concerned parties in Japan petitioned the Straits States and the Intergovernmental Maritime Consultative Organization (IMCO) (now the International Maritime Organization in London) to undertake measures to promote navigational safety in the Straits of Malacca and Singapore. As it is well known, most of the tankers (approximately 70%) that transit the Straits of Malacca and Singapore are destined for Japan and the Far East. These tankers have used the Straits of Malacca as an alternative convenience to the much longer route via Lombok and Makassar Straits within the Indonesian archipelagic waters. In October 1965, the Japan Captains Association, for example, submitted a petition to the Japan Maritime Agency calling for a thorough hydrographic survey and chart revision of the Malacca/Singapore Straits. The Ministry of Transport in Japan also received petitions from other interested parties following the *Torrey Canyon* disaster in March 1967. It was the *Torrey Canyon* incident that led to a series of measures adopted by the IMCO to promote navigational safety at sea. The idea of a TSS in some restricted waterways like the Straits of Malacca and Singapore was a direct result of the *Torrey Canyon* disaster.

The Japanese fear of disaster in the Straits of Malacca was heightened following the grounding of *Tokyo Maru*. On 4 April 1967, the *Tokyo Maru* (159,815 DWT) ran aground in the Straits of Malacca off the coast of Tg. Medang while navigating with a draft of 16.37 m. Fortunately for *Tokyo Maru*, the bottom of the seabed was sandy, its oil cargo did not escape and a major disaster was averted. Following later petitions from the Japanese Shipowners' Association and other concerned parties, the matter was brought before the Maritime Safety Committee of IMCO. Working together with the three Straits States, it was possible for Japan to pressure IMCO to survey the Straits of Malacca and Singapore and to recommend preventive measures [including the establishment of TSS, new charts and installation of navigational aids in the Straits of Malacca and Singapore]. As alluded to earlier, Japan has spent US$70 million for its Malacca Straits projects between 1968 and 1993. The point to be driven home is the willingness of the major beneficiary of the services in the Straits, i.e., Japan, not only to fund the cost of improving navigational safety aids but also to provide adequate means to survey and rechart the Straits. The Japanese did not expect the less endowed Straits States to pay for all the services which they too enjoy by virtue of their existence. Their positive contribution provides a basis for others to emulate.

The Japanese contribution has not been substantial when compared to the cost borne by the Strait States to install and maintain specific services in the Straits of Malacca and Singapore. But it is more than a symbolic gesture. However, so far Japan is the only nation which has volunteered to share or contribute to the cost for installing navigational aids, removing wrecks, dredging bottoms, surveys and other related services.

This assistance from Japan is not a one-time contribution. Japan has from time to time come to the assistance of the Straits States. For example, in June 1996, through JICA Japan funded a four-nation joint resurvey of critical areas in the Straits of Malacca and Singapore (JICA, 1996). By continuing to fund such services in these Straits and instituting a Yen 400 million Revolving Fund in 1981, the Japanese, as a stakeholder have not only recognized the importance of keeping the Straits safe for navigation at all times. They have also provided a strong precedent in cost sharing in modern-day. They have also become a responsible stakeholder as they realize their economic interests are also at stake. The problem is, apart from Japan, no other external stakeholder in the Straits of Malacca finds it necessary to contribute. Other examples can be cited.

In Great Britain, Northern Ireland, Eire, the Channel Islands, the Isle of Man and the adjacent seas, all expenses relating to lighthouses, buoys and beacons are currently maintained by the General Lighthouse Authorities (GLAs). These expenses are met out of a self-supporting fund known as the General Lighthouse Fund. This fund is maintained by light dues income, the collection and accounting of which are centralized and controlled from Trinity House. These light dues are levied on a scale and in accordance with the rules laid down in the Merchant Shipping (Light Dues) Regulations–1990 and various amendments (Marlow, 1997).

Navigation dues are also payable for services in the Persian Gulf area. Except for warships, vessels which enter for bunker fuel, vessels which enter from stress of weather, sailing ships and vessels below 250 net registered tons, all other vessels trading or permanently based in the designated Gulf area are required to pay navigation dues to the Middle East Navigation Aids Service (MENAS). MENAS is a company registered in London but operating in the Gulf at Manama, Bahrain (Marlow, 1997).

There is reliable information[10] that Turkey is also toying with the idea of introducing a service on a voluntary basis in connection with oil spills, fire fighting and rescue in the Turkish Straits. Those who want to enjoy these services have to register as members of an organization known as MARPOL Base Center. As

[10] *Private communication with Norpol Marine Services Norway and Captain Dagci of TURMEPA or Turkish Marine Environment Protection Association, 9 October 1998.*

subscribing members, they are entitled to receive assistance from an independent contractor for the listed services. These services are not provided free. Instead, the members have to pay the MARPOL Base Center the following agreed rates according to vessel size.

- The rates for transiting vessels are: US$400 for vessels under 50,000 DWT and US$800 for 80,000 DWT and above.

- Special emergency service is also provided by the MARPOL Base Center on a pro-rata basis at US$18,000 a day on a first-come-first-served basis.

The compensatory financial mechanisms or burden-sharing regime in the Straits of Malacca, in the Middle East and the Turkish Straits are still voluntary in nature. The fact that some have agreed to pay or compensate or assist the Straits States for providing services, installing facilities and maintaining them points to some form of an accepted state practice.

Conclusion

The reasons for international funding support are obvious. Firstly, it is **not** inconsistent with international law. Under the commonly accepted user pays principle, users of specific services in the Straits of Malacca ought to pay for these services which have been rendered to them at a cost. Secondly, the element of burden-sharing or cost-sharing is now an accepted international norm. This places further obligation on users. While it is true that the services directly benefit the coastal states, but being common facilities the other users also benefit. It is incumbent upon them to pay for this benefit. Thirdly, there is a risk that some very critical navigational aids and services may not be provided in the future if Straits users, apart from coastal states, are not prepared to chip in. As the financial cost can be too high for the coastal states to bear alone, without matching support from the other beneficiaries, they may not have the incentives to provide *additional* specific services. Moreover, it is unfair to expect the Straits States to bear all the expenses relating to navigational safety and pollution management in Straits used for international navigation.

Despite the discontinuance of practices in the recent past, there would appear to be willingness on the part of some to contribute to the installation and maintenance of navigational facilities in Straits used for international navigation.

It was pointed out in the paper and elsewhere that Japan has from time to time made voluntary contribution to the Malacca Straits States. In the Persian Gulf, those who use the MENAS facilities also pay for these services. Soon the Turkish Marine Environment Protection Association (TURMEPA) will introduce a mechanism requiring ships transiting the Turkish Straits to pay for services provided by an organization known as the MARPOL Base Center. Presently, these mechanisms are voluntary in nature. The challenge to the coastal states is to expand these financial recovery mechanisms to involve all responsible stakeholders to spread the cost as well as risk.

The UNCLOS is quite specific on this matter. Article 26(2) of UNCLOS permits coastal states to levy charges on vessels for using specific services. Since the services which Straits States provide in the Straits of Malacca, for example, are specific and common in nature and they benefit those who transit the Straits, a levy or fee can be instituted. Such levies will not be contrary to Article 26(8). However, it is admitted that collection of levies would be impractical. Hence, it is easier for all stakeholders in the Straits of Malacca to contribute to an international fund or provide direct assistance as Japan has done. A revolving fund, along the line set up by Japan in 1981 would also be a way forward.

Whatever cost-recovery system is adopted, it should not be profit motivated nor discriminatory in nature. The fund should be used only for installing, improving and maintaining specific and common services and the coastal state should not use this fund for any other purpose. It would make sense, however, for the fund to be deposited and managed by coastal states as it is currently practiced with regard to the Japanese revolving fund.

In conclusion, under the user pays principle of customary international law an obligation exists for users to "pay" for specific services provided for their use in Straits used for international navigation as in the Straits of Malacca and Singapore. It is only the mode of cost-recovery or compensation that remains to be resolved.

References

Chua, W. and Chiew Chee Mun. 1998. Development of electronic navigational charts – The Singapore experience. *In* Seminar on Enhancing Safety of Navigation in the Straits of Malacca and Singapore, 24-25 June 1998, Bangi, Malaysia.

Hamzah, B.A. and M. Nizam Basiron. 1995. The Straits of Malacca: Some funding proposals. Maritime Institute of Malaysia, Kuala Lumpur.

Hamzah, B.A. 1997. Navigational safety and environmental protection in the Straits of Malacca: The need for global funding. *In* M. Kusuma-Atmadja, T. Mensah and B. Oxman (eds.) Sustainable development and preservation of the oceans: The challenges of UNCLOS and Agenda 21. Law of the Sea Institute, Hawaii.

JICA (Japan International Cooperation Agency). 1996. Report on the Four Nation Joint-Resurvey of Critical Areas and Investigation of Dangerous and Unconfirmed Shoals and Wrecks in the Straits of Malacca and Singapore, October 1996.

Kikuta, T. 1998. Summary of the four nation joint re-survey of critical areas and investigation of dangerous/unconfirmed shoals and wrecks in the Straits of Malacca and Singapore. *In* Seminar on Enhancing Safety of Navigation in the Straits of Malacca and Singapore, 24-25 June 1998, Bangi, Malaysia.

Marlow, P. 1997. Financing Straits management: Inherent problems, p. 165-180. *In* Hamzah Ahmad (ed.) The Straits of Malacca: International co-operation in trade, funding and navigational safety. Pelanduk Publications (M) Sdn. Bhd., Malaysia in association with the Maritime Institute of Malaysia, Kuala Lumpur. 359 p.

Muhammad Razif bin Ahmad. 1997. The financial cost of risk management in the Straits of Malacca, p. 187-219. *In* Hamzah Ahmad (ed.) The Straits of Malacca: International co-operation in trade, funding and navigational safety. Pelanduk Publications (M) Sdn. Bhd., Malaysia in association with the Maritime Institute of Malaysia, Kuala Lumpur. 359 p.

Naipul, S. 1995. Navigation in the Straits of Malacca: Technical components of the use of VTS to reduce risks. Paper presented at the Conference on Vessel Traffic System, 5 December 1995, Maritime Institute of Malaysia, Kuala Lumpur.

Ono, A. 1997. Japan's contribution to safety and pollution mitigation in the Straits of Malacca, p. 241-246. *In* Hamzah Ahmad (ed.) The Straits of Malacca: International co-operation in trade, funding and navigational safety. Pelanduk Publications (M) Sdn. Bhd., Malaysia in association with the Maritime Institute of Malaysia, Kuala Lumpur. 359 p.

Osman, M. Sidik S. 1995. A vessel traffic system for the Straits of Malacca, Singapore and Johore. Paper presented at the Vessel Traffic System (VTS), 5 December 1995.

Roach, A. and R. Smith. 1994. Excessive maritime claims. US Naval War College Studies. Vol. 46. Newport, Rhode Island.

Santos, V.A. and D.T. Lennhoff. 1951. The Taganak Island lighthouse dispute. Am. J. Intl. Law 45: 680-688.

Thompson, J.T. 1852. Account of the Horsburgh Light-House. The Journal of the Indian Archipelago and Eastern Asia (1852): 497.

Regional Convention as an Effective Mechanism for Marine Pollution: The European Experience*

Marc Richir

European Commission
Environment, Nuclear Safety and Civil Protection/Water Protection
TRMF 3/106, Rue de la Loi 200, B-1049 Bruxelles, Belgium

RICHIR, MARC. 1999. Regional convention as an effective mechanism for marine pollution: The European experience, p. 276-286. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Regional marine environment cooperation in Europe can be seen as a system with two functions: integrating the international requirements at the regional level and providing solutions to regional environmental problems. This system encompasses two complementary approaches: on the one hand, the integrated framework of the European Community (EC) and, on the other hand, the regional Sea Conventions for the Marine Environment. The EC has built up a body of policy and binding legislation to protect the marine environment and coastal zone. It has also played an important role in international and regional action where the coordination between the Member States has allowed the EC to speak with one voice. However, providing effective solutions to marine environmental problems transcends the EC framework and requires the involvement of all the parties concerned. On the basis of the marine conventions, the states bordering the main European marine areas have built up an effective system of regional cooperation to which the EC has progressively participated. Over the past twenty years, these marine conventions have proven to be a means of building confidence and mutual understanding between the often different contracting parties

* *The expressed opinions are those of the author and do not engage the European Commission. The author only used generally accessible documents.*

and conventions. They have fostered information and experience exchange and contributed to improve the state of scientific knowledge about the marine environment and sources of pollution. They have also proven to be the most appropriate forum for the design and implementation of concrete solutions to regional marine pollution problems and for distribution and coordination of the available resources. But a convention is only a tool; its usefulness depends very much on continued political support for its work and on the constant determination of the contracting parties to implement the agreed measures faithfully.

The Marine Environment in Europe: An Overview of the Problems

The seas and the coastal environment, representing major economic and ecological resources, are essential for Europe. The high degree of industrialization and densely populated areas—about one-third of the European population lives within 50 km of coastal waters—has contributed to pollution of the seas. Not surprisingly, Europe also suffers from the negative effects of pollution.

It is, of course, difficult to attempt to diagnose the state of European coastal waters given the lack of reliable indicators. Nevertheless, according to the Second Assessment of the European Environment, published in 1998 by the European Environment Agency, it can be observed that, in the marine areas bordering Europe, the main problems are:

- Eutrophication: One of the major pollutants threatening Europe's coasts is nutrients, mainly from direct discharges from industry, agriculture and sewage, by river transport and by deposition from the atmosphere. As the nutrients break down, they use up so much oxygen that only a few plant species (essentially algae) are able to survive. The proliferation of the plant species steadily suffocates the surrounding ecosystem and gradually affects the recreational uses of marine and coastal zones;

- Contamination, particularly by heavy metals, persistent organic pollutants and oil: Contamination of sediments and biota by chemicals is common in almost all European seas. Elevated concentrations of heavy metals and polychlorinated biphenyls (PCBs) have been found in fish and sediment, with high levels near the point sources of emission. The annual number of oil spills seems to be on the decrease but small and occasional large spills and many illegal discharges of smaller amounts of oil in zones of heavy boat traffic still cause significant local damage;

- Overfishing: Many of the fish stocks are heavily exploited by European vessels. Overfishing causes changes in the species composition of the biological communities and changes in the size and age structure of the affected species; and

- Degradation of coastal zones: The coastal zones of Europe attract a wide range of human activities. The population of coastal urban agglomerations continues to grow, resulting in increased competition for limited resources as well as promoting pollution, habitat destruction and coastal erosion. Continuing pressure to develop coastal areas for housing, industry, tourism, fisheries and other uses will exacerbate these problems and further threaten the coastal ecosystems.

As a result of these problems, a multitude of decisions and initiatives have been implemented by a huge variety of actors at the regional, national and international levels, to protect and to halt the damage to the coastal and marine environments in Europe.

Regional Marine Environment Cooperation in Europe: One System; Two Complementary Approaches

The panorama of cooperation in the field of marine environment protection against pollution in Europe can be seen as a system which has two main tasks:

- To integrate at the regional level the international requirements for marine environment protection resulting from global conventions (e.g., UNCLOS) or global specialized conventions (e.g., London Dumping Convention, Persistent Organic Pollutants [POPs] Convention, Convention on Biodiversity, MARPOL Convention); and

- To take into account the specific problems of each regional marine area and to provide the adequate regional solutions.

The European marine environment protection system is, thus, an interface between the international requirements and particular regional circumstances.

In order to fulfill these tasks, the European marine environment protection system operates under two frameworks of cooperation which coexist and complement each other. On the one hand, over the last 30 years, the EC with its 15

Member States has developed an important body of binding legislation and other measures to protect directly or indirectly European coastal areas and the marine environment. On the other hand, Europe has three regional conventions: the OSPAR Convention for the Northeast Atlantic, the Helsinki Convention for the Baltic Sea and the Barcelona Convention for the Mediterranean Sea. These conventions are subject to international law and they were set up with the aim of promoting international cooperation between all stakeholders in each marine area (i.e., the EC Member States and non-EC Member States together).

This paper presents an overview of the EC's approach to marine environment protection and how the regional conventions operate.

The European Community Framework: An Integrated Approach

Aquatic environments are very complex systems, and there is a need for a comprehensive approach addressing all the relevant sources of pollution from land- and sea-based sources and point and diffuse sources.

The EC aimed first of all at tackling the sources of pollution within its own boundaries. Therefore, it has mainly taken initiatives to prevent pollution from land-based sources. Most of these were legislative measures to prevent discharges of pollutants to Europe's rivers and lakes and to prevent air pollution. Apart from water protection and control on air emissions, the EC legislation also includes restrictions on marketing and use of certain dangerous substances, instruments for the protection of species and habitats, and management of waste including waste from ships. The EC also aims to support and assist Member States in the control of accidental pollution by establishing an information system that allows prompt access to information on human and material resources throughout Europe. Concerning the integrated management and sustainable development of coastal areas, the European Commission has launched in 1995 a demonstration program aiming to provide a technical basis for identifying the conditions which have to be met so that sustainable development could be achieved in the various European coastal situations; to stimulate debate between the principal parties involved in the development of the coastal zones and to permit the design of proposals for a coherent program of actions and measures which would form the European Strategy. As explained at the beginning of this paper, overfishing is a problem within European Union waters. It was considered that a number of stocks have exceeded the maximum sustainable yield or would become so at current levels of fishing. To tackle this problem, the EC developed a Common Fisheries Policy based on the concept of total allowable catches (TACs). The TACs are divided among Member States in the form of quotas. This approach is supported by a policy of limited fishing effort and the reduction of the fishing fleet to a size that is compatible with the availability of the stocks.

In addition to the Community legislation, the EC is involved in several international marine conferences and conventions. These include notably, at global level, the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities managed by the United Nations Environment Programme (UNEP), the Commission for Sustainable Development's (CSD) work on Oceans and the International Maritime Organization's (IMO) work on Marine Pollution under its Marine Pollution Convention (MARPOL).

At the regional level, the Community is a contracting party to the Helsinki Convention for the Baltic Sea, the OSPAR Convention for the Northeast Atlantic and the Barcelona Convention for the Mediterranean Sea. Notably, only the EC is a contracting party to all three conventions. Consequently, the Community has an important role to play in ensuring that the measures taken by the contracting parties in the context of the conventions are coherent. Even if the Community's role in these conventions differs according to the extent of its formal competence, the European Commission tries to coordinate Member States' view in advance of negotiations to present a common position and to ensure that the measures taken are compatible with—and at least as ambitious as—the existing Community legislation.

The Regional Sea Conventions

The OSPAR Convention, Helsinki Convention and Barcelona Convention are very different. They are concerned with totally different marine areas and their contracting parties are very different in nature. For example, the contracting parties to the OSPAR Convention are all similar socioeconomically. This is not the case at all for the contracting parties of the Mediterranean Convention. Not all of the contracting parties to the Helsinki Convention are part of the EC although many of them will join the Community sooner or later.

However, the regional marine conventions in Europe have also many things in common. First, they were all initiated more or less at the same time, at the beginning of the 1970s, in the context of growing public awareness of the importance of protecting the environment. At the beginning of the 1990s, after 20 years, they were all reviewed at the same time. These reviews took place in the general context of the preparation of international action on environmental matters (notably, the United Nations Conference on Environment and Development). The review provided an opportunity to modernize the conventions (and even, in the case of the Barcelona Convention, to extend its scope) as well as to integrate new principles (precautionary principle, polluter pays principle, and the use of best available technology and best environmental practices). The review also provided an opportunity to improve public access to information and to foster a broader participation of the public in the process through recognizing the role of nongovernment organizations. The organizations acting at the regional, national and local levels play an important part in identifying problems and raising environmental awareness and managing action programs.

The conventions have also established permanent secretariats to administer multilevel structures of political direction and decision-making, coordination of programs and dedicated working groups. They all cover the same or related environmental topics (e.g., hazardous substances, eutrophication, protection of species and habitats, offshore pollution, pollution from shipping, emergency circumstances and coastal management).

Are the regional marine conventions an effective mechanism for marine pollution? To answer this question, it is necessary to examine what the tasks of these conventions are and how these tasks are fulfilled. In general terms, the regional environment marine convention tries to fulfill two main tasks: the monitoring and assessment of the marine area and providing instruments to achieve their objectives.

Monitoring and Assessment of the Marine Area

The regional conventions must monitor their marine areas and make an assessment of the nature of the environmental problems in each area so as to develop a reliable platform for the selection of measures to be taken to ameliorate these problems and to assess the impact of these measures. This is not an easy task due to the complexity of the marine environment, the diversity of the sources of pollution and the nature of the data that have to be collected. Nevertheless, all the European regional conventions have tried to develop measures for the monitoring and assessment of the marine environment.

Turning now to the Mediterranean Action Programme, the activities related to the assessment and control of marine pollution are organized and coordinated by the MED POL Programme. The Programme, developed over 20 years, focuses on long-term monitoring to assess marine pollution and research to provide a scientific basis for the implementation of the convention and its protocols. The MED POL Programme has moved towards pollution control and capacity building activities for its implementation. But, from the outset, monitoring data proved to be heterogeneous and difficult to compare. Consequently, a Data Quality Assurance Programme was launched in 1987, including training, scientific visits and equipment checking and maintenance, with the aim of obtaining reliable and comparable information about the state of the Mediterranean Sea. This has led to the real improvement of capacities in the countries concerned.

The OSPAR Commission also felt that it was important to have reliable data about the state of the marine environment. A quality status report on the marine environment of the Northeast Atlantic is being prepared and will be published in the year 2000. This is the first time that a comprehensive quality status report on this scale will be produced. It should prove to be an important scientific basis for identifying and prioritizing future tasks for the convention within an overall comparative approach.

The final report of the Helsinki Commission, published in 1998, mentioned that the experience gained from the compilation and assessment of pollution load data in the Baltic highlights that the monitoring methodologies in current use are insufficient. Even if the pollution load data compiled by the contracting parties have improved, the quality of pollution load data still varies from country to country resulting in conflicting estimates of the total pollution load to the Baltic Sea. In some cases, other research findings indicate higher levels of pollution. Such uncertainties call for further development of additional tools to evaluate how well the convention's measures are being implemented.

In conclusion, this issue is a horizontal problem for the regional conventions in Europe. Therefore, particular emphasis should be put on achieving a better scientific understanding of the ecological processes and on improving the standardization, collection and dissemination of environmental information, with a view to developing a sound basis for regional action in this field.

Achieving the Objectives of the Convention

The regional conventions use two main types of instrument to achieve their objectives, the legal instruments and the action programs.

Legal instruments

The contracting parties to the regional marine conventions have adopted a number of important legal instruments during their 25 years of cooperation. These legal instruments can take different forms: there is the Barcelona system (Barcelona Convention and its protocols), the decisions taken by the OSPAR Commission (decisions can be adopted and entered automatically into force after a period of 200 days) and recommendations. Although the adoption of these legal instruments has fostered cooperation between the contracting parties, it is difficult to assess to what extent these measures have actually been implemented by the contracting parties.

The regional marine conventions operate mainly through sectoral regulations in the form of recommendations to the governments of the contracting parties. Regular reporting to the Convention Commission monitors the state of compliance. From a legal point of view, the recommendations are "soft law", hence, they are not binding. The implementation of these recommendations is entirely the responsibility of national authorities, who are expected to make the appropriate provision to incorporate them into their national legislation. In practice, their successful implementation depends on the national environmental priorities of each contracting party, and on the availability of the necessary financial and technical resources.

Taking the case of the Baltic Convention, the final report of the Helsinki Commission published in 1998 showed that more than 40 recommendations were adopted by the Helsinki Commission to serve the goals set by the 1988 Ministerial declaration. The extent to which they have been implemented by the contracting parties varies according to the field or sector concerned. For example, according to the final report in 1998 of the Helsinki Commission, measures on the prevention of pollution from ships have been implemented to a significant extent, mainly due to the fact that they were strongly backed up by obligations under the MARPOL 73/78 Convention and the work of the International Maritime Organization. However, only a few of the recommendations concerning land-based pollution were reported to have been fully implemented by all contracting parties. This was mainly due to weak enforcement mechanisms at the national level and the substantial financial implications of introducing best available technologies and best environmental practices to tackle these problems.

Thus, the rapid development of international environmental law which has taken place over the past two decades has not always been matched by a corresponding effort to implement the existing agreements. For this reason, it is essential to establish appropriate mechanisms to monitor compliance with regional and international environmental agreements. It is also important to engage all the relevant international actors in addressing questions about how best to prevent and settle environmental disputes.

Action programs

Actions programs are the second type of instrument that the European regional conventions have used to reach their objectives. These action programs reflect a move from a sectoral approach (regulations for specific sectors) to a strategic approach based on three pillars: a political commitment, a pragmatic approach and financial and technical resources. The Baltic Sea Joint Comprehensive Environmental Action Programme (JCP) is a good example of an action program.

The JCP was approved in 1992. It provides a practical basis for achieving the objectives of the Helsinki Convention with a view to fostering capital investment in “preventive” and “curative” measures to reduce pollution from both point sources (industry and municipalities) and diffuse sources (agriculture and transport). The JCP establishes a framework for sustained cooperation among the Contracting Parties to the Convention, other governments within the Baltic catchment area, the EC, international financial institutions (European Bank for Reconstruction and Development, European Investment Bank, Nordic Investment Bank, Nordic Environment Finance Corporation and World Bank) and nongovernment organizations. The JCP provided the first comprehensive overview of the particular sources of pollution of the Baltic Sea, from the regional point of view rather than that of individual countries. It focused on 132 “hot spots” which represented major opportunities for cost-effective and timely capital investment from national or local authorities and international financial institutions. Today, tangible progress can be seen particularly with respect to investments at point source pollution hot spots (municipal wastewater treatment plants and industrial plants). Activities are beginning to have results on the ground: frameworks for interventions have been developed, technical assistance with secured investments and important opportunities for effective use of local skills and transfer of experiences, methods and technologies are being provided. Consequently, more than fifteen hot spots have been removed from the list following the implementation of pollution abatement measures or the cessation of polluting activities. Although it now needs to be adjusted to the new circumstances, the JCP can be seen as a core tool in the implementation of the Helsinki Convention’s objectives and a model for use in other regions within Europe and beyond.

Other purposes: building mutual cooperation

Apart from the obvious objective of improving the quality of the aquatic environment, the European regional marine conventions have proven to be an effective means of building confidence and mutual understanding between the very different countries that contract to the Conventions.

In the 1970s, the Baltic Convention was instrumental in bringing East and West together to deal with practical problems. It helped foster a tradition of Baltic cooperation in environmental matters and a feeling of the existence of a Baltic Sea "family". In doing so, it also made a significant contribution to the overall process of international détente. Today, the Baltic Convention provides a setting for technical cooperation with countries where some of these are candidates for accession to the EC. Hence, the Baltic Convention is also a vehicle for the approximation of their legislation.

Furthermore, experience shows that the regional marine conventions serve as a mechanism for the contracting parties to influence the legislative processes of the EC and to raise the environmental standards, consequently resulting to the general level of environmental protection in the Community. Although regional agreements are often less binding than Community commitments, they are slowly and surely turned into Community legislation. For instance, when the OSPAR Commission adopts a measure concerning the banning of hazardous substance or the restriction on use of products, the entry into force of this measure creates disagreement in the internal market of the EC. Consequently, the European Commission finds it sometimes necessary to propose a more stringent legislation for all the Member States of the EC.

The cooperation between contracting parties in the context of the Mediterranean Action Plan and the Barcelona system has contributed to the integration of the environment policies with the development policies. Although the initial focus of the Mediterranean Action Plan was on marine pollution control, experience soon confirmed that socioeconomic trends, combined with poor management and planning of development are the root causes of most environmental problems, and that meaningful and lasting environmental protection is inseparably linked with social and economic development.

Conclusion

It is difficult to assess, in a systematic way, the progress that has been achieved by the work of the conventions. However, there is direct and indirect evidence that a large number of concrete actions were taken by many countries in conformity with the requirements and provisions of the European regional marine conventions, thus influencing the environmental policies and practices of the European countries. The regional marine conventions have been significant instruments for change and progress concerning environmental matters in Europe. Among their particularly important achievements are the creation of public awareness about the importance of a healthy environment for the present and future, a marked change of attitude towards protection of marine environment and the creation of a sense of solidarity and the importance of collective action. Over the past 20 years, these marine conventions have proven to be a means of building confidence and mutual understanding between the often different contracting parties. They have contributed to the exchange of information and experience and an improvement in the scientific knowledge about the marine environment and the sources of pollution at sea. They have also proven to be the most appropriate forum for the design and implementation of concrete solutions to regional marine pollution and for distribution and coordination of the available resources. But a convention is only a tool. Its usefulness depends very much on continued political support for its work and on the constant determination of the contracting parties to implement the agreed measures faithfully.

Damage Assessment and Claims in Oil and Chemical Spills: Responsibilities of Polluters and Claimants

Michel Girin

CEDRE (Centre de Documentation, de Recherche
et d'Expérimentations sur les Pollutions Accidentelles des Eaux)
Tecnopole Brest-Iroise BP-72-29280 Plouzane
France

GIRIN, MICHEL. 1999. Damage assessment and claims in oil and chemical spills: Responsibilities of polluters and claimants, p. 287-306. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Many countries now have a marine spill response plan, and more are joining every year. But the damage compensation chapter of those plans, when existing, rarely includes more than a few general sentences stating that those affected will be entitled to seek fair compensation in application of the polluter pays principle. However, fair compensation is a highly complex matter. The rights of those affected vary from one country to another, depending on national laws and international conventions the country is party to. The definition of compensable versus non-compensable damage changes with the nature and source of the spilled product. Victims rights and compensability may be subject to interpretation, particularly when national laws contradict international conventions.

Polluters know their rights and responsibilities. Most affected parties unfortunately learn them after the accident, in the hard form of rejected claims. For their information, this paper reviews the situations they may face, summarizes the applicable compensation schemes, and highlights the respective responsibilities of polluters and claimants in damage assessment and claims documentation.

The Problems

Accidental marine pollution, whether hydrocarbon spillage or chemical, organic or nuclear pollution, inevitably leads to various forms of immediate to possibly long-term consequences, affecting extensive geographical areas and large numbers of victims. The public assumes this is settled through the straightforward principle: **polluter pays**. The reality is far more complex.

The party legally responsible for the pollution is not necessarily immediately singled out for public condemnation, nor the main source of future payments. Compensation comes much less frequently from polluters than from insurance companies and compensation funds financed by parties often have little relation to the specific case of pollution.

As an example, when a ship pollutes, depending upon the situation, the legal and/or financial responsibilities may fall upon the sole crew member who made the wrong move, or may be extended to the ship master, to the owner of the vessel, to the charterer of the voyage, to the owner of the cargo concerned. Jailing a crew member or a master is a far less effective move than establishing the objective responsibility of a properly insured shipowner, or the co-responsibility of an industrial conglomerate with either a high environmental conscience or boycottable interests in the region where the pollution occurred.

Once the difficult question of the responsibility is cleared, damages have to be assessed, and claims have to be documented and fought for. Whether through an amicable negotiation or a court battle, compensation implies two parties: the victims and the polluter in the language of those affected, the claimants and the liable party in legal language.

The two parties are far from even. **Those who represent the liable party are professionals**. They belong to a handful of entities which make a living of those situations. They know each other well. They can call in lawyers, solicitors and experts having detailed knowledge of the management and consequences of such pollution. They have no guilty feelings. Their job is to check the reality of the claimed damages, to verify their direct link to the pollution, to analyze their compensability, and to propose suitable settlements. They apply pre-set rules, in the framework of national laws and international agreements in force. They generally have no interest to hurry: time heals wounds and is their best friend.

The claimants are a highly diverse mass of entities and individuals, with conflicting interests and little experience in the management of pollution consequences. Their essential common point is the desire to be paid quickly and fully. The lawyers, solicitors and experts they rely upon, although competent in their own specialities, are rarely familiar with the specificity of accidental pollution. Seeing little result coming fast, claimants may be tempted to leave the negotiation table, to express loudly their impatience and anger, to threaten the other party with retaliation, and to revert to court with the dream of changing the rules.

It is often a trial of strength between a handful of professionals and a crowd of amateurs. The latter will understand often too late that they could have avoided severe disappointments and drawbacks by first studying the rules and how the professionals on the opposing side make use of them.

Who is Liable? With What Money

The era when it was necessary not only to have a responsible party, but also to take the mother company to court for damages in its own country, at considerable expense of time and money, is now over as regards oil pollution by ships. It does not mean that all pollution will be paid for, nor that the rights of victims will be the same in every case of pollution and against each polluter. Three main types of situation can be encountered:

- The absence of an identified polluter (orphan pollution), typically represented by oil slicks or dangerous goods of unknown origin drifting at sea;
- An identified polluter, evidently responsible, typically represented by a ship running ashore, burning at sea or losing containers; and
- An identified polluter, not evidently guilty, typically represented by a spill from an oil or chemical tanker after a collision at sea or in the channel of a harbor.

The lack of an identified polluter is statistically the most frequent situation. It generally concerns small and short-lived pollution, but not always.

Without an identified polluter, no compensation can be paid, unless the local or national authorities open the tap of public aid, or international donors step in. Permanent surveillance and effective polluter identification are essential for the interests of the victims. At sea, these are tasks entrusted to the Navy, Coast Guard or Customs, but only as a second priority behind defence, safety at sea and combat against smuggling. Victims have tried to claim from those structures, arguing that they failed in their entrusted duties. All such claims were rejected. See Box 1 for examples.

Box 1. Examples of Orphan Pollution in France.

A tide of pyrotechnic detonators
More than 23,000 pyrotechnic detonators were washed ashore from December 1993 to May 1994 along a thousand km of the French Atlantic coastline, forcing the authorities to close beaches to the public and to repeatedly comb them. The maker of the detonators could be identified and a ship reported having lost a container of similar detonators in a storm, months before, off the bay of Biscay. But no formal link could be established between that incident and the detonators on the beaches. All response costs were borne by the French taxpayers.

A trawler master against the Navy
After a trawler caught a leaking drum of toxic chemical in its net and brought it on deck, crewmembers had to be hospitalized and income was lost. The master sued the Navy for compensation in the administrative court, arguing that it had failed in its coastguard duties to keep the seabed clear from dangerous goods. The court dismissed the claim in 1997, ruling that the Navy, which had been informed of the lost cargo and had failed to find it, had undertaken a reasonable search effort and had no obligation to be successful.

As polluters do not voluntarily declare their acts of pollution and Governments accept no liability for failing to find the polluter, the cost of orphan pollution falls on those affected. Thus, in general, there is no finding of liability in cases of orphan pollution situations. Not only is damage caused to the affected parties and the environment, but potentially liable parties in subsequent cases would use it as a precedent and claim discriminative treatment.

With an identified, and clearly responsible polluter, the situation is of course far different, as two evident sources of compensation can be tapped: the polluter and his insurer. The difficulty lies in the extreme range of national rules and response capacity of the polluter/insurer party.

On the insurance side, individuals are covered for pollution by their individual civil liability insurance, ships are covered by the civil liability entered in their mutual Protection & Indemnity Club (P&I Club), and industrial plants are covered either by their civil liability insurance, or by a specific pollution contract, when civil liability excludes pollution. Such specific pollution insurance is today generally provided by national consortia, with many limitations. As an example, all such consortia in Europe exclude damages suffered from natural phenomena such as water, air, soil, fauna, flora, the use of which is common to all, unless the action undertaken would prevent compensable damages. The extent of the pollution damages covered by civil liability contracts may have specific limitations or, in the case of the P&I Clubs, be only limited by the laws in force in the country where the pollution takes place.

On the polluter's side, the capacity to complement items excluded by insurance varies between the extremes of an individual sailor and a large industrial conglomerate. The laws of the country where the pollution took place determine who are liable, and claims from affected parties from the first day have far different chances in different countries.

Furthermore, national pollution compensation laws vary greatly from one country to another. Some provide only for economic compensation to those affected, and fines for breached rules. Others add compensation for lost amenities and environmental restoration. Others add punitive damages and/or environmental damage compensation. The maximum claimable amounts are different from country to country. Insurers and P&I Clubs know about that diversity. They adapt to the circumstances their response and their recommendations to their clients. Box 2 shows examples.

Living in a country with strict rules, giving access to the insurance and financial capacity of a reputed company, and not only to those of a poor sailor from a

Box 2. Examples of the Diversity of Rules in Europe.

Deballasting at sea is fined a maximum US$700,000 in waters of the United Kingdom, and only up to US$100,000 in the adjacent waters of France. The fine is payable by the owner in the former, by the master in the latter.

In case of accidental or operational spill, Danish authorities must find the individual who performed the act that was the proximate cause of the pollution (e.g., opening the wrong valve), while it is the company that is liable in the United Kingdom.

Under the French national water law, authorities require a polluter to restore a marine site to its original conditions. The Italian environmental law empowers its courts to order a polluter to pay an environmental damage lumpsum to the state and local authorities concerned, based on an assessment performed by experts of the choice of the court.

developing country, selected as the scapegoat, makes a great difference for those affected.

With an identified polluter, not necessarily guilty, the situation differs with the nature of the international conventions the country is entered in.

For persistent oil (crude oil, fuel oil, heavy diesel oil, lubricating oil and whale oil) transported in bulk, the 1969 and 1992 Civil Liability Conventions (CLCs) apply the principle of strict liability of the shipowner when an oil discharge causes damage in a signatory country. Whether any of his crewmembers, his master or he himself was at fault or not, the owner has to pay for the damages caused by oil spilled from his ship. This constraint is balanced for him by a right to limit his liability in relation to the tonnage of his ship. When the affected country is party to one of the two International Oil Pollution Compensation Fund Conventions (IOPC Funds), all affected parties within that country are automatically given access to supplementary compensation above the liability of the shipowner, up to limits established by the Fund and ship tonnage, when the polluter is identified, whether at fault or not. Those Funds are financed by contributions of all entities within the countries that have imported in the previous calendar year more than 150,000 tonnes* of crude oil or heavy fuel oil transported by sea.

This two-step system relieves those affected from the considerable burden of providing evidence of fault and proving the guilt of a party. But not all have access to it. A number of countries are still not entered in CLCs, and still less are entered in the IOPC Funds conventions. Affected parties of countries entered in the IOPC Fund 71 have access to its compensation capacities only for pollution caused by laden tankers, while those of countries entered in the IOPC Fund 92 have access to compensation also for pollution by tankers sailing on ballast, with better provisions relating to environmental restoration and higher compensation limits.

A handful of countries have opened to their nationals access to compensation above that offered by the IOPC Funds. Canada does it through a national fund complementing the IOPC Fund to which it is a party. The USA has elected not to enter in the IOPC Funds, and to build, through a national Oil Pollution Act, a national compensation fund financed by contributions of all companies shipping oil to US ports, whether from national or foreign ports. It is therefore of paramount importance for claimants to find out before any action what will apply in their country and particular situation.

* *1 tonne = 1 metric ton*

For all other pollutants than persistent oil, fault has to be demonstrated and a guilty party has to be found, unless national laws would establish a principle of strict liability of the shipowner, or the shipowner would be willing to face the consequences of the pollution caused by his ship and make it his problem to seek later compensation from other, guilty parties. A convention has been agreed upon at the International Maritime Organization for the establishment of a future International Hazardous and Noxious Substances Fund. It will take several years before that convention is ratified by the number of countries required for its entry into force.

Knowing the Players and Their Rules

Claimants often find it difficult to understand who sits in front of them, with what powers. They are also often stunned that those people show no shame for their pollution, call them claimants and not victims, request proofs of their damages and of the link of causation of those damages to the pollution. It is of paramount importance for them to precisely understand the role of those professionals and how they work, in order to avoid severe disappointment (Box 3).

Box 3. The Pollution Management Professionals Working for the Liable Party.

- The front line, which claimants will see onsite and at all meetings, are the agents and surveyors. Mostly national, with neither advisory nor decision-making powers, they are only charged with receiving and sending letters, and checking technical matters onsite.
- The technical experts are in general staff from the London-based International Tanker Owners Pollution Federation Ltd. (ITOPF), a nonprofit federation incorporated by a great majority of the world tanker owners to advise them on pollution response and claim handling. With important advisory powers, but no decision-making ones, they are present at key technical meetings. They undertake site visits with members of the front line.
- The money-handlers, officers of the Protection & Indemnity Club concerned and of the International Oil Pollution Compensation Fund, appearing at major meetings, are the only ones with real decision-making powers.
- The lawyers are usually national. Their showing up at meetings is the clearest indication that the money-handlers will probably resort to court action than pursue amicable settlements.

Front line staff have the role of acknowledging questions, providing answers corresponding to the instructions they have been given, checking the documentation on the claims, undertaking and certifying site verifications. These are done on the basis of the essential rule of the whole compensation system: it is the responsibility of the claimant to quantify and document his claim, including demonstrating the relation of the damage to the pollution (see Appendix 1). Shouting at them that one is a victim and should not in addition be asked to prove evident damages is useless. They will never, as many claimants imagine they should, quantify a claim and propose a compensation.

The technical experts are there to check the reasonableness of the claims and to inform the money handlers of the order of magnitude of the total expectable damages. They are members of a small circle of professionals, used to being treated with a certain mistrust, if not open hostility. They are quick to countercheck information received from a victim or an administration with other information from other victims and other administrations. They work in a network where information circulates fast and informally, allowing them to efficiently compare accidents of the same type or in the same region. Claimants often see them as evil: not only are they capable of stating in a meeting or in court that local fisheries kill more fish every year than the pollution did, but they may even undertake to demonstrate it. Evil or not, they are highly experienced and they have the confidence of those who are holding the keys to the compensation money.

The Protection and Indemnity Clubs constitute a system of a mutualization of risks among shipowners. Covering most of the responsibilities linked to the running of a ship, they have become the principal system of maritime responsibility insurance. Most of them are members of an "International Group", which lays down common rules covering risks and ensures a common program of reinsurance. There is no stated maximum amount to the coverage they provide, but it is limited to damages which have a direct link to the running of a ship, are expressly mentioned in the Club's rules and are submitted by third parties, beyond a contractual franchise. The consequences of pollution and expenses linked to preventive measures are part of the general cover, whether the pollution is caused by hydrocarbons or other substances. The clubs are responsible to their members, on immediate and final performance criteria. The less they pay and the later, the better. Their priority is the negotiation of a "fair deal" that will not affect the future by providing any form of precedent.

The IOPC Funds are international bodies, concerned only with persistent oil, governed by an assembly and an executive committee made up of delegates of the member countries. The Director and staff have no interest to either pay less or to defer payments, but the absolute obligation to apply with great vigor the terms of the IOPC Funds and CLC conventions, as they are interpreted and specified by the Executive Committee. It is of paramount importance for the claimants to know what the relevant IOPC Fund can compensate and to whom, so as not to lose neither time nor money in claiming what it cannot pay. Among other major points, ecological damages are not compensable (only reasonable restoration measures, under strict conditions) and the polluter himself is a claimant with the same rights as all others (for his expenses to avoid or to reduce pollution). Any excessively restrictive application of its rules by a Fund can be disputed before a national jurisdiction, whose decision will be enforceable by the Fund. In practice, out-of-court settlements with a Fund, which the Fund will elect whenever possible, are still always in conformity with its own rules. And taking it to court will lead to a fight against an opponent defending much more than money: principles.

Finally, once **the lawyers** have stepped in, it must be clear to all that the time of amicable negotiation is over and that any information produced by one of the parties involved may be exploited against it by the other. This does not necessarily mean that a judge will be needed: there always remains the possibility of settling differences at the door of the Court, a frequent practice in countries whose legal systems are based on British standards, and an exception in countries whose legal systems are based on Latin standards.

What is Compensable?

Until the 1970s, the essential cost of pollution corresponded to **response costs** (damage mitigation, cleaning polluted sites and property). Compensation was essentially limited to expenses paid out in relation to the crisis period immediately following the accident. In the 1970s and 1980s, these costs were progressively overtaken in various cases by **economic damage** affecting activities linked to the sea, in particular tourism, fishing and aquaculture. Accidental oil spills at the end of the 1970s, especially the case won in the United States by the French victims of the infamous black tide of the *Amoco Cadiz* (1978), played an important role in this evolution. Today, following major revisions of the American laws generated by the accident of the *Exxon Valdez* (Alaska 1989), certain countries have integrated a third category, of much greater importance than the other two: **ecological damage**. It concerns damage affecting the natural heritage of humanity, posing three essential problems: how to accord a value to nature, who should receive the compensation money, and for what purpose? Refer to Box 4.

Pollution response costs constitute an element today well defined in the general domain of compensation. Evaluation techniques have become more refined over the years and professional cleaners have established themselves in many

Box 4. Two Historical Examples, Both Ruled by US Courts.

The *Amoco Cadiz* record spill in Brittany, 1978 (230,000 tonnes of crude oil)
The objective consequences, impacts on property, amenities, fisheries, tourism, aquaculture, marine life, ranged from short lived to still measurable after 15 years. The economic settlement awarded by the Court of Appeals of Chicago, 14 years after the incident, valued the pollution fighting costs and economic consequences of the spill at US$180 million. Including interest, that decision entitled the claimants to receive a total of US$220 million, 18 years after the incident. Including legal expenses, the total cost of the spill amounted to over US$300 million for the Amoco Company. After deducting the fees and expenses of the experts and lawyers, the claimants received some US$150 million.

The *Exxon Valdez* spill in Alaska, 1989 (40,000 tonnes of crude oil)
The objective consequences—impacts on property, amenities, fisheries, tourism, aquaculture, marine life, environment—ranged from short lived to still measurable today. The Exxon Company has spent an estimated US$3.1 billion (a third of which was repaid by its insurers) in contribution to and repayment of response costs, out-of-court payment of damages, funding of a trustee to finance impact monitoring and environmental conservation. Expenses in favor of the environment have exceeded the actual restoration of affected sites, including among others the purchase of vast forest areas to ensure the preservation of natural habitat important to the marine communities. Exxon was in addition ordered in 1994 to pay US$5 billion to commercial fishermen and affected communities, a decision which it has appealed. Lawyers and experts costs are already estimated to have exceeded the total settlement of the *Amoco Cadiz* spill.

countries. Negotiations between the victims of pollution and the payers can be built on quite precise bases, with resort if necessary to arbitration by recognized experts (Box 5).

Ecological damage (or general damage to the environment) constitutes a delicate and extremely complex subject on which a wide range of points of view are confronted. As shown above, many insurers reject even the principle of compensating it, considering that it is impossible to financially quantify a temporary alteration of the commons not subjected to commercial exploitation. Ecological organizations advocate that polluters should finance the restoration of habitats, flora and fauna to their original state, whatever the price, which poses the problem of precisely defining the original state and presupposes that it is technically possible for man to re-establish that state. Lawyers consider that national laws and international conventions in force should be the only basis for discussion. But debates on principles often draw discussions on the matter to passionate grounds in which politics and the media play a major role.

Box 5. The Keywords of the Payers: Reasonableness and Competitiveness.

Nearly all countries in the world put either the command or the bulk of pollution response in the hands of a public body. Public bodies are unused to justifying and documenting their actions. They preferably use the means they have at hand, even if oversized, than contract private means. Because of their administrative structure, their overheads are often higher than those of comparable institutions in the private sector.

The payers have set two fundamental rules to protect themselves against the risk of inflated claims from such public bodies:

- Response must be reasonable, in comparison with the risks generated by the pollution: all actions deemed technically unjustified, all means deemed excessive, will be contested by the experts of the liable party and compensated only within the limits of reasonableness; and
- Prices charged must be competitive with those of the open, private market: all public costs above competitiveness will be contested by the experts of the liable party and the maximum to be paid would be private market prices.

Damage to economic activities constitutes an intermediate domain between the two preceding ones. On the face of it, such damage would appear quite easy to evaluate: interrupted fishing activities, affected aquaculture crops and cancelled hotel reservations are tangible and easily quantifiable realities. But a multitude of problems are posed when one enters into the details of damage value and effective link with the pollution. Negotiations may involve very divergent and contradictory evaluations and discussion may leave the rational domain, turning into passionate arguments. This is particularly evident for damage concerning living resources, whether in capture fisheries or aquaculture.

Evolution towards the taking into account of new sectors of damage has produced considerable debate and ruling, generating substantial financial flows. When the pollution cleaners have returned home, a new battle begins, less publicized than that against the pollutant, but much longer and more complex. **Months or years later, decisions made and notes written in urgency are analyzed and weighed in every detail by experts and lawyers**, with consequences far beyond the intent of those who decided or wrote long ago. Each case is unique in this respect. Not only because rules differ from one incident, ship and country to another. The victims' reaction, the strength of their determination and their knowledge of their rights play an extremely important role in the final result.

P&I Clubs and the IOPC Funds are making considerable efforts to inform potential claimants on the rules and on their responsibilities. The yearly report of the IOPC Funds, the full texts of the Conventions and a Claims Manual are distributed free of charge by the IOPC Funds secretariat on request. But many claimants fear bias in favor of the interests of the money handlers and seek alternative sources, more favorable to their interests. Objective information is, however, extremely difficult to secure. P&I Clubs, as all members of the insurance world, seldom open their books to external observers. And one has to be involved in the reality of the dossiers to acquire experience.

Learning from Actual Experience

Box 6. Recent Incidents in which CEDRE was Involved as Regards Compensation.

- Bunker pollution by a grounded French trawler in Galway Bay, Western Ireland, 1991, impacting shellfish cultivation facilities.
- A 400- to 1,000-ton crude oil leak from a laden tanker in the channel leading to the Bay of Cienfugos, Cuba, 1992, affecting fisheries, aquaculture and tourism activities.
- A 230-ton spillage of monomer styrene in the access channel of the port of Zhanjiang, Southern China, 1995, in a collision, with impact on fishing, aquaculture and certain construction works.
- A 2,600-ton spillage of edible wheat close to an inhabited reef, south of the French island of Corsica, 1996, affecting a marine reserve.
- A 100-ton gas oil spill from a loaded coastal tanker in the Bay of Noumea, French Caledonia (1997), impacting a coral lagoon, amenity beaches and mangroves.
- A 180- to 200-ton crude oil leak from a laden tanker in the harbor of Le Havre, France, 1997, affecting the port, amenity beaches and small-scale shrimping.

For incidents settled by P&I Clubs within the set above, without disclosing confidential details on the dossiers in which CEDRE experts were involved, the most important lessons learned include the following (see Box 6):

- All incidents now entirely settled were concluded out-of-court, one at the very door of the court: P&I Clubs hate the expense and precedent of written judgments;

- None of those dossiers included any compensation for environmental damages: claimants unwillingly had to acknowledge the fact that their national laws concerning environmental damage were not strong enough to give them a real chance on that matter;

- Pollution fighting and cleaning expenses were repaid with a 40% to 70% success, without particular difference between pollutants;

- Tourism and other land-based economic claims were repaid with a 20% to 60% success, considerable debate taking place on the actual links of the claims to the pollution; and

- Fisheries and aquaculture claims were repaid with a 10% to 30% success, considerable debate taking place on the actual links of the alleged losses to the claim and on the value of the assessment methods used.

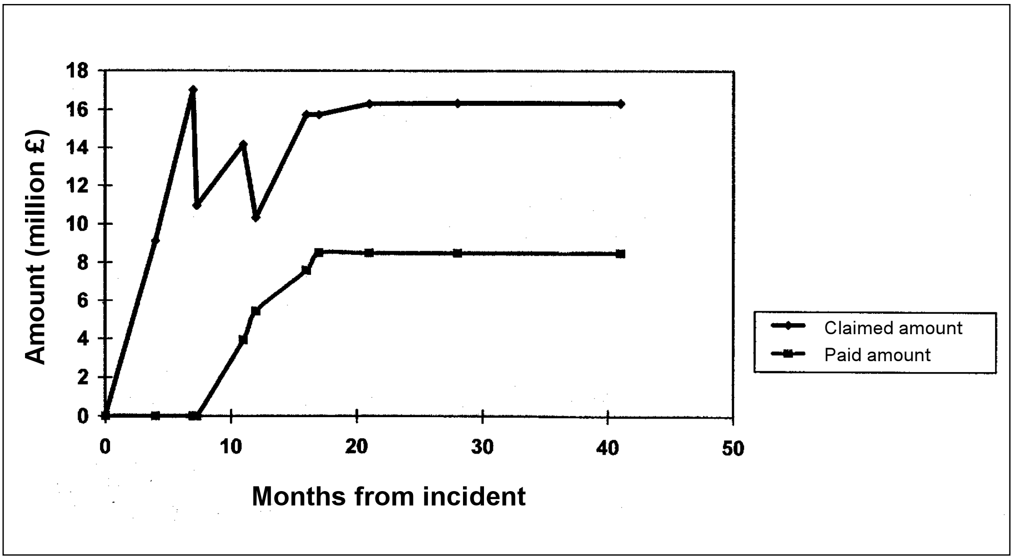
Mutual understanding was in all cases a major problem. Differences in language, culture, experience and ways of seeing the same things had to be overcome. This was in general made honestly and often required considerable effort from the parties concerned. But we also had opportunities to see at times P&I Clubs deliberately playing the clock against genuine claims, in particular to discourage potential claimants located by the limits of the affected zone from attempting to claim. On the other side, we also saw at times claimants (including public bodies) claiming more than their share of expenses or losses. Such exaggeration included among others catches from out of the polluted zone in the lost income of affected fishing boats, expenses for seeding that never existed in claims for losses in aquaculture, or cancelled bookings by foreign tourists unrelated to the pollution.

Information on IOPC Funds cases is more easily accessible, in the form of yearly resumes available to anyone from the IOPC Funds annual reports, and in more detail to Government representatives and authorized observers, from Executive Committee documents.

Comparative graphs showing the evolution of the claimed and paid amounts during the first 3 years of an incident are highly informative. The right to claim of affected parties is limited to 3 years after an incident, unless the party concerned informs the owner or the Fund through the proper procedure before the time bar, that it has started a legal proceeding.

The example of the *Agip Abruzzo*, 1991, Italy (Figure 1) shows a typical pattern for a small incident, fully settled. Claims grow fast, while the payment procedure takes some time to start. Then, the constraint of properly substantiating claims discourages some when the first payments arrive, but other claims are made when the money starts flowing. Finally, in the course of the second year, positions of both parties stabilize with an important gap. At the end of the 36th month, unsatisfied claimants finally abandon their intent to go to court because of the related expenses.

Figure 1. A Closed IOPC Fund 71 Dossier: Evolution of the Claimed and Paid Amounts Since the Time of the *Agip Abruzzo* Incident (Italy, 1991, 2,000 tonnes spill).



The example of the oil tanker *Aegean Sea*, in Spain, 1992 (Figure 2) is typical of a deadlock situation caused by claimants going against the rules of the Fund and intend right from the beginning on having the case settled in court. While the claims progressively increase, payments remain very small, all parties preparing for a long court battle the outcome of which no one can predict. As of this date, a decision has been made on the appeal but it is not implemented.

The example of the oil tanker *Braer* grounded on the Shetland Islands, United Kingdom, 1993 (Figure 3) is typical of pragmatic handling of a case by well advised claimants. Starting at fairly reasonable amounts, claims are rapidly settled and the paid amount curve closely follows that of the claimed amount, until shortly before the 36th month time bar. At that time, claims suddenly increase, a number of claimants informing the owner and Fund that they have begun a legal proceeding

Figure 2. An Unsettled IOPC Fund 71 Dossier: Evolution of the Claimed and Paid Amounts Since the Time of the *Aegean* Sea Incident (Spain, 1992, 40,000 tonnes spill).

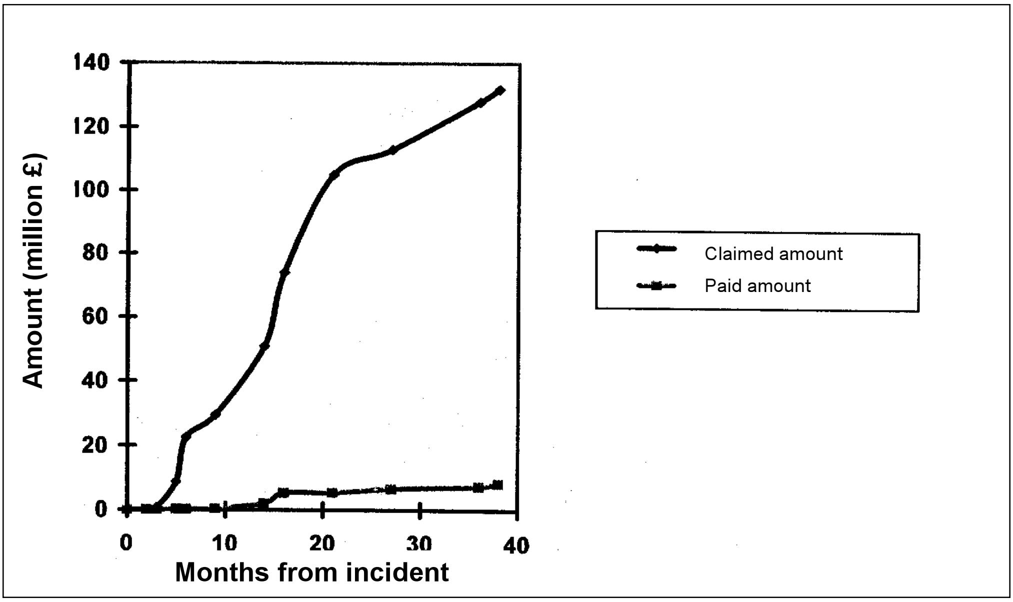


Figure 3. An Unsettled IOPC Fund 71 Dossier: Evolution of the Claimed and Paid Amounts Since the Time of the *Braer* Incident (Shetland, United Kingdom, 1993, 84,000 tonnes spill).

on items rejected by the Fund rules, but potentially acceptable under British laws. Most of those items are now getting settled for highly reduced amounts at court doors. Some may have to be submitted to court.

Discussion

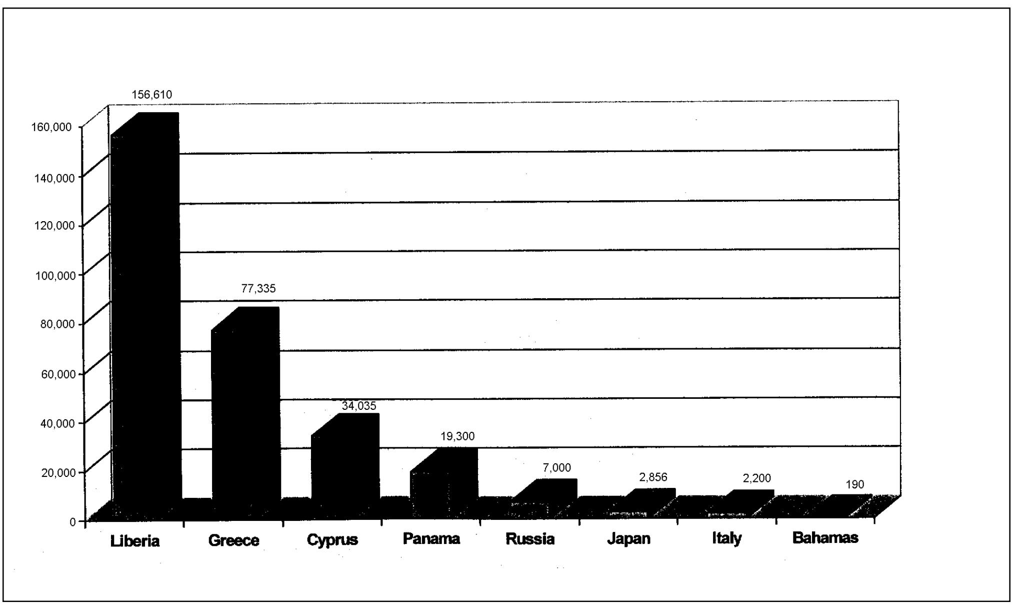
As with all new systems which have not yet reached a balance, the world of pollution compensation today finds itself with two opposing sides:

- The polluters, the insurers and the compensation Funds, partisans of a cautious policy, where each new step must be rigorously weighed and equal for all, on the natural logic of **"more may lead to chaos"**; and

- Victims of pollution and the public opinion, asking for the maximum, immediately, looking fixedly at those who have obtained more, on the natural logic of **"if others got more, why not us?"**

Chaos is not on the agenda for the near future. The average total compensation paid per tonne of oil spilled for incidents entered within the IOPC Funds over the period 1988 to 1997 shows no dramatic inflation (Figure 4). But, as the

Figure 4. The First Eight Polluter Flags, in Tonnes of Oil Spill: Incidents Entered in the IOPC Fund 71, within the 1988-1997 Period.



above examples of the *Amoco Cadiz* and *Exxon Valdez* (see Box 7) show, affected parties in different countries far from benefiting from comparable treatment and it is understandable that those not so well treated would envy the situation of others.

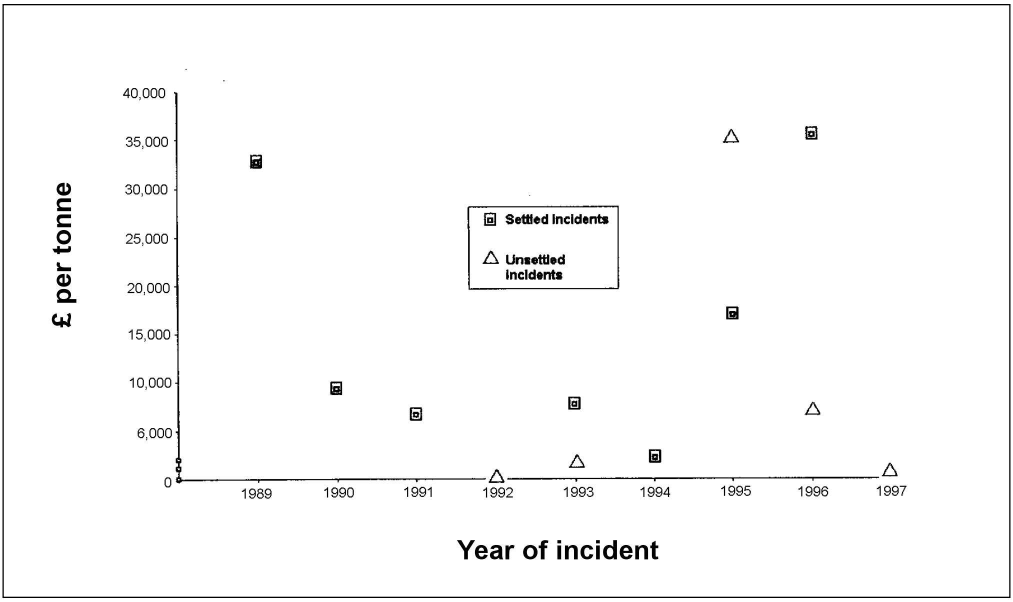
Box 7. The *Exxon Valdez* Treatment.

A summary of compensable costs in that incident in Alaska (1989, USA):

- Costs of cleaning up and restoring sites, properties and soiled assets to a point judged necessary by the victims of pollution, with the means they have chosen;
- Economic damage to all professional marine activities (fishing, transport, aquaculture, tourism, etc.) directly affected by the pollution on a short, average or long-term basis;
- Pure economic losses of operators not directly affected by the pollution but whose activity may have suffered from loss of image or loss of customers (restaurants, hotels, shops, etc.);
- The loss of leisure opportunities on the basis of expenses the users (amateur fishermen, amateur sailors, etc.) used to spend for their own enjoyment (gas, time, equipment, etc.);
- Effects on the environment and non-exploited wild species, on the basis of financial contributions that representative samples of the population would have been ready to offer to save animals or to restore the environment to its original condition;
- The cost of experts, judiciary council, legal proceedings undertaken by all the applicants to construct and to make a case for their demands; and
- The cost of the scientific program to follow up on the restoration of the site to its original state.

On another hand, one must admit that the most advanced compensation system, that of the IOPC Funds, is far from being an actual implementation of the polluter pays principle, with deterrent effects on potential polluters. The annual reports of the Funds show that the flag of Liberia, a party to the IOPC Fund 92, at no cost to its importers (Liberian imports are below the limit entailing a financial contribution), was by far the top oil polluter flag of the world, in tonnes of oil spilled, over the period 1988-1997 (Figure 5).

Figure 5. Average IOPC Fund Compensations Per Tonne of Oil Spilled for the 1988-1997 Period.



The essential point in favor of the existing compensation systems is that they do function. Claimants, on the condition that they document their losses in accordance with the rules, do get compensated for their losses, within the limits established by the rules. The problem is that many claimants find it extremely difficult to accept those rules, which do not reflect their understanding of their rights.

It is therefore not surprising that the victims of an accidental oil or chemical pollution, when realizing that their demands on a point or another are rejected on the basis of rules opposed to principles they have been made to believe apply in their country, feel wrongly treated and engage in either a judicial procedure or in violent action, with the aim of obtaining what they think is due to them. This important problem must be addressed by national authorities, which have the responsibility to inform potentially affected parties that their rights under the international conventions in force may not fit with wide interpretations of national laws. Having been inadequately informed before the incident is however not an excuse for those affected to include in their claims expenses or losses that never took place.

Appendix 1. Essential Rules Regarding Oil Pollution Compensation.

1992 Protocol Concerning Civil Responsibility (CLC)

Article 1 (excerpt)

"Damage by pollution" signifies:

- harm or damage caused outside a ship by contamination occurring after a leakage or a discharge of hydrocarbons from the ship, wherever this leakage or this discharge happens, being understood that compensation paid for the change in the environment, other than lack of earnings due to the change, will be limited to the cost of reasonable restoration measures which have been, or which will be, effectively taken; and

- the cost of safety measures and other harm or damage caused by these measures.

"Event" signifies all facts and all groups of facts of the same origin and from which results a pollution or which constitutes a serious and imminent threat of pollution.

1992 Convention Concerning the Creation of the IOPC Fund

Article 4.1 (excerpt)

In this present article, expenses incurred and sacrifices voluntarily consented to by the owner to avoid or to reduce pollution, are considered, as long as they are reasonable, as is the case of pollution damage.

Article 6

The rights to compensation provided for by article 4 are disappearing because of the failure to bring judicial action on the application of the measures of these articles, or to give notification complying to article 7, paragraph 6, in the three years which follow the date on which the damage was caused. Nevertheless, no judicial action can be brought after a delay of six months counting from the date on which the event having caused the damage took place.

Article 8

Subject to any decision concerning distribution provided for by article 4, paragraph 5, all judgment pronounced against the Funds by a competent court in accordance with article 7, paragraphs 1 and 3, and which, in the original State, has become enforceable and cannot be the object of an ordinary appeal is considered enforceable in all contracting States on the conditions provided for by article X of the 1992 Convention on responsibility.

IOPC Funds Manual: General Claim Criteria

- Any expense/loss must actually have been incurred.

- Any expense must relate to measures which are deemed reasonable and justifiable.

continued

Appendix 1. Essential Rules Regarding Oil Pollution Compensation (continued).

- A claimant's expense/loss or damage is admissible only if and to the extent that it can be considered as caused by contamination.
- There must be a link of causation between the expense/loss or damage covered by the claim and the contamination caused by the spill.
- A claimant is entitled to compensation only if he has suffered a quantifiable economic loss.
- A claimant has to prove the amount of his loss or damage by producing appropriate documents or other evidence.

MARPOL and International Regimes on Liability and Compensation for Oil Pollution Damage: Implementation in the East Asian Seas Region

Zafrul Alam

Policy Division
Maritime and Port Authority of Singapore
460 Alexandra Road #18-00,18 Storey PSA Bldg.
Singapore 119963

ALAM, ZAFRUL. 1999. MARPOL and international regimes on liability and compensation for oil pollution damage: Implementation in the East Asian Seas Region, p. 307-320. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The 1973/1978 MARPOL Convention is generally regarded as the most important international treaty ever adopted by the International Maritime Organization (IMO) in recognition of the importance of prevention as the first line of defense against pollution from ships. There are 106 countries representing 94% of the world's total tonnage that have accepted the Convention.

No matter how much preventive measure is taken, pollution incidents still occur. When large spills occur, the costs of cleanup and damages can be substantial. In response to this, the IMO, in 1992 adopted the 1992 Civil Liability and Fund Conventions to provide for these costs.

This paper gives a status of the implementation of these conventions in the East Asian Seas (EAS) Region and examines the reasons for slow acceptance and implementation. Practical experiences relating to national, regional and international efforts, especially Singapore's efforts in accepting and implementing the conventions are described. Specific problems faced by some countries (e.g., reception facilities) are examined and solutions are suggested. Benefits, costs, challenges and opportunities in making effective use of the conventions are explored.

Introduction

The East Asian Seas (EAS) are of great significance to the East Asian countries which include Brunei Darussalam, Cambodia, China, Indonesia, Malaysia, the Philippines, Democratic People's Republic of Korea, Republic of Korea, Singapore, Thailand and Vietnam. The EAS are rapidly and increasingly used by various economic sectors to meet the demand for food, energy, medicine, transportation and recreation. Studies by the United Nations Environment Programme (UNEP) in 1995 have shown that more than three-fourths of the total pollution load received by the oceans and seas in the EAS Region were from land-based sources. However, ships are also a significant source.

As the shipping industry is international by nature, the best way to deal with pollution from ships is to implement international conventions on marine pollution. This paper discusses the ratification and implementation of MARPOL 73/78 Convention and 1992 Protocols to the 1969 Civil Liability and the 1971 Fund Conventions in the EAS Region, which deal with prevention and compensation (for oil pollution damage) aspects of marine pollution, respectively.

MARPOL 73/78

Prevention is infinitely preferable to action after the worst has happened and there are pollutants in the sea. MARPOL 73/78 prescribes preventive measures. It deals with all forms of marine pollution. MARPOL 73/78 not only strengthens regulations dealing with operational pollution but also introduces for the first time measures to mitigate the effects of oil pollution resulting from tanker accidents.

The Convention has six Annexes, which deal with various forms of marine pollution. Annex I (Pollution by Oil) and Annex II (Pollution by Noxious Liquid Substances Carried in Bulk) are compulsory annexes. Annex III (Pollution by Packaged Dangerous Goods), Annex IV (Pollution by Sewage) and Annex V (Pollution by Garbage) are optional annexes. Annex IV has yet to come into force internationally. Annex VI (Air Pollution from Ships) was added to MARPOL 73/78 by the 1997 Protocol to MARPOL 73/78 and has not come into force internationally. To date, only two countries, i.e., Sweden and Norway have accepted this Annex.

CLC 69, Fund 71, CLC 92 and Fund 92

The International Convention on Civil Liability for Oil Pollution Damage 1969 (CLC 69) together with the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1971 (Fund 71), both adopted by the International Maritime Organization (IMO), set out the international rules and procedure for dealing with liability and compensation for oil pollution damage. The Conventions provide for the sharing of the costs of compensation between the shipowners and cargo interests. Compensation is initially paid by the owner, whom CLC 69 makes strictly liable for oil pollution damage. Since CLC 69 also generally provides for limitation of the owner's liability, additional compensation is available, if needed, from the International Oil Pollution Compensation Fund (the IOPC Fund). The Fund is financed by contributions from importers and receivers of oil.

CLC 69 and Fund 71 were found to be inadequate to meet current levels of claims. In 1992, the IMO adopted two Protocols to amend CLC 69 and Fund 71. The Protocols known as CLC 92 and Fund 92 primarily raised the level of compensation that victims of oil pollution can claim as a result of an oil pollution from ships. They also provide for wider scope of application than the Conventions in their original versions.

Status of Ratifications and Implementation of MARPOL 73/78, CLC 69, CLC 92, Fund 71 and Fund 92 in the EAS Region

The status of key IMO conventions on marine pollution is shown in Table 1. A country which ratifies a convention has certain rights and responsibilities and enjoys certain privileges. One of the key international treaty obligations for a party to the convention is to give effect to the provisions of the convention in its national laws and enforce the provisions of the laws. When all parties to an international convention on marine pollution are at the same stage of development, have similar priorities, share its interests and values and find no difficulty in its implementation, then compliance is not an issue. However, parties to IMO conventions on marine pollution include developed and developing nations.

Even within the EAS Region, countries are at different levels of economic development and know-how and have different levels of resources. Interests and values in developed and developing nations are not equally shared by those who are required to comply. For example, as a country becomes more affluent, there will be growing demand for recreation and greater consciousness of the need for

Table 1. Status of Key IMO Conventions on Marine Pollution.

Country	MARPOL 73/78	CLC 69/ CLC 92	Fund 71/ Fund 92	OPRC	London Convention 72/96
Brunei Darussalam	I & II	CLC 69	Fund 71	No	No
Cambodia	I,II,III,IV & V	CLC 69	No	No	No
China	I,II,III & V	CLC 69 & CLC 92	No	Yes	London 72
North Korea	I,II,III,IV & V	No	No	No	No
Indonesia	I and II	CLC 69	Denounced Fund 71	No	No
Malaysia	I,II & V	CLC 69	Fund 71	Yes	No
Philippines	No	CLC 92	Fund 92	No	London 72
Singapore	I,II & III Accession to V before June 1999	CLC 92	Fund 92	Acceded on 10 March 1999	No
South Korea	I,II,III & V	CLC 92	Fund 92	No	London 72
Thailand	No	No	No	No	No
Vietnam	I & II	No	No	No	No

better health and better living conditions, i.e., a higher quality of life. Marine leisure activities like swimming, wind surfing, sailing, SCUBA diving and other water sports and leisure activities will increase. Such affluent society can afford and will not mind paying the costs of maintaining the domestic and coastal waters clean whereas the priorities of a relatively poor society will be the improvement of its economy to provide basic necessities of life. In a developing economy, it is more difficult for authorities to demand compliance with the provisions of a convention when compliance brings more hardship or difficulties than benefits, especially when the benefits are not apparent. When an international convention is prepared, it may not always be possible to include solutions to implementation problems in the convention itself. Many details of rights and obligations are not clearly spelled out in the conventions. IMO's Technical Cooperation Committee through its regional programmes such as the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (GEF/UNDP/IMO Regional Programme) helps developing nations to implement the highly complex conventions in countries, which may not have the capability to implement a convention. However, it is a difficult task.

The key constraints for the slow acceptance and implementation of the IMO conventions on marine pollution vary among the different countries in the EAS Region. They are similar with the constraints faced by developing nations in other parts of the world. They depend upon the resources available in each country. Some of the countries in the region are in full compliance or very close to 100% compliance. It is difficult to achieve a 100% compliance. Even some of the developed countries are not in full compliance with IMO conventions on marine pollution. For example, in a recent paper submitted to IMO, INTERTANKO pointed out the serious inadequacy of reception facilities in several ports of Western Europe. However, several countries in the EAS Region compared with Europe or North America have a long way to go to achieve full compliance.

The information provided below on the implementation of international conventions are based on the proceedings of seven workshops (see Box 1).

Box 1. Workshops that Provided Information on the Implementation of IMO Conventions on Marine Pollution.

- IMO/APCEL/MPA Workshop on the Ratification and Implementation of MARPOL 73/78 in the East Asian Seas, Singapore, 30 October to 1 November 1996.
- National Workshop on IMO Conventions for the Prevention and Management of Marine Pollution, Hanoi, 21-22 April 1997, Ho Chi Minh City, Vietnam, 24-25 April 1997.
- Brainstorming Workshop for Top Scientists and Policy-makers from the East Asian Seas Region, Subic Bay, Philippines, 3-6 July 1997.
- National Workshop on the Implementation of MARPOL 73/78 in Indonesia: Cost-effective Shore Reception Facilities, Jakarta, Indonesia, 14-15 January 1998.
- Legal Training Program on Strategies, Tools and Techniques for Implementing International Conventions on Marine Pollution in the EAS Region, Bangkok, Thailand, 21-24 September 1998.
- National Workshop on International Treaties for the Marine Environment Protection, Hanoi, Vietnam, 29-30 September 1998.
- APEC/ANZEC Regional Workshop "Working Together on Preventing Ship-based Pollution in the Asia-Pacific Region", Townsville, Australia, 20-23 April 1998.

The papers presented by different speakers representing their countries' maritime and port administrations, environment and other relevant agencies and others in the above mentioned workshops reveal the following implementation situation/reasons why ratification and accession of IMO conventions on marine pollution in the region have been rather slow:

Lack of Human and Financial Resources, Including Technical Expertise and Incentives

- Ratified conventions not implemented due to lack of capability and due to priorities given to economic development.

- Vessels operating in domestic or coastal waters are not generally fitted with approved oily-water filtering equipment, slop tanks, oil discharge monitors, etc.

- Inadequate reception facilities or non-existence of facilities particularly in small ports and terminals.

- Financial commitments from the government and the private sector—the shipowners, shipyards, terminal operators, petroleum and petrochemical companies that are necessary for effective implementation are weak.

- Little incentive for domestic shipping to meet convention standards as their profit margin is low.

- Existing approved facilities underutilized as ships can make money by giving oily wastes to illegal disposal contractors.

- Some foreign investors not keen in investing in shipping and port developments if convention standards are strictly enforced.

- Marine pollution is given low priority as whatever resources are available are directed to tackle pollution on land which needs more immediate attention.

- Limited capacity to collect information necessary for the formulation of policy, to translate policy into implementing measures and to effectively enforce the measures as infrastructure for collecting information is lacking and training and retention of skilled personnel to collect information requires long-term financial commitments.

- Lack of technical know-how as environmental concerns have become important issues only in the last few decades and it takes time and resources to build up technical know-how.

- Few technical experts as funding is lacking to train staff.

- Difficulty in translating the highly complex technical requirements of the conventions in the local language. English is not the official language in several countries.

- The coast of several States is in natural state unlike developed countries. As pure environmental damage (or damage to resources without owners) is not covered by the Fund Convention, these countries feel that the cost outweighs the benefit from the Fund Convention. Claim mechanisms, including surveillance and monitoring, are not yet well-established to make full use of compensation available under the Fund Convention.

Administration Issues

- Diffusion of authority over marine-related activities to many government agencies because of low priority given to marine pollution problems.

- Unclear division of functions leading to conflicts due to overlapping jurisdiction or, on the other extreme, the absence of accountability of an agency.

- Priorities of autonomous local governments are different from central governments.

- Little or no coordination among agencies, resulting in piecemeal or duplication of efforts.

- Turf conflicts between national and local governments.

Legislation and Enforcement

- No laws or inadequate laws to implement the conventions. The situation of laws not meeting their objectives is common in many of the countries.

- Penalties are not severe to discharge violations.

- Too many laws but not able to enforce because of inadequate capacity to do so.

- Lack of uniformity and consistency in the law and its application.

- Weakness of the judicial system and a general lack of awareness of the importance of a predictable application of laws and regulations.

- Pollution of the rivers not controlled. Hence, there is little justification to control pollution of the sea which is less apparent.

- Technical skills regarding law enforcement are limited, from the administration offices to the police, prosecutors and courts.

- Lack of consistency among government officials on the enforcement of laws and the perception that it hinders development.

- Lack of confidence in the integrity of law enforcers.

- High cost in terms of time, effort and money in pursuing criminal and civil court procedures.

- Raw municipal sewage is directly discharged into the domestic waters. Hence, there is little justification to control sewage from ships.

- Individual provisions on marine pollution in many separate laws not guided by a coherent overall policy. However, efforts are underway to streamline legislation and policy in several countries.

- Coordination of pieces of legislation is left to the implementing agencies after passage of the law rather than exercised as part of the drafting process.

- Lack of enforcement measures such as documentation, reporting, monitoring and the use of market-based instruments in legislation.

- Large bureaucracy with a multiplicity of implementing agencies.

- Implementing agencies not sufficiently equipped with enforcement authority or strategies.

Lack of Awareness

- Lack of active participation in the formulation of the international conventions on marine pollution at IMO, as it is expensive to send delegates to IMO meetings on a regular basis.

- Little knowledge and no sense of commitment in adopting the initiatives made at IMO.

Lack of Political Will

- Public pressure, which plays an important role in enforcement, is not strong enough.

- Low political will or slow rise of political will to deal with the problem of marine pollution.

It is, however, encouraging to note that general awareness of pollution problem in the EAS Region is evolving although environmental concerns are still perceived as obstructive to development, to competitiveness, to profitability and even outright livelihood by certain groups of the society in the region. Let us now see how Singapore has overcome some of the above constraints in accepting and implementing MARPOL 73/78 and CLC 92 and Fund 92.

Implementation in Singapore

Singapore is a small country in the EAS Region. Fortunately it does not face many of the problems faced by bigger countries in the region. It has one level of government, a small relatively affluent population and one major port in one location. Even then it took many years for Singapore like any other developing nation to prepare the groundwork for its accession to MARPOL 73/78 and the Fund Convention. Singapore learned not only from experiences of the countries in the region but also from developed countries which implemented the Conventions. Singapore also went through the current stage of economic development as in several countries in the region not very long ago. The economies of the region and the health of the marine environment are critical to Singapore's continuing economic goal. Hence, the countries in the region may find Singapore's experience as described below relevant and useful.

In Singapore, responsibilities of various government agencies are spelled out in legislation administered by each agency. The Maritime and Port Authority (MPA) of Singapore is given the responsibility to control pollution from Singapore ships anywhere in the world and other ships while in Singapore waters and pollution from land (e.g., refineries on islands and along the coast of the mainland) into Singapore waters. It is also responsible for combating oil pollution in Singapore waters and coordinating claims for compensation. The MPA has resources to prepare the country to accede to any IMO Convention and implement it.

Singapore acceded to Annexes I and II of MARPOL 73/78 in 1990. Extensive consultations were held with the shipping industry, oil and chemical companies and terminal operators, shipyards and relevant government agencies for a number of years to advise them of their responsibilities under the Convention. Numerous circulars were issued and seminars and courses were conducted to create awareness in the maritime community. Several surveys were carried out to ascertain the extent of compliance with MARPOL 73/78 by Singapore registered ships, ships calling at Singapore and ships operating in domestic waters and to ascertain the number, type and capacity of reception facilities required. The Prevention of Pollution of the Sea Act 1971 which was mainly based on OILPOL 54 Convention was amended and five sets of regulations were prepared to give effect to Annexes I and II of MARPOL 73/78. The Act prescribes measures to control pollution not only from ships but also from land. Six classification societies (now nine) were authorized to conduct surveys on Singapore ships and issue pollution prevention certificates to ships. In addition to central reception facility for oil residues provided by PSA Corporation and four major shipyards on an island, five oil terminal operators provided facilities for oily residues. Two terminals provided facilities for chemical residues. Administrative arrangements for surveillance, reporting of pollution incidents, investigation of casualties, enforcement of the provisions of the Convention, prosecution of offenders, Port State Control, discharge of flag state responsibilities and communication of necessary information to IMO were made.

When the full preparatory work including preparation of legislation was completed, Singapore deposited instrument of accession with IMO. We went through the same rigorous preparatory work when Singapore acceded to Annex III of MARPOL 73/78 in 1994. We have completed similar preparatory work for Singapore to accede to Annex V of MARPOL 73/78 and the 1990 Oil Pollution Preparedness, Response and Cooperation (OPRC) Convention. Singapore acceded to the OPRC Convention on 10 March 1999. It is expected to accede to Annex V of MARPOL 73/78 in the first half of this year. The main difficulties faced in implementing MARPOL 73/78 were convincing the terminal operators, PSA Corporation and shipyards to provide the reception facilities and convincing operators of small ships to upgrade to MARPOL standards. The Convention provides flexibility for the flag and port administrations to deal with ships operating in domestic waters and restricted voyages to comply with its requirements. A thorough understanding of the Convention requirements helped in using these flexibilities to make the upgrading program less economically painful for the shipowners.

As regards Civil Liability and Fund Conventions, Singapore was a party to CLC 69 until 30 December 1998. CLC 92 and Fund 92 came into force for Singapore on 18 September 1998 and 31 December 1998, respectively. Shipowners, oil majors/traders/storage companies and relevant government agencies were consulted and they supported Singapore's accession to CLC 92 and Fund 92. The main obstacle was convincing major oil companies and traders who are liable for contributions to the 1992 International Oil Pollution Compensation Fund to support Singapore's accession to Fund 92. Several meetings were held with relevant parties, in particular with oil traders/importers and storage companies to allocate responsibilities for submitting a report on the amount of crude/fuel oil they received in a calendar year. A mechanism to verify the oil figures provided by the oil receivers had to be formulated and put in place as Fund 92 makes it mandatory for the government of a party to verify the oil figures given by the oil receivers. In 1997, oil companies in Singapore received 70.8 million tonnes[*] of crude/fuel oil making Singapore the sixth largest contributor to Fund 92.

Shipowners were not financially affected as upgrading CLC 69 P & I Club blue card to CLC 92 blue card required a nominal administrative charge of £30 only. Most ships have a US$500 million insurance cover from P & I Club, hence, there is no extra charge for upgrading CLC 69 blue card to CLC 92 blue card. The Merchant Shipping (Oil Pollution) Act 1981, which was based on CLC 69, was amended by the Merchant Shipping (Civil Liability and Compensation for Oil Pollution) Act 1998 to give effect to CLC 92 and Fund 92. Again when we were ready to fulfill our obligations under CLC 92 and Fund 92, Singapore acceded to these Conventions.

Benefits for Implementing MARPOL 73/78

- Economic advantage, as a consequence of preventing and managing pollution, as opposed to cleaning up and paying for damage caused by pollution.
- Reduced vulnerability, avoiding liability as a result of pollution.

[*] *1 tonne = 1 metric ton*

- Improved efficiency, avoiding delays in international ports because of non-compliance.

- Facilitation of enforcement, investigations as a result of similar requirements among all parties.

- Enhanced regional cooperation, through Port State Control.

- Resale value of vessels, because they meet international standards.

- Sustainability of coastal and marine waters environment and development.

- Protection of health.

- Sustainability of income from fishing, aquaculture, tourism and water sports.

- Supply of clean waters for power generating plant, desalination plant and coastal factories.

- Business opportunities. For example, establishment of reception facilities should not be seen as a financial obligation of the government but as a potential economic and business opportunity. Accession can help a country market its pollution prevention equipment and enhance its competitive edge in shipbuilding and ship repair. It can also help its maritime industries obtain loans from banks and reduce its insurance costs.

Benefits for Implementing CLC 92 and Fund 92 Compared with the Old Regime of CLC 69 and Fund 71

- Expenses incurred for preventive measures are recoverable even where no oil spill occurs, provided that there was a grave and imminent threat of pollution damage.

- Pollution damages both in the territory (including the territorial sea) and the exclusive economic zone (EEZ) are compensated.

- Spills from sea-going vessels constructed or adapted to carry oil in bulk as cargo, whether laden or unladen and spills of bunker oil from such ships are covered.

Role of the GEF/UNDP/IMO Regional Programme

It is increasingly recognized that global action is best achieved through regional implementation. Starting in 1994, the GEF/UNDP/IMO Regional Programme has helped develop the essential working models and innovative approaches to address many of the environmental concerns in the EAS Region. The GEF/UNDP/IMO Regional Programme has successfully demonstrated the effectiveness of public-private sector cooperation in addressing marine pollution problems as well as catalyzing the increased ratification and implementation of marine environment related international conventions among the governments in the region. The number of ratification and accession to marine pollution related conventions increased from 34 in 1994 to 62 in 1997. It assisted Cambodia, Indonesia, Philippines and Vietnam in better understanding of the MARPOL 73/78 Convention.

Conclusion

In conclusion, the following is a quote from Mrs. Frances Lai of the Southeast Asian Program in Ocean Law, Policy and Management (SEAPOL) who summarized the problem of implementation of IMO conventions in developing countries in a paper presented to the APEC/ANZEC Regional Workshop (see Box 1).

> *"The problem of implementing IMO Conventions is highly complex and demands a high level of sophistication. Many developing countries do not have the infrastructure or the capacity to meet the requirements of these Conventions. Even the initial task of translation may be difficult and time-consuming, in some countries, as the translated text has to be approved by a legislative committee before it can be debated. Integration with existing laws and regulations may simply overtax the small bureaucratic elite possessing the appropriate skills. Full implementation may involve a level of coordination among government departments, central and local government offices, public and private institutions, that is virtually unattainable. Even partial implementation may call for a streamlining of the bureaucratic structure: decentralized for better implementation and monitoring but centrally coordinated and supervised for effective and comprehensive planning and action. Personnel need to be trained. In some cases, new equipment needs to be installed. In addition, scientific studies have to be conducted in order to pinpoint pollution sources or assess pollution impacts specific to the country or the region".*

Pollution recognizes no boundaries. Any discharge of wastes into coastal waters from one country will quickly find its way into the waters and beaches of neighboring countries. It is, therefore, important for every country in the region to play its part to control pollutive discharges into coastal waters from land and from ships through the implementation of IMO Conventions on marine pollution. Compliance with IMO Conventions can only be achieved by persistent capacity building of the countries in the region, as well as by networking and mutual exchanges and support among various stakeholders such as policy-makers, scientists, experts, business and local communities. Without a coordinated and concerted effort, it would be impossible to confront a task with such enormous scope and complexity.

Implementation of Marine Pollution Treaties as Municipal Law in East Asian Countries: The Need for Guidelines

Juita Ramli

Centre for Ocean Law and Policy
Maritime Institute of Malaysia (MIMA)
B-06-08 -B-06-11, 6th Floor, Megan Phileo Avenue
12, Jalan Yap Kwan Seng, Kuala Lumpur 50450, Malaysia

RAMLI, JUITA. 1999. Implementation of marine pollution treaties as municipal law in East Asian countries: The need for guidelines, p. 321-331. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Treaties often fail to define specific principles that may nevertheless be fundamental to the purpose of the treaty. This leaves such principles open to differing interpretations. Usually, countries interpret international treaties in a manner which accommodates their domestic needs, and such interpretations are reflected in municipal laws. In particular, marine environmental treaties which provide the international basis to protect and preserve the marine environment and its resources are often subject to differing interpretations by various State Parties. This is especially likely to be the case where political and cultural differences are acute.

Politically and culturally different countries bound the East Asian Seas. Naturally, a tendency to define marine environmental treaties in a manner which is acceptable by the government of the day or other important actors, may be irresistible. This paper argues that there may be scope within a defined geographical region, for States to identify a common ground for interpretation of vague treaty provisions and principles. Although universal acceptance of all aspects of every relevant treaty is unlikely, each term or principle which enjoys shared interpretation will serve to enhance the collective effectiveness of individual national effort.

As a first step, one proposal is to identify and clarify common State obligations and rights provided by the United Nations Convention on the Law of the Sea (UNCLOS) 1982 and Agenda 21, and secondly, to identify issues which have been widely accepted within this region.

INTRODUCTION

> *"International law, as reflected in the provisions of the* United Nations Convention on the Law of the Sea ..., *sets forth rights and obligations of States and provides the international basis upon which to pursue the protection and sustainable development of the marine and coastal environment and its resources. This requires new approaches to marine and coastal area management and development, at the national, subregional, regional and global levels, approaches that are integrated in content and are precautionary and anticipatory in ambit..."*
>
> *Chapter 17.1, Agenda 21*

Every treaty[1] establishes various rights, responsibilities, obligations, duties and, if any, liabilities to be borne by the country—the State Party. Some may mistakenly view treaties as instruments that primarily confer benefits, but treaties may be crafted in a manner that deprives States of certain rights that seem to be offered by participation in any particular treaty. The "devil is in the detail", and the details entail interpretation of vague principles.

When a country chooses to enter into a treaty, the country expresses its consent to be bound by the stipulated provisions of that particular treaty as espoused by the international law maxim *pacta sunt servanda*.[2] At the domestic level, the

[1] *Treaty means an international agreement concluded between States in written form and governed by international law, whether embodied in a single instrument or in two or more related instruments and includes bilateral and multilateral agreement, convention or understanding that imposes obligation upon a State Party.*

[2] *Which means every treaty in force is binding upon the parties to it and must be performed by them in good faith.*

State Party would be required, most often than not, to implement the treaty according to its domestic procedures in order to execute rights and obligations provided by the treaty. Article 27 of the *Vienna Convention on the Law of Treaties* provides that: "A party may not invoke the provisions of its internal law as justification for its failure to perform a treaty". Internal limitations are recognized as an encumbrance towards full implementation of a treaty but does not exempt the State Party from being bound by the requirements of the treaty. Such internal limitations would include lack of understanding and appreciation of treaty rights, obligations and responsibilities. The lack of understanding more often than not stems from failure to appreciate vital terminology or provisions enshrined in a particular treaty. Certainly when one begins to discuss marine or ocean related treaties or even matters concerning the management of the marine environment or resources, familiar buzzwords would not escape from the discussion. Today, it seems difficult to ignore vogue terminology which has been accepted as established principles in many maritime treaties[3] when discussing ocean management. The words 'sustainable development', 'integrated coastal management', 'precautionary principle', 'maritime sovereignty' and 'sustainable fisheries' are some of the familiar phrases.

Such phrases do not enjoy universally consistent interpretation, and this is reflected in the differing manner in which they have been adopted by East Asian States. However, wide acceptance of these notions, particularly since late 1990s, suggests that they are influencing the marine policies of East Asian countries and are likely to continue to do so.

Before identifying some suggested phrases or provisions which arguably have, or might, cause some confusion, a short history is provided of the development of marine pollution treaties since the advent of the United Nations Conference on the Human Environment in 1972, which simultaneously coined certain phrases for environmental management of the oceans.

---

[3] *Likewise if one reads academic journals, government declarations, national legislation (see Herriman, 1997).*

INTERNATIONAL TREATIES ON THE PROTECTION OF THE MARINE ENVIRONMENT

Since the 1972 Stockholm Declaration, more than 50 treaties for the protection of the marine environment have been developed. The first multilateral marine environment treaty was the London Convention[4], followed by MARPOL[5] in 1973. Both are IMO-generated treaties which govern vessel-source pollution.[6] Other marine pollution prevention treaties at both international and regional levels have since been established under the auspices of the United Nations particularly UNEP[7].

In 1982, the UNCLOS was adopted and opened for signature providing a framework for the governance of the oceans. With the exception of Thailand and the Democratic People's Republic of Korea, all other East Asian States are already parties to the UNCLOS. The UNCLOS has been widely embraced by other community States and has been largely accepted—as the international law—governing the relationships between a large majority of States regarding ocean use. Part XII of the UNCLOS provides a general regime for the protection of the marine environment.

Following the acceptance of the UNCLOS, the general Assembly at UNCED[8] 10 years later accepted a resolution for the "Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas and coastal areas and the protection, rational use and development of their living resources".[9]

---

4 *See Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, done at London, 29 December 1972, ILM 1294 (1973). Entered into force 30 August 1975.*

5 *See International Convention for the Prevention of Pollution from Ships, done at London 2 November 1973, ILM 1319 (1973). Entered into force 2 October 1983; modified by the Protocol of 1978 relating thereto (MARPOL 73/78), done at London 17 February 1978, ILM 546 (1978).*

6 *IMO also subsequently established specific instruments relating to emergency and safety situations, liability and compensation for oil pollution damage, and the establishment of an appropriate compensation fund.*

7 *i.e.,United Nations Environment Programme. The treaties inter alia are: the Convention on the Prevention of Marine Pollution from Land-based Sources, 1974 (for North Atlantic, Arctic Ocean and the North Sea); Convention for the Protection of the Natural Resources and Environment of the South Pacific region, 1986; the Basel Convention, 1989; Protocol to the Kuwait Convention concerning Marine Pollution resulting from Exploration and Exploitation of the Continental Shelf, 1989. Most of the treaties were regional treaties designed to prevent, abate and combat marine pollution arising from specific activities occurring in particular regions.*

8 *United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 adopted a declaration and global agenda for management of the environment into the next century.*

9 *See Report of the United Nations Conference on Environment and Development, UN doc. A/CONF.151/26/Rev.1 (Vol. I), Chapter 17 of Agenda 21.*

Common State Obligations and Rights Provided by UNCLOS and Agenda 21 and Other Marine Environment Protection Treaties

While Article 193 of the UNCLOS confers State Parties the sovereign right to exploit their natural resources, State Parties must do so "pursuant to their environmental policies and in accordance with their duty to protect and preserve the marine environment" as required under Article 192. States also have the obligation to ensure that activities under their jurisdiction shall not cause pollution damage to the marine environment of other States. The UNCLOS imposes on States the duty to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source—using the best practicable means in accordance with their capabilities—and shall endeavor to harmonize their policies.[10] In similar breath, Agenda 21 in confirming and recognizing the rights and obligations of States set forth in the UNCLOS, recommends "new approaches to marine and coastal area management and development, at the national, subregional, regional and global levels... that are integrated in content and are precautionary and anticipatory in ambit."

In line with the UNCLOS and Agenda 21, other marine environmental treaties often require State Parties to "take implementation measures and to harmonize their policies towards the general goal of protecting the marine environment against pollution by specific substances".[11] Adede (1993) presents a checklist of 27 major clauses occurring in environmental treaties concluded since the 1972 Stockholm Conference which affirm State obligations in protecting the marine environment. There are at least six categories of provisions reflected in several treaties which are of immediate relevance to the protection of the marine environment. They include:

1) Provisions on the general obligation of States to protect and preserve the marine environment when exercising sovereign rights to exploit their natural resources:

    a) UNCLOS, Articles 192–194; and

    b) Convention on Biological Diversity, 1992, Article 3.

---

[10] *See Article 194, UNCLOS. The UNCLOS also imposes on States the duty to take measures to prevent, reduce and control pollution resulting from the use of technologies and the introduction, intentional or accidental, into the marine environment of new or alien species that may cause significant and harmful changes to a particular part of the marine environment, see Article 196.*

[11] *Adede (1993), specifically referred this phrase to State obligations as required by the London Convention, 1972. However, it is submitted here that the requirement is applicable generally taking into account the general objectives of all marine environment protection treaties.*

2) Provisions on the obligation to take measures to prevent, reduce and control pollution of the environment:

   a) UNCLOS, Article 194;

   b) London Convention, 1972; and

   c) Convention for the Prevention of Marine Pollution from Land-based Sources, 1974, Article 4.

3) Provisions on the obligation not to transfer environmental harm from one State to another or not to substitute one form of environmental harm for another:

   a) UNCLOS, Article 195; and

   b) London Convention, 1972, Article IV.

4) Provisions on prompt notification of environmental emergencies:

   a) UNCLOS, Article 198;

   b) IAEA Convention on Early Notification of a Nuclear Accident, 1986;

   c) Convention on Biological Diversity, Articles 14(1)(d) and (3);

   d) International Convention on Oil Preparedness, Response and Cooperation (OPRC), 1990, Article 5(1)(c); and

   e) Convention for the Protection of the Mediterranean Sea against Pollution, 1976, Article 9.

5) Provisions on contingency plans and assistance in case of environmental emergency arising from accidents:

   a) UNCLOS, Article 199;

   b) Kuwait Protocol concerning Regional Cooperation in Combating Pollution by Oil and Other Harmful Substances in Case of Emergency, 1978, Article 2(2);

   c) OPRC 1990, Article 3; and

d) Agreement for Cooperation in dealing with Pollution of the North Sea by Oil, 1983, Article 7.

6) Provisions on specially protected areas:

a) UNCLOS, Article 234;

b) Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, 1983, Article 10;

c) Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region, 1985, Article 10; and

d) ASEAN Agreement on the Conservation of Nature and Natural Resources, 1985, Article 13.

In general, the following State obligations are addressed commonly in major environmental treaties (Adede, 1993).

1) Recognition of sovereign rights of States to exploit their natural resources pursuant to their environmental policies and the corresponding duty to protect and preserve the environment.

2) The obligation of States to take measures to prevent, reduce and control pollution of the environment with the best practicable means at their disposal.

3) The obligation of States to ensure that, in taking such measures, they do not transfer directly or indirectly, damage or hazards from one area of the environment to another or transform one type of pollution into another.

4) The obligation of each State to notify other States in case planned activities or events in its territory are likely to cause environmental damage to other States.

Common Treaty Provisions or Principles Including 'Vogue' (or Vague?) Treaty Provisions or Principles

While treaty provisions might be seen as an attempt to clarify State obligations respecting marine environmental protection, words or phrases like "dumping", and concepts such as "sustainable development" established in such provisions are often either left undefined, or ill-defined, allowing States to adopt freely their own interpretation suitable for domestic implementation. The risk this poses is that States may differ in their interpretation and this can hamper efforts to harmonize environment policies as required by UNCLOS and Agenda 21. Such discordant interpretation may be crucially harmful where marine bioregion straddles political boundaries.

For example, Article 1 of the UNCLOS defines "pollution of the marine environment" as:

> *"... the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities."*

The term "marine environment" however is undefined and left largely to interpretation by States. Chapter 17 of Agenda 21 interprets the marine environment as including 'the oceans and all seas and adjacent coastal areas' which together 'form an integrated whole that is an essential component of the global life-support system and a positive asset that presents opportunities for sustainable development'. Does the Agenda 21 definition help clarify meaning for the purpose of law? And even if it does, to what extent does a soft law provision influence treaty implementation? Are living creatures in the marine environment or do they form a component part of it? In answering this question, perhaps one can reflect on the status of organisms such as corals?

The phrase 'prevent, reduce and control pollution' which recurs in the UNCLOS has also been left open to interpretation. A suggestion put forward is that perhaps, the phrase is "intended to cover all possible measures to combat pollution, in whatever phase" (Molenaar, 1998).

To further illustrate this point, Chapter 17 of Agenda 21, for example, declared three important principles underpinning ecologically sustainable development of ocean resources. In order to adopt the spirit of Agenda 21, State management for such development would necessarily implement the principles of 'integration', 'precautionary' and 'anticipatory'. But each of these terms in themselves gives rise to the possibility of differing interpretation. For example, what degree of environmental damage warrants application of the 'precautionary principle':

any damage, *severe* damage, *irreversible* damage, or perhaps even the mere threat of some temporary change? Indeed, what constitutes 'damage' in the context of an ever-changing marine environment?

Acceptance of Marine Environment Treaties in the East Asian Seas Region

The East Asian Seas countries[12] are politically and culturally different. However, ocean affairs are an integral part of the countries in this region. All countries share a common sea area. Brunei Darussalam, Indonesia, the Philippines, Malaysia, Thailand, Cambodia, Vietnam and China bound the South China Sea; China, Democratic People's Republic of Korea, Republic of Korea bound the Yellow Sea whereas Indonesia, Malaysia and Singapore are the littoral States of the Straits of Malacca. The current state of implementation of international conventions on marine environment protection in the East Asian countries is far from satisfactory. It is well and good to document a list of 'implementing national laws' but if enforcement of the laws is slack because we do not understand what needs to be done, where we can do it, how do we do it and who among us can do it—the objective of achieving a common goal, i.e., to protect and preserve the marine environment while simultaneously harmonizing the policies therewith—would be futile. No doubt there are significant factors[13] which together impede the smooth implementation of treaties at the domestic level. However, understanding and appreciating the significance of established marine environment protection terms is a vital component to successful implementation of such treaties. It should be recognized that ratification or implementation of treaties nationally may be influenced by problems in assessing the implications of the instruments and in effecting implementation. Unclear terms and imprecise definition exacerbate such difficulties.

One other important observation is that many treaties have only come into force within the last 10 years or so. Countries in this region which began to define

[12] *The East Asian countries of Brunei Darussalam, Cambodia, Democratic People's Republic of Korea, Indonesia, Malaysia, People's Republic of China, Philippines, Republic of Korea, Singapore, Thailand, Vietnam are the 11 participating nations in the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas; Japan has an observer status; and Laos is the land-locked State that has the right to participate in discussions and negotiations concerning the protection and exercise of its rights as provided under Part X of the UNCLOS 1982. Source: GEF/UNDP/IMO Regional Programme brochure.*

[13] *Chua et al. (1999) reported that lack of legal professionals in the region, inaccessibility of legal information and reference materials in the countries, differences in legal systems, languages, demographic and social characteristics and economic development among the countries were the factors identified as impediments to implementing international conventions component of the GEF/UNDP/IMO Regional Programme.*

their ocean policy have to grapple with many newly-emerging principles which might not be properly translated into their own language.

A study undertaken by the Maritime Institute of Malaysia (MIMA) (Ramli, 1998) from 1996 to 1998 on the status of maritime laws and conventions in Malaysia revealed that although Malaysia is a party to or signatory to many international legal instruments, implementation at the domestic level is rather poor due to a number of factors. The lack or absence of municipal laws implementing particular treaties pointed to the common failure of implementing agencies to grasp fully the obligations, responsibilities or even rights created by the treaties.[14] The issue becomes more problematic when more than one implementing agency is responsible for the enforcement of a treaty. Often, implementing agencies and other significant actors interpret the laws to suit and meet their *raison d'être*. This can result in ineffective and inefficient implementation of the treaty. Thus, Malaysia has recognized that a common interpretation of terminology and general provisions of a treaty requires the collaboration of the different concerned actors.

Such a principle would seem also to hold the promise of benefit within defined geographical regions (Bridgewater, 1996)[15]—States could identify common ground for interpretation of vague treaty provisions and principles. Although universal acceptance of all aspects of relevant treaty is unlikely, shared interpretation of specific term or principle would serve to enhance the collective effectiveness of individual national effort. For States which border enclosed or semi-enclosed seas, such an effort would lend substance to their obligation to "cooperate" and "coordinate" as specified in Article 123 of UNCLOS.

Conclusion

Politically and culturally different countries bound the East Asian Seas. Naturally, a tendency to define marine environmental treaties in a manner which is acceptable by the government of the day or other important actors, may be irresistible. Perhaps, as a region, there is a need to define what exactly should be achieved and to question the seriousness in establishing common goals and values.

[14] *Other factors include lack of scientific research; lack of dedicated personnel to attend to specific matters which often results in the poor coordination among agencies to resolve problems requiring immediate attention.*

[15] *Bridgewater (1996) suggests the adoption of a bioregional approach where marine management and conservation would mean also managing marine biodiversity.*

East Asia is the only region which has yet to develop a regional marine environment protection treaty.[16] This is a sad comparison against other regional sea areas[17] which have developed many specific regimes to prevent, abate and combat pollution in the marine environment. An essential first step is to ensure that common understanding is shared. Clarification of certain terms and treaty provisions, as they are to apply to East Asia is important to harmonize laws and policies for effective marine management. Unless all play the same tune, they are just making noise.

References

Adede, A.O. 1993. International environmental law digest: Instruments for international responses to problems of environment and development 1972–1992. Elsevier Science Publishers B.V., Amsterdam.

Bridgewater, P. 1996. Managing and conserving the marine environment, p. 47-53. *In* Tsamenyi and M. Herriman (eds.) Rights and responsibilities in the marine environment: National and international dilemmas. Wollongong.

Chua, T.E., S.A. Ross, H. Yu, G. Jacinto and S.R. Bernad. 1999. Sharing lessons and experiences in marine pollution management. MPP-EAS Technical Report No. 20, 94 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Herriman, M. 1997. Acceptance of Post-UNCED environmental management concepts in East Asia. Paper presented at the Ocean University of Qingdao, China, 2 September 1997.

Molenaar, E.J. 1998. Coastal state jurisdiction over vessel-source pollution. University of Utrecht, The Netherlands. PhD dissertation.

Ramli, J. 1998. MIMA report on the status of maritime-related national laws and maritime conventions in Malaysia. Maritime Institute of Malaysia (MIMA), Kuala Lumpur.

---

[16] *Although UNEP is understood to be coordinating a program to encourage East Asian States to come to an agreement in establishing, in the near future, a regional treaty concerning issues in the South China Sea.*

[17] *They include the Mediterranean Sea, West and Central African Region, Southeast Pacific, Red Sea and Gulf of Aden, Wider Caribbean Region, Eastern African Region, South Pacific Region, Baltic Sea and Belts, North Sea, Antarctic and Arctic Regions and the Northeast Atlantic.*

The Use of Environmental Guarantee Funds and Environmental Monitoring Funds in the Philippine EIA System

Brenda Jay C. Angeles

Institute of Human Rights
University of the Philippines Law Center
Diliman, Quezon City 1101, Philippines

ANGELES, BRENDA JAY C. 1999. The use of environmental guarantee funds and environmental monitoring funds in the Philippine EIA system, p. 332-340. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper provides a brief overview of the environmental impact assessment (EIA) system in the Philippines, with emphasis on the environmental guarantee fund (EGF) and environmental monitoring fund (EMF) mechanisms provided under the EIA implementing guidelines of the Department of Environment and Natural Resources (DENR). Evolving from a mere regulatory instrument into a planning and management tool, the EIA process now requires the creation of these two funds for individual projects and activities which are considered by law as environmentally critical.

This paper examines the evolution and assesses the effectiveness of EGF and EMF as mechanisms for enhancing private sector responsibility and public participation in environmental management. Although environmentally critical projects covered by the Philippine EIA system mostly involve permanent structures and industries undertaken on land, this paper explores the possibilities of applying the EGF and EMF concepts to human activities that impact on the marine and coastal environments.

In the end, this paper hopes to provide a context for wider discussions about the feasibility of developing the EGF and EMF mechanisms as tools for the effective management and prevention of marine pollution in the East Asian Seas.

INTRODUCTION

Environmental issues in the Philippines are normally addressed through the exercise of the State's command-and-control (CAC) authority whereby the State, as a superior body, lays down standards that all must follow, monitors compliance with such standards, and enforces compliance by coercive or other similar measures (La Viña, 1994). The constitutional provisions laying down the manner of utilizing the country's vast land and natural resources best illustrate this approach. As virtual owner of these resources, the exploration, development and utilization of natural resources was placed under the full control and supervision of the State.[1]

This explains the role of the Department of Environment and Natural Resources (DENR) as the primary government agency responsible for the conservation, management, development and proper use of the country's environment and natural resources.[2] Furthermore, it establishes the basis for the issuance by the DENR of rules and regulations governing the implementation of the Philippine environmental impact statement (EIS) system.[3]

Nonetheless, such approach is increasingly becoming complemented with or is shifting towards the use of other approaches, such as community-based and market-based systems.

THE PHILIPPINE EIA SYSTEM: ITS EVOLUTION

The term "environmental impact assessment" was first used in the Philippines as part of the government's environmental policy pronouncement in 1977.[4] The Philippine EIS system was formally established the following year by virtue of Presidential Decree No. 1586.[5] The Decree requires all agencies and instrumentalities of the national government, including government-owned and controlled corporations, as well as private corporations, firms and entities to prepare an EIS for every action, project or undertaking which significantly affects the quality of the environment.[6]

---

1 *Article XII, Sec. 2, 1987 Constitution.*

2 *Sec. 4, Exec. Order No. 192 (1987) and reiterated in Exec. Order No. 292 (1987).*

3 *Pres. Decree No. 1586; DENR Admin. Order No. 96-37.*

4 *Pres. Decree No. 1151 (1977), otherwise known as the Philippine Environmental Policy.*

5 *Pres. Decree No. 1586 (1978) is entitled "The Philippine Environmental Impact Statement System".*

6 *Sec. 4, Pres. Decree No.1151 (1977); Sec. 2, Pres. Decree No. 1586.*

Although intended as a management tool, EIA was introduced into the country as a traditional decision-making and permitting process, a usual exercise of the State's CAC authority. It was therefore highly regulatory in nature with the government, through the DENR, having full control and supervision over its implementation. Among its regulatory features include the following provisions:

(1) Criteria for coverage within the EIA system are set forth in the laws;[7]

(2) Proponents of projects covered by the EIA system are required to obtain an environmental compliance certificate (ECC) prior to commencement of any project activity. Sanctions are provided by law when a covered project is found to be operating without an ECC;

(3) Penalties ranging from the payment of fines to suspension or cancellation of ECC, and closure of establishments may be imposed for any violation of the laws or the conditions of the ECC; and

(4) Monitoring of compliance with the conditions of ECCs and the EIA rules are primarily undertaken by the government's national and regional DENR offices.

In recent years, however, the rules governing the Philippine EIA system significantly include provisions that are characteristic of environmental planning and management approaches. Other stakeholders in the environment, particularly the affected communities, nongovernment and people's organizations, local governments and the private sector, are given increasing roles and responsibilities in the EIA review and monitoring processes. The State-driven, regulatory nature of the EIA is, therefore, gradually being complemented by community-based and market approaches to environmental management.

This remarkable development may be attributed to both international and national experiences.

[7] *Pres. Decree No. 1586 (1978) along with Presidential Proclamation No. 2146 and NEPC Circular No. 3, series of 1986, proclaim projects that are environmentally critical or within environmentally critical areas as within the coverage of the EIA system. Proponents of these projects are required to submit a detailed study of the impacts of their projects and to secure an environmental compliance certificate prior to commencement of project activity.*

At the international level, the soft law principles enunciated during the 1992 Earth Summit[8], which were later adopted by the Philippine government[9], may be deemed as factors that contributed to this shift in the Philippine EIA system. Among the significant principles are:

(1) Principle 10: Environmental issues are best handled with the participation of all concerned citizens. This includes every individual's right of access to information concerning the environment and the opportunity to participate in decision-making processes;

(2) Principle 13: States shall develop national law regarding liability and compensation for the victims of pollution and other environmental damage;

(3) Principle 16: Taking into account that the polluter should, in principle, bear the pollution, the internalization of environmental costs and the use of economic instruments should be promoted by the national authorities; and

(4) Principle 17: Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment.

At the national level, lessons can be drawn from experiences during the incipient years of implementing the EIA system. The EIA process was often perceived as another bureaucratic hurdle, a stumbling block to the swift execution of proposed projects that are usually pegged on interest-bearing, bank-approved loans. The ECC was also seen as an ordinary business permit that merely signifies commencement of proposed projects. Investors and the government normally overlook the value of public processes leading to the grant of an ECC and were not keen on internalizing social and environmental costs *vis-à-vis* return of investments. Upon its issuance, the responsibility of monitoring the project rests primarily with the government.

The government, for its part, sorely lacks the resources, capacity and political will to effectively fulfill its legal mandate of reviewing, monitoring and enforcing the EIA system. It often finds itself in difficult positions with local communities which oppose projects on the grounds of inadequate information about the project and lack of public participation in the EIA process.

---

[8] *Rio Declaration on Environment and Development, Rio de Janeiro, Brazil (1992). The Rio Declaration reaffirms and seeks to build upon the Declaration of the United Nations Conference on the Human Environment, adopted at Stockholm in 1972.*

[9] *Philippine Agenda 21.*

This development in the Philippine EIA system is best demonstrated in the latest legal articulation of the objectives of the EIA process,[10] which are: (a) to ensure that environmental considerations are incorporated at the earliest possible stage of project development; (b) to further streamline the EIA procedures in order to improve its effectiveness not only as a regulatory tool, but also as planning and management instruments; and (c) to enhance maximum public participation in the EIA process for the purpose of validating the project's social acceptability and ensuring the fullest consideration of its environmental impact.

In order to significantly contribute to the attainment of these objectives, the EIA process now requires the creation of two fund mechanisms—the environmental monitoring fund (EMF) and the environmental guarantee fund (EGF)—for individual projects and activities that are considered by law as environmentally critical.

THE EMF AND EGF MECHANISMS

An EMF is a fund that project proponents are required to establish when an ECC is issued by the government to be used to support activities related to monitoring the project holder's compliance with the designated certificate.[11] A multisectoral team, commonly referred to as the MMT, is convened for the purpose of conducting the compliance monitoring, with the composition and responsibilities of the team to be agreed upon, through a Memorandum of Agreement (MOA), by the proponent, the DENR and the major stakeholders.[12]

The EGF, on the other hand, is required of proponents with projects that pose significant public risk, or which require rehabilitation or restoration. Its purpose is to answer for damages to life, health or property and the environment, including the costs of rehabilitation or restoration.[13]

---

[10] *Sec. 2.0, Article I, DENR Admin. Order No. 96-37 which is entitled "Further Streamlining and Strengthening the Implementation of the Philippine Environmental Impact Statement System".*

[11] *Article I, Sec. 3.0 (p), DAO 96-37.*

[12] *Supra, Article I, section 3.0 (s). The MMT is supposed to be composed of representatives of the proponent and a broad spectrum of stakeholder groups. Aside from the officials of local government units, other members may include representatives from the nongovernment organizations, people's organizations, the community, women's sector, concerned provincial and community environment officers (PENRO and CENRO), with support from the Regional Office and/or the Environmental Management Bureau of the DENR, whenever necessary, the academe, relevant government agencies, and other sectors that may be identified in the negotiations leading to the execution of the MOA.*

[13] *Supra, Article I, Section 3.0 (i). The concept of EGF, however, was first provided under DENR Admin. Order No. 21, series of 1992 as one of the possible conditions that may be stated in the ECC. It was initially contemplated to address both monitoring and rehabilitation concerns.*

Public risk is understood as "any exposure of public health or the environment to toxic substances, hazardous or organic wastes, extraction of natural resources or activities or structures that could endanger life, health, property or the environment".[14] While it is the DENR which is tasked to finally determine whether a project poses significant public risk, or where rehabilitation or restoration is indeed required[15], the rules also create a presumption of public risk in certain instances.[16]

Advantages of the EMF and EGF

In its ideal form, the EMF and EGF mechanisms offer some advantages:

(1) For the government, it is better able to perform its mandate despite limited resources and capacities by involving other sectors in taking on responsibility for environmental protection. Requiring the establishment of EMF and EGF does not mean allowing the DENR to renege on its primary role of ensuring proper utilization and management of natural resources, and protection of the environment. Instead, it allows opportunities for building partnerships and linkages with the other stakeholders;

(2) For the project proponents, these can be regarded as effective management tools to monitor compliance with environmental rules, as well as the effects of their project activities "as predicted". The EGF and EMF are examples of economic instruments that make project proponents, or the market, take greater responsibility in ensuring that their activities do not have deleterious impact on the environment. In consonance with the polluter pays principle, these economic instruments call for the increasing role of the private sector in environmental management. Both funds may then serve as important feedback facility insofar as the proponent's environmental track record and the specific project activity are concerned. The funds would definitely entail additional costs to the project proponents. Its nature as a deposit, trust or insurance that would readily be available should a contingent event occur nonetheless far outweighs the costs that will eventually accrue to them if there is no such fund; and

---

[14] *Supra, Article I, Section 3.0 (y).*

[15] *Supra, Article I, Section 4.0.*

[16] *Supra. Public risk is presumed in any of these cases: (a) presence of toxic chemicals and hazardous wastes as defined in Republic Act No. 6969; (b) extraction of natural resources that requires rehabilitation or restoration; (c) presence of structures that could endanger life, property, and the environment in case of failure; or (d) presence of processes that may cause pollution as defined under Pres. Decree No. 984, or other related pollution laws.*

(3) For other stakeholders, such as the host communities, the fund mechanisms as well as the fund committees provide venue for increased citizens' participation in the monitoring activities, and offer assurance of protection through the payment of compensation and/or damages in proper cases. These become major institutional mechanisms for greater public involvement in decision-making processes on projects of national significance.

Some Considerations in Establishing the EGF and EMF Mechanisms

Having been recently introduced into the Philippine EIA process, documented experience on the actual application of the EMF and EGF mechanisms is still limited. Its nascent stage in the implementation of the EIA system reveals that there are many gaps that need to be filled up in terms of fulfilling the objectives for which these funds were created.

There are various issues that must be considered in deciding to put up these fund mechanisms. One issue concerns the determination of the nature of the funds. A decision on whether these funds are public or private, and whether it should be held in trust or as a deposit, consequently leads to another question regarding the appropriate holder of these funds. Compliance with legal and administrative matters, including safety and security provisions, needs to be ensured in the process.

Another relevant set of questions concerns the form and amount of the funds. When would cash or trust funds be required? What are the legally acceptable guarantee instruments? What is the extent of the proponent's contribution? What is the basis of the amount of the EGF and EMF? In the Philippine EIA system, the amount of the fund is subject to whatever is agreed upon by the parties, but always not exceeding 10% of the firm's annual operating expenses.[17] While the determination of the amount is nonetheless guided by some factors, such as the degree of environmental risk involved and the valuation of affected resources,[18] leaving the parties to negotiate among themselves still poses a problem. This process, while affording the needed flexibility for varying circumstances, may still be questioned, particularly in situations where there are issues regarding balance of power among negotiating parties and relative distrust in the process.

---

[17] *Second Version of the Procedural Manual for DENR Admin. Order No. 96-37 (1998).*

[18] *Initial version of the Procedural Manual for DENR Admin. Order No. 96-37 (1997), p. 8-6. Other factors include the environmental impact statement (EIS) committed programs and the proponent's ability to provide the funds.*

Preparation of guidelines for the assessment of damage caused, proving claims, and payment schemes must also be considered. Finally, the legal feasibility of increasingly involving the local government units in EGF and EMF matters must be examined, particularly with respect to individual projects that are found or proposed to be undertaken within its territorial jurisdiction.

Value of the EMF and EGF Mechanisms to Current Marine Pollution Prevention Initiatives in the East Asian Seas

Within the context of the Philippine EIA system, the possibilities of applying the EMF and EGF mechanisms to current initiatives in preventing and managing marine pollution in the East Asian Seas may appear remote.

First, the present EIA system is still project-specific and mostly covers permanent structures and activities undertaken on land. Efforts to prevent and manage marine pollution, on the other hand, are directed towards more expansive areas and activities that are normally undertaken on water.

While marine pollution largely emanates from land-based sources, these consist predominantly of domestic (household and agricultural) wastes. On the contrary, the Philippine EIA system has been traditionally designed to govern industry-generated wastes and pollution.

Finally, despite recent developments, the EIA process is still largely considered as a regulatory instrument utilized by the national government, and quite distant from the local government units and coastal communities that directly or proximately experience marine pollution. Despite their legally ordained powers to raise local revenue and promote the people's general welfare, local government units are still unable to access these national government-implemented funds for coastal and local marine pollution management activities. In a pollution case of wide magnitude but indiscernible cause, for instance, any proposal to consolidate the EGF and EMF of individual projects within the affected territory for the purpose of responding to this problem, at the local level, is legally difficult.

These facts, however, do not rule out the possibility of applying the concepts of EGF and EMF to marine pollution prevention and management efforts, as well as the possibility of replicating EMF and EGF experiences in other countries in East Asia. Considering that marine pollution largely emanates from land-based sources, which consist of domestic yet toxic wastes, and noting that existing international instruments dealing with land-based sources of pollution are either weak[19], or have remained recommendatory,[20] national legislation on the establishment of EMF and EGF may be adopted, with particular consideration of the vital role that local governments and coastal communities can assume in these efforts.

Local government units and coastal communities may also initiate the development of similar funding mechanisms for the enhancement of their coastal and marine pollution management activities within their respective areas. The EGF and EMF best serve as conceptual models for such undertaking.

In summary, the EMF and EGF are important mechanisms that do not only increase the responsibility of the private sector in environmental management while providing opportunities for public participation and complementing the regulatory functions of the government. The fund mechanisms are also valuable tools for promoting collaborative efforts and developing partnerships among these different stakeholder groups in environmental protection and management. The interaction of the members of its multisectoral committees may provide opportunities for enhanced communication and productive environmental conflict management, specifically on issues relating to compliance monitoring, resource valuation, risks and damage assessments. It is in these aspects that the EGF and EMF mechanisms may prove applicable to marine pollution prevention and management in the East Asian Seas.

Reference

La Viña, A.G.M. 1994. The right to a balanced and healthful ecology: The odyssey of a constitutional policy. Philippine Law Journal.

[19] *Example is the UN Convention on the Law of the Sea (UNCLOS).*

[20] *Example is the 1995 Global Programme of Action (GPA1995). Since very few countries have so far adopted this Programme of Action, this is largely considered as recommendatory.*

Design and Implementation of Marine Functional Zoning Scheme in Xiamen, China

Ruan Wuqi

Fujian Institute of Oceanography, 22-40 Haishan Road
Xiamen 361012, People's Republic of China

Huming Yu

GEF/UNDP/IMO Regional Programme for the Prevention and
Management of Marine Pollution in the East Asian Seas
P.O. Box 2502, Quezon City 1165, Philippines

RUAN WUQI and HUMING YU. 1999. Design and implementation of marine functional zoning scheme in Xiamen, China, p. 341-354. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

A marine zoning scheme was developed and implemented in Xiamen addressing use conflicts in coastal waters. This paper discusses the rationale and process in the development of the scheme. The results and lessons learned from the implementation were evaluated. The experience shows that the adoption of the scheme depends on extensive consultation among concerned agencies and sectors. However, the zoning should be based on the ecosystem and socioeconomic functional quality of the various marine areas, taking into account traditional uses in those areas. The paper concludes that the development of integrated coastal management mechanisms in Xiamen ensures the effectiveness of the zoning scheme.

Why Zoning

Xiamen is one of the major maritime ports in China. During the past 10 years, the average annual gross domestic product (GDP) was about 20%. The accelerated economic development puts heavy pressure on the use of coastal and marine resources. Competition among coastal uses for limited space and other resources aggravated multiple use conflicts (Box 1), particularly the following:

- Shipping/port expansion vs. fisheries;
- Coastal reclamation vs. protection of ecosystem/habitat health;
- Waste disposal vs. protection of public health; and
- Navigation vs. marine protected areas.

Single-sector or single-resource oriented management systems hinder, rather than facilitate, the resolution of these use conflicts. Since 1994, the Xiamen Municipal Government has implemented an integrated coastal management (ICM)

Box 1. Examples of Multiple Use Conflicts in Xiamen.

Commercial vs. Fishing Ports. In the West Sea area, ports for both commercial and fishing ships coexisted for a long time. There was no clearly defined boundary between these two types of ports. In the 1970s, fishing communities complained that their traditional fishing port area was encroached by the expansion of commercial ports. The dispute hampered the development planning of both ports.

Shipyard vs. Seafarming. In 1995, the Xiamen Municipal Government approved the establishment of a new shipyard in the West Sea area near Paitou Village, Haicang Township where shipping was given priority through initial marine functional zonation. However, seafarmers considered the new shipyard site infringed on their traditional activity area and refused to yield their use rights in the same area.

Coastal Development vs. Navigation. Construction of causeways and land reclamation significantly reduced the West Sea area from 110 km^2 in 1952 to 52 km^2 in 1997. This led to the reduction of tidal inflow and serious siltation in certain localities, thus significantly increasing the need and cost of dredging in major navigational channels.

Coastal Development vs. Habitat Loss. Lancelet (*Branchiostoma belcheri*), a warm water benthic species found in coarse sandy sediments and a specimen for the study of the evolution of Chordata, is listed in Category II of plants and animals that need government protection in China. Some 22 km of lancelet fishing ground existed in Liuwudian, Tong'an Bay during the 1950s, but cannot be found today. The loss of habitat was attributable to overfishing and the change of sediment from sand to silt supposedly caused by coastal reclamation, e.g., construction of Gao Ji causeway.

Source: ITTXDP (1996).

demonstration project (the Project) with support from the GEF/UNDP/IMO Regional Programme. One key activity was to develop a zoning scheme for Xiamen coastal waters.

Marine functional zonation is defined here as the zoning of natural resource uses through integrated consideration of ecosystem and socioeconomic functions of coastal lands and waters. Its objective is to determine the multiple use priority, reduce use conflicts and increase socioeconomic benefits of these uses to the society as a whole, while sustaining ecosystem functions and resource base.

Zoning Process

The zoning process covered four major stages:

- Zoning scheme preparation;
- Approval;
- Implementation; and
- Refinement.

Research and stakeholder consultation cut across all the stages. The lessons learned from the implementation provide feedback to the zoning refinement.

In 1995, the Project organized a task force to undertake research on the functional characteristics of various resource systems and development of the zoning scheme. The task force is made up of major stakeholders, including experts and specialists from 18 units of the local government, universities and research institutions. Related information and opinions of the stakeholders have been shared, reconciled and incorporated in the zoning scheme. This paves the way for its subsequent approval and implementation.

The zoning mainly relied on the existing data and information derived from:

- Sectoral development programs including urban areas, fisheries, tourism and shoreline development;

- Sectoral zoning schemes including those for the general environment, marine environment and fisheries of the municipality;
- Environmental impact assessments; and
- Scientific reports and publications.

However, several field surveys were also conducted in selected areas and sites where key information was lacking, insufficient or requiring validation.

By the end of 1996, a draft zoning scheme had been prepared. The scale used was 1:200,000. Recognizing the importance of marine zoning scheme for rational sea space utilization, the municipal legislative assembly adopted in January 1997 "Regulations for the Uses of the Sea Area for Xiamen" (OSC/XMPA, 1997) which contains the following legal requirements:

- The Xiamen Municipal Government shall develop a marine functional zonation scheme for the purpose of integrated management of the sea areas.
- Competent marine management agency shall supervise the implementation of the zoning scheme.
- All development activities must be consistent with the zoning scheme.

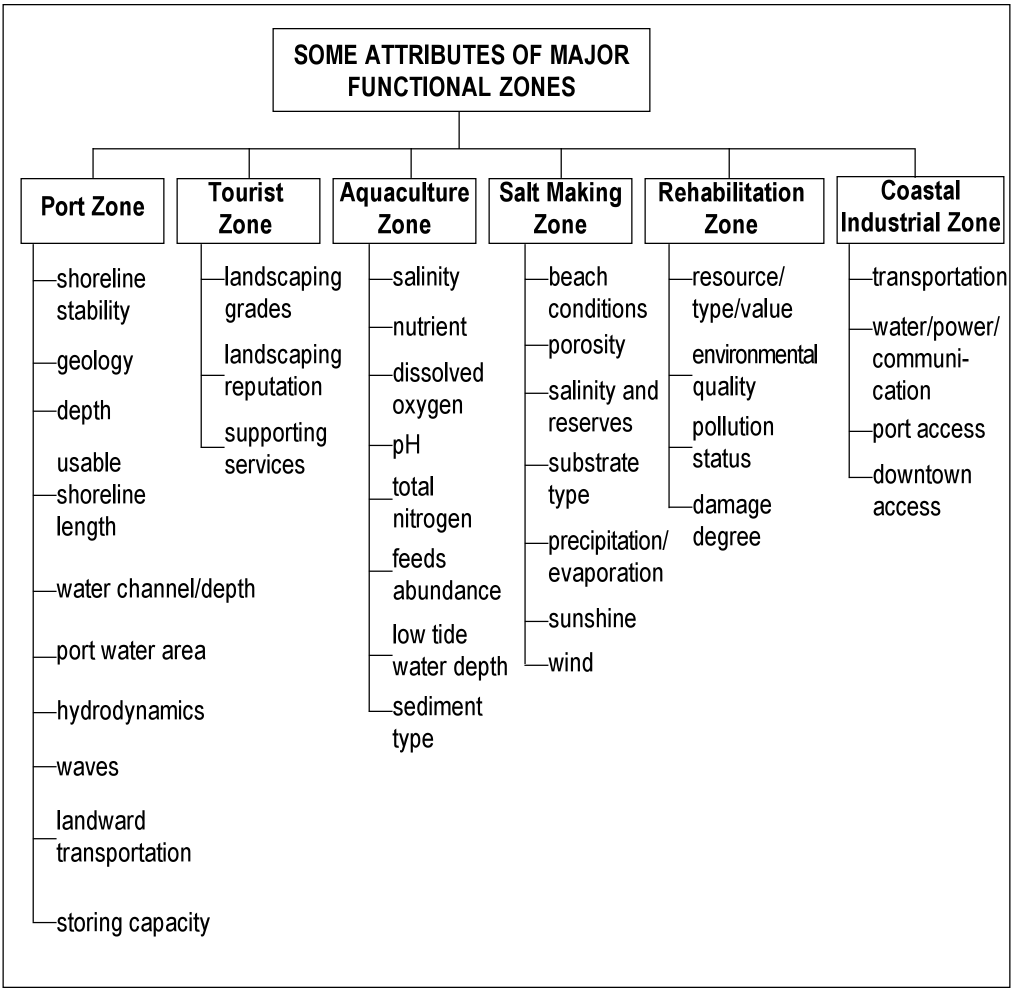
Throughout 1997, the draft zoning scheme was further reviewed, validated and refined through various expert meetings, stakeholder consultations and public hearings. By December 1997, the Xiamen Municipal Government had adopted the zoning scheme and requested 23 related agencies, through an administrative order, to implement the scheme in the formulation and execution of their respective sectoral programs (OXMPG, 1997a).

Classification Scheme

Marine functional zonation in Xiamen covers an area of 334 km^2 and a 234-km long coastline, including marine waters, islands, shorelines and the adjacent land areas under the jurisdiction of the Xiamen Municipality.

In the light of their ecosystem and socioeconomic attributes, Xiamen marine area has been classified in terms of subarea, also called multiple-functional zone, and by the priority of use functions in each subarea. Some of the attributes considered in the zoning are shown in Figure 1.

Figure 1. Attributes Considered in Xiamen Marine Functional Zoning.



Defining the Subareas

The subareas have been determined through applying the following guidelines, wherever appropriate:

- A subarea should be a distinct geophysical unit in which the ecosystem and socioeconomic attributes are similar, e.g., water depth, temperature, salinity or level of access to various resources;

- The subarea is usually dominated by certain combinations of resource services and use patterns that are different from those of other subareas, e.g., a combination of shipping, fishing and tourism; and

- In a subarea, major resource use problems are similar and may require the same types of conservation measures, e.g., alteration of habitats for certain types of endangered species.

As a result, four subareas in Xiamen have been defined for the purpose of the zoning: the West Sea, Tong'an Bay, East Sea and Dadeng Sea.

Defining the Use Priority

Before prioritizing the various uses, the ecosystem functions, resource functions and use functions in each subarea were determined. The use functions include:

- Navigation;

- Tourism;

- Fisheries;

- Mining;

- Military uses; and

- Conservation.

Based on the use functions, a zoning classification scheme was developed. The scheme contains the following nine major zone classes:

- Shipping/port zone;

- Tourism zone;

- Aquaculture zone;

- Coastal industrial zone;
- Ocean engineering zone;
- Mining zone;
- Nature reserves;
- Special function zone; and
- Rehabilitation zone.

A detailed classification scheme is shown in Figure 2.

Prioritization of use functions is the key to the zoning. It depends on the levels of socioeconomic effects and the associated environmental impacts of the uses. Based on the assessment of these effects and impacts, the zoning has defined the use priority in terms of "dominant, compatible or restricted functions." The "dominant function" is assigned to the use(s) considered high priority; "compatible function" to those considered no significant adverse effects on the priority use; and the "restricted function" to those that should be reduced, moved out or closed due to their detrimental effects on the priority and other functions. The zoning results with regard to the four subareas are outlined in Table 1.

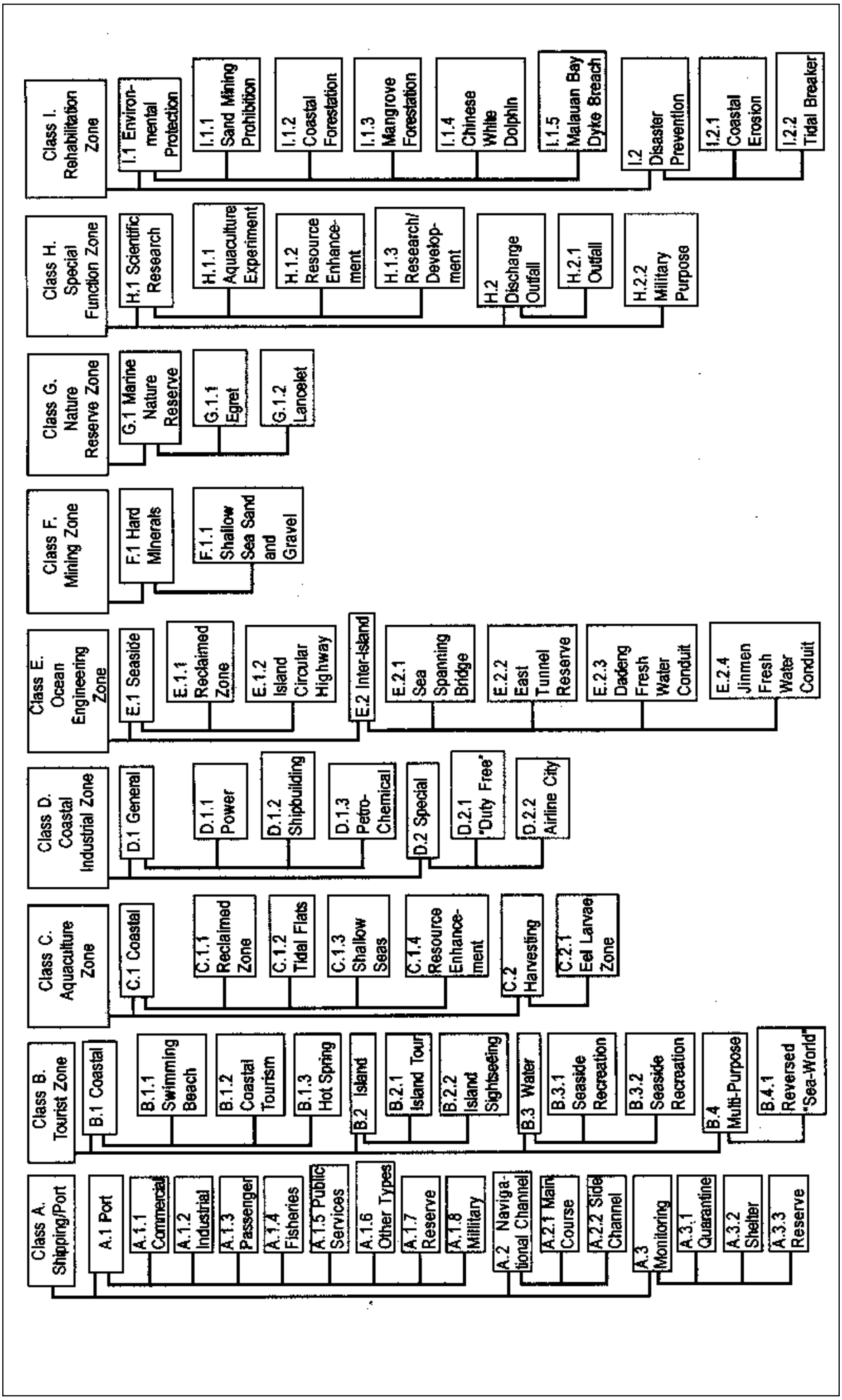
Table 1. Xiamen Marine Use by Priority.

Function	West Sea	Tong'an Bay	East Sea	Dadeng Sea
Dominant	Shipping/port	Aquaculture	Tourism	Aquatic resource enhancement
Compatible	Tourism/nature reserve	Tourism/port/nature reserves	Shipping/engineering/ nature reserve	Shipping/tourism
Restricted	Aquaculture	Waste disposal	Aquaculture	Waste disposal

Achievements and Constraints

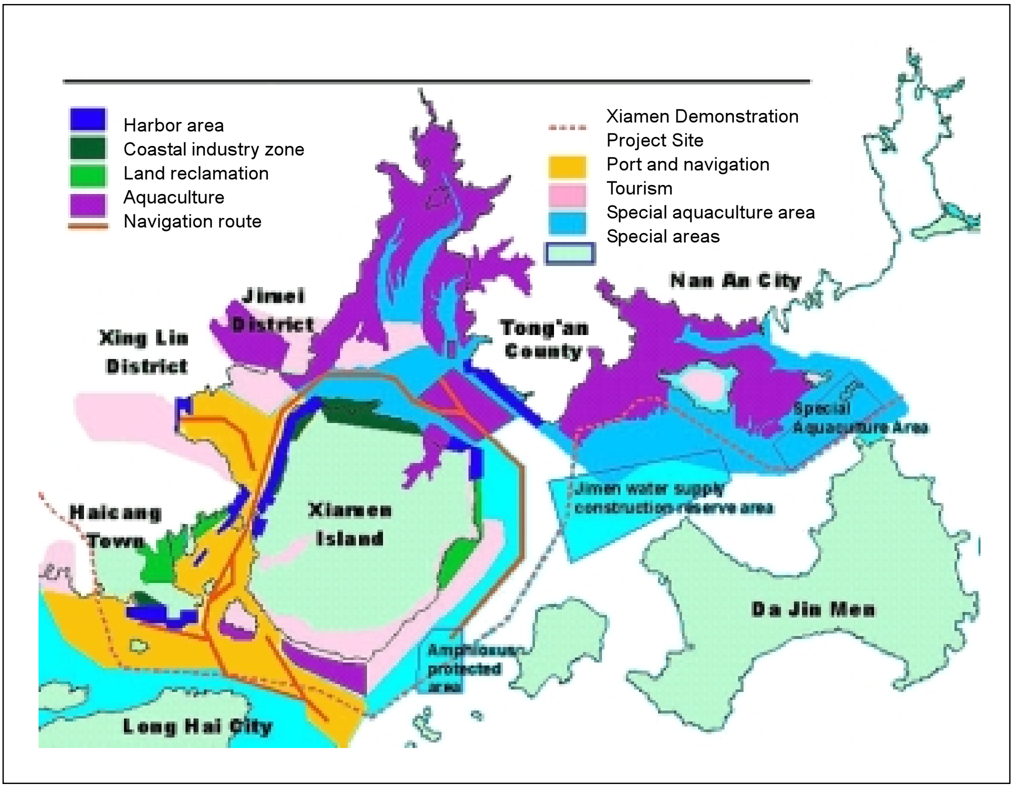
Marine functional zonation has been a subject of research in Xiamen for over 10 years. Prior to the project, zoning remained an exercise of research/education institutions, and had no significant effect for management improvement. The Project, building on the information and expertise developed in the past, focused on the policy and technical aspects of the zoning that would increase its potential

Figure 2. Marine Functional Zonation in Xiamen: Classification Scheme.



for implementation (see Figure 3 for the resultant zoning scheme). This means that a workable zoning scheme should be acceptable to the concerned users, particularly those with conflicting interests. In this regard, the zoning in Xiamen was a process of stakeholder consensus-building. In the process, the Project team provided its functional quality assessment to the stakeholders to increase their awareness on the use impacts and to induce perception change. This facilitated the resolution of multiple use conflicts. Some examples are given below.

Figure 3. Marine Functional Zoning Scheme in Xiamen.



Resolution of Conflicts between Shipping and Seafarming

Xiamen has been known as a major maritime port. This is largely due to the shipping activities in the West Sea. However, the West Sea has also been traditionally used for fishing and seafarming. Moreover, Gulangyu Islet, a renowned tourism spot, is located in the West Sea. As shown in Table 1, shipping/port development is determined as the dominant function, while seafarming as the restricted function in the West Sea. The following considerations helped in setting the use priority in the West Sea:

- The West Sea has unique hydrographic conditions for deepwater channels and ship berths. There is no alternative similar condition elsewhere in Xiamen for shipping and port;

- Tong'an Bay offers a better alternative to the West Sea in seafarming in terms of ecosystem features;

- Studies show too much investments in coastal aquaculture, resulting in decreasing yields and increasing nutrient contamination in the marine environment; and

- The shipping value of the West Sea is estimated in the order of RMB billion (the Chinese yuan), while the value of fisheries or tourism is about RMB hundred million.

Despite these findings, the seafarmers were reluctant to yield the "rights of way" to the shipping. A typical example is the dispute between the shipyard and the seafarmers (Box 1). The Project Office, being the secretariat for the inter-agency Executive Committee for Xiamen Demonstration Site, organized consultations between the shipping and fisheries sectors. This led to a settlement under which the shipyard agreed to compensate the seafarmers for relocation of their aquaculture facilities to Tong'an Bay. The settlement also allowed a three-year grace period for phasing out mariculture in the area, as requested by the seafarmers. The incidents of encroachment by mariculture facilities on navigational channels in the West Sea were also reduced.

Sites for Mangrove Nature Reserve

The intertidal zone of Haicang by the side of the West Sea used to be habitats for mangroves. During the past 40 years, these habitats were lost to shrimp ponds and other reclamation activities. Over the past 10 years, Haicang became the fastest growing industrial zone in the municipality. The zoning scheme designated the remaining pockets of mangroves and former mangrove sites as a nature reserve where mangrove reforestation can be implemented. However, some Haicang development proponents opposed the reserve scheme, claiming that these sites were to be leased for industrial projects. The Executive Committee for Xiamen Demonstration Project organized stakeholder consultations, providing the rationale for the reserve and working together with the developers for alternative sites. The consultation has, thus, overcome the resistance to the reserve scheme.

Protection of Dolphin and Other Endangered Species

The Chinese white dolphin *(Sousa chinensis)* is among those species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As the West Sea is a habitat for the dolphin, it has been classified as a nature reserve for the dolphin. The reserve potentially conflicts with the dominant function in shipping, as conventional nature reserve law would preclude shipping activities in the area. Through stakeholder consultation, particularly the scientific community, the dolphin reserve proponents, the municipal government issued a special ordinance to implement the Xiamen Municipal Regulations for the Protection of Chinese White Dolphin (OXMPG, 1997b) which also allows navigation and other activities in the area subject to the following legal requirements:

- Ship cruising under 8 knots;
- No bottom trawling/gill nets;
- No recreational boating and surfing;
- No effluent discharge above standards;
- No underwater explosion; and
- Special permit required for reclamation.

In addition, the Chinese White Dolphin Nature Reserve Management Division (CWDNRMD) was established under the fisheries agency to enforce the ordinance. A 55 km^2 area where the dolphins were frequently sighted has been designated as core protection zone. A Special Fund for White Dolphin Protection currently at about RMB1.1 million has been set up to provide feeds for the dolphin, to promote related research and education, and to implement protection measures (CWDNRMD, 1998). Some 19 public institutions and 900 individuals contributed to the fund in 1997. No dolphin catching or killing has been reported since the implementation of the ordinance.*

---

* *Personal communication with the Director of CWDNRMD, Xiamen Fisheries Agency, Xiamen Municipal Government (1999).*

In the same manner, the zoning scheme has set aside a 18 km^2 marine area as nature reserve for the lancelet (Box 1), and the entire Dayu Islet as nature reserve for the egret *(Egretta eulophotes)*, a seabird regarded by the local people as Xiamen's symbol. The local government has adopted special regulations to implement the nature reserves.

Issues and Solutions

A review of the implementation of the zoning scheme has suggested a number of issues and possible solutions discussed below.

Valuation of use functions

In many instances, environmental impacts and socioeconomic effects of coastal uses may not be as well studied as for the West Sea. Multiple use interactions are still poorly understood, especially concerning the accumulative and non-marketable effects. In the zoning scheme, some areas are set aside for future zoning due to information uncertainties, or controversy of stakeholders. Valuation of resource uses and the effects of their interactions in particular should be strengthened.

Integration of land- and sea-use planning

Marine functional zonation occurs against the backdrop of well-established urban and land-use pattern. In Tong'an Bay, there have been several wastewater discharge outfalls, which conflict with mariculture, the dominant function of the bay as defined by the zoning. Recommendations were made by the zoning team to the government to restructure the industrial activities and relocate the discharge outfalls in the adjacent land area.

Impacts across administrative boundaries

The West Sea is also the catchment of wastes and sediments coming from the adjacent industrial zone in Zhangzhou Prefecture located outside of Xiamen's jurisdiction. Efforts are underway to develop the Xiamen-Zhangzhou joint environment management regime and concerted zoning efforts in the two regions.

Enforcement mechanisms

Although the application of the zoning scheme is a legal requirement in the approval and review of coastal and marine development projects, it still remains as a general exhortation, as there are no specific mechanisms for compliance. Implementation is left to the discretion of concerned government agencies. This should be tackled through the strengthening of the institutional arrangements for ICM.

Application of geographic information system (GIS)

In the early design, the Project included the application of GIS in the processing of related information and data. However, GIS development and operation were delayed when the zoning scheme was ready for adoption in 1997. Thus, the zoning project did not have the benefits of GIS. The zoning scheme is now being incorporated into the GIS to facilitate its future updating.

CONCLUSION

Marine functional zoning scheme provides a set of scientific guidelines for restructuring multiple coastal and marine uses, thus outlining an operational path of sustainable development. The implementation of the zoning scheme has facilitated use conflict resolution and biodiversity conservation. However, improvement can be made through further studies on multiple use interactions and effects, integration of land- and sea-use planning, and the strengthening of inter-agency and transboundary coordination for better implementation. Below are some lessons learned.

- Zoning is a delivery mechanism in the application of scientific results for management improvement. ICM needs zoning as a guide for multiple use prioritization and coordination, whereas the implementation of the zoning scheme is possible only through the working of ICM mechanisms.

- The purpose of zoning is to address the external adverse effects of use conflicts. However, the zoning scheme should be constantly updated, absorbing the latest scientific results and new knowledge, so that it will not become a stereotype administrative intervention when circumstances have changed.

- Zoning is not merely research, but involves planning processes. The involvement of all the stakeholders is essential. The zoning scheme should be the result of building stakeholder consensus.

References

CWDNRMD. 1998. Work Correspondence, a news bulletin published by the Chinese White Dolphin Nature Reserve Management Division (CWDNRMD), Xiamen Fisheries Agency, No. 1, Xiamen, China.

ITTXDP (Integrated Task Team of the Xiamen Demonstration Project). 1996. Coastal environmental profile of Xiamen. MPP-EAS Technical Report No. 6, 110 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

OSC/XMPA (Office of the Standing Committee for Xiamen Municipal People's Assembly). 1997. Regulations for the Uses of the Sea Area for Xiamen. Xiamen Municipal Legal Series No. 25, 8 p.

OXMPG (Office of Xiamen Municipal People's Government). 1997a. Xiamen Municipal People's Government on the Implementation of Marine Functional Zoning Scheme.

OXMPG (Office of Xiamen Municipal People's Government). 1997b. No. 65. Ordinance of Xiamen Municipal People's Government concerning Xiamen Municipal Regulations for the Protection of Chinese White Dolphin.

Harmonization of National Legislation: A Case in Xiamen, China

Li Haiqing

Department of International Cooperation
State Oceanic Administration
1 Fuxingmenwai Ave., Beijing 100860
People's Republic of China

LI HAIQING. 1999. Harmonization of national legislation: A case in Xiamen, China, p. 355-371. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Xiamen is one of the coastal cities in China that has experienced very rapid economic development since China adopted the "Open Policy" in 1978. However, balancing such a rapid economic development and the protection of marine resources and environment so as to achieve sustainable development has been an outstanding issue confronting the city government.

The establishment of a system of laws and regulations in Xiamen represents a first and an important step toward achieving the goal of sustainable development in coastal areas. Taking advantage of the legislation right granted to Xiamen by the National People's Congress in March 1994, the city has been promulgating a set of laws and regulations covering nearly all fields of marine resources development and environmental protection. This process was particularly accelerated through China's implementation of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (GEF/UNDP/IMO Regional Programme) from 1993 to 1999 in which Xiamen was established as a pilot site.

The purpose of this paper is to analyze how to harmonize the national legislation in Xiamen in terms of coastal resources development and environmental protection. The paper provides an overall view of the national legislation, analyzes the deficiencies of the legislation, introduces various specific laws and regulations *promulgated so far and demonstrates their effectiveness in protecting the marine environment and resources in Xiamen. The paper summarizes the experience gained in Xiamen in harmonizing the local legislation with national legislation for the purpose of protecting marine resources and environment and identifies the gaps in which further work may be required.*

Introduction

Xiamen is a medium-size coastal city in the southern part of China with a total population of 1.2 million. It is endowed with natural landscape and rich natural resources, making it a famous tourist city. Along its 234 km of coastline and 334 km^2 of sea area, various economic activities are taking place—port and harbor development, shipping, coastal construction, tourism, agriculture, aquaculture, fisheries and various industrial and human settlement projects. As one of the five special economic regions in China, the gross domestic product (GDP) of Xiamen has been growing at an average rate of 20% since the 1980s until the financial crisis in 1997.

However, as an emerging industrialized city, it is confronted with nearly all the problems of other cities: rapid economic development, fast growing population, rapid spatial expansion of the city and increasing pressure on resources and environment. Due to unregulated development activities, use conflicts of marine resources are increasingly acute and pollution is becoming serious. As a result, significant environmental degradation has occurred in Xiamen. Balancing the rapid economic development with resources and environmental protection was the objective of a joint initiative between the city government of Xiamen and the GEF/UNDP/IMO Regional Programme.

China's Ocean Legislation

Under the Chinese legal system, laws are classified into several types. The first type is termed "special laws" (basic laws) which are incorporated into the Constitution. Next comes the laws approved by the Standing Committee of the National People's Congress, termed "second-class law" (second category) and finally those approved by the State Council or its subordinate ministries and agencies which are considered as "third class law" (third category), often termed as regulations, rules or orders. The higher the category, the more important the law is. When different types of laws contradict each other, the basic law prevails.

So far, China has promulgated quite a number of ocean-related laws of different categories and for various purposes (Table 1). At the same time, China has also ratified or acceded to a number of international treaties related to ocean affairs, including the United Nations Convention on the Law of the Sea, the Convention on Biological Diversity, the Framework Convention on Climate Change, London Convention 1972, MARPOL 73/78 and other maritime conventions, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. Therefore, the ocean-related laws in China have wide coverage and have formed the basis for the rule of law in various fields of ocean affairs.

However, there are apparent deficiencies with respect to the implementation of these laws. First, the current ocean management system in China is, to a great extent, based on the sectoral approach, although the State Oceanic Administration (SOA) is entrusted with more coordinating responsibilities in ocean management than any other ocean-related government departments (Table 2). This means that the national laws related to the ocean are basically drafted by sectoral departments, reflecting the sectoral concerns and interests and aiming at solving sectoral problems. Second, there is not an integrated ocean policy-making and coordination mechanism among or above the ocean-related departments and, therefore, the laws and policies related to marine affairs are not effectively integrated horizontally among various government departments at the national level. Third, there is no national law regulating ocean uses and activities in the coastal zone. Fourth, although China has promulgated the laws on the Territorial Sea and the Contiguous Zone, the Exclusive Economic Zone and the Continental Shelf, no implementing agency or agencies have been identified therein, leaving the laws virtually unattended. Fifth, a unified law enforcement mechanism at sea is lacking and marine law enforcers are distributed among various government departments (Table 2). The deficiencies of national ocean legislation and management system affect the effectiveness of local marine legislation.

Coastal and Marine Management

Problems in Xiamen

For a long period in the past, the local authority in Xiamen had encountered, among others, the following coastal management problems:

- Conflicts arising from competitive use of coastal and sea areas for aquaculture, fisheries and navigation; salt making and other coastal construction activities;

Table 1. Ocean Legal Regime in China.

OCEAN SPACE

- Declaration of the Government of the People's Republic of China on China's Territorial Sea (4 September 1958)
- Law of the People's Republic of China on the Territorial Sea and the Contiguous Zone (adopted at the 24th Meeting of the Standing Committee of the 7th NPC on 25 February 1992)
- Decision of the Standing Committee of the National People's Congress of the People's Republic of China on the Ratification of the United Nations Convention on the Law of the Sea (adopted on 15 May 1996)
- Declaration of the Government of the People's Republic of China on the Baselines of the Territorial Sea of the People's Republic of China (15 May 1996)
- Law of the People's Republic of China on the Exclusive Economic Zone and the Continental Shelf (adopted by the Standing Committee of NPC on 26 June 1998)

RESOURCES MANAGEMENT

- Tentative Regulations on the Use and Management of the Sea Areas (promulgated by the Ministry of Finance and the State Oceanic Administration on 31 May 1993)
- Regulations of the People's Republic of China on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises (promulgated by the State Council on 31 January 1982)
- Fisheries Law of the People's Republic of China (adopted by the Standing Committee of NPC and promulgated by President on 20 January 1986)
- Regulations for the Implementation of the Fisheries Law of the People's Republic of China (adopted by the State Council and promulgated by the Ministry of Agriculture on 20 October 1987)
- Implementation Regulations on Protection of Aquatic Wildlife of the People's Republic of China (promulgated by the State Council on 5 October 1993)
- Mineral Resources Law of the People's Republic of China (adopted by the Standing Committee of NPC on 19 March 1986 and revised on 29 August 1996)

ENVIRONMENTAL PROTECTION

- The Marine Environmental Protection Law of the People's Republic of China (adopted by the Standing Committee of NPC and promulgated by the NPC on 23 August 1982)
- Regulations of the People's Republic of China Concerning Environmental Protection in Offshore Oil Exploration and Exploitation (promulgated by the State Council on 29 December 1983)
- Regulations of the People's Republic of China Concerning the Prevention of Pollution of Sea Areas by Vessels (promulgated by the State Council on 29 December 1983)
- Regulations of the People's Republic of China Concerning the Dumping of Wastes at Sea (promulgated by the State Council on 6 March 1985)
- Regulations of the People's Republic of China Concerning Prevention of Environmental Pollution by Ship-Breaking (promulgated by the State Council on 18 May 1988)
- Regulations of the People's Republic of China Concerning Prevention of Pollution Damage to the Marine Environment by Coastal Construction Projects (promulgated by the State Council and effective as of 1 August 1990)
- Regulations of the People's Republic of China Concerning Prevention of Pollution Damage to the Marine Environment by Land-based Pollutants (promulgated by the State Council and effective as of 1 August 1990)

continued

Table 1. Ocean Legal Regime in China (continued).

NAVIGATION AND SHIPPING

- Regulations Required to be Observed by Merchant Vessels Passing through the Lao Tie Shan Channel (1956)
- Regulations with Respect to Seaport Pilotage Issued by the Ministry of Communications of the People's Republic of China (12 November 1976)
- Regulations Governing Supervision and Control of the Foreign Vessels by the People's Republic of China (adopted by the State Council on 22 August 1979)
- Maritime Traffic Safety Law of the People's Republic of China (adopted by the Standing Committee of NPC and promulgated by the President of China on 2 September 1987)
- Regulations Governing the Investigation and Settlement of Maritime Traffic Accidents of the People's Republic of China (approved by the State Council on 11 January 1990 and promulgated by the Ministry of Communications)
- Measures on the Management of Foreign Merchant's Participation in the Salvage of Sunken Vessels and Sunken Objects in China's Coastal Waters (promulgated by the State Council and effective as of 12 July 1992)
- Regulations of the People's Republic of China on the Management of Maritime Navigational Warnings and Navigational Notices (approved by the State Council on 22 December 1992 and promulgated by the Ministry of Communications)
- Regulations of the People's Republic of China on the Inspection of the Ships and Offshore Installations (promulgated by the State Council on 14 February 1993)
- Measures for the Inspection of International Voyage Ships' Entering or Leaving Ports of the People's Republic of China (promulgated by the State Council and effective on 21 March 1995)
- Regulations of the People's Republic of China Concerning Navigational Marks (promulgated by the State Council and effective as of 3 December 1995)

SCIENTIFIC SURVEY AND RESEARCH

- Survey and Mapping Law of the People's Republic of China (adopted by the Standing Committee of NPC and promulgated by the President of China on 1 July 1993)
- Regulations of the People's Republic of China on Management of the Foreign-related Marine Scientific Research (promulgated by the State Council and effective as of 1 October 1996)

STRAIT MANAGEMENT

- Regulations Governing Non-military Foreign Vessels Passing through the Qiongzhou Haixia (promulgated by the State Council on 8 June 1964)

OTHERS

- Regulations on Management of Laying Submarine Cables and Pipelines (promulgated by the State Council and effective as of 1 March 1989)
- Regulations of the People's Republic of China on the Protection of Underwater Cultural Relics (promulgated by the State Council on 20 October 1989)

Table 2. Government Departments Involved in Ocean Management and Law Enforcement before 1998.

Government Department	Functions	Jurisdictional Responsibility	Law Enforcement Force at Sea
State Oceanic Administration	Ocean law drafting and enforcement; policy-making; ocean and coastal management; ocean service; marine survey and research	Regulations on management of sea area uses Regulations on ocean dumping Regulations on offshore oil pollution control Regulations on submarine cable and pipeline laying Regulations on foreign marine research	Marine surveillance
Ministry of Communications	Ship inspection; port superintendence; maritime safety; salvage, etc.	All maritime safety laws Regulations on vessel-source pollution Regulations on shipbreaking	Bureau of Harbor Superintendence; Registry of Shipping (now called China Maritime Safety Administration)
Ministry of Agriculture	Fishing port and ground inspection; aquatic resources protection	Fisheries law and regulations Regulations on aquatic wildlife	Bureau of Fisheries Management and Fishing Port Superintendence
General Administration of Customs	Anti-smuggling	Law on customs	Anti-smuggling troops and vessels
Ministry of Public Security	Security at sea		Sea patrol
Ministry of Health	Quarantine	Rules for vessel quarantine Regulations on boundary quarantine	
State Environmental Protection Administration	Environmental protection	Marine environmental protection law; regulations on land-based pollution; regulations on coastal construction projects	
Ministry of Light Industry	Salt administration (sea salt section)	Law on salt management	Salt administration
Ministry of Petroleum	Offshore oil and gas exploitation	Regulations on offshore petroleum	
State Land Administration	Land resources management	Law on land management	
State Administration of Cultural Heritage	Protection of cultural relics	Regulations on protection of underwater cultural relics	
State Bureau of Surveying and Mapping	Mapping	Survey and mapping law	

- Illegal use of unallocated sea areas by individuals or groups due to unclear ownership. This not only prevents the State from obtaining benefits from their use but also hampers any planned construction projects of the government especially when these individuals and groups demand large sums of undeserved compensation when given notice to vacate; and

- Damage of resources and environment caused by unreasonable land reclamation, sand mining and construction projects on beaches.

A number of factors contribute to the aforementioned problems. Inadequate attention given to sustainable economic development has resulted in neglecting the need to conserve and protect the environment. The most fundamental factor lies perhaps in the inexistence of laws for managing the coastal zone as a whole as well as the inadequacies of existing laws enacted for regulating specific issues within a sector. There are no laws enacted to manage the conflicting uses of the coastal areas. Legislation of national and local governments conflict with each other. Behind all these is the shortage of understanding and appreciation of the special characteristics of the ocean where the resources, environment and space are horizontally and vertically intertwined with use conflicts more serious than those on land. Therefore, it is imperative to establish a legal regime for coastal and marine management with harmonized and coordinated laws able to respond to the emerging problems at the local level.

The Need for Marine Legislation in Xiamen

Before the 1980s, there already existed a limited number of local marine legislation. These laws, enacted when the coastal development was much less intense and marine environmental problems were less serious, aimed at tackling such simple issues as lancelet protection and safety of ships. However, since the 1980s, the marine economy has developed at an unprecedented rate and scale. Serious issues relating to resources overuse and environmental degradation arose. At the same time, the illegal occupation of sea areas by industries, other commercial enterprises, groups and individuals became an increasing social and economic issue requiring management intervention. The procedures for obtaining sea use permits were confusing and complex. Thus, development activities in the sea area were rather unregulated. Several reasons contributed to these problems.

First, the existing local laws, given their limited coverage, were outpaced by the rapid development of marine economy. Second, although there were a number of marine laws at the national level, each law dealt only with one issue with little or no integration with legislation dealing with other issues. Most of these laws were very generic and promulgated for all regions of the country. As a result, these laws were not effective in addressing the specific and practical problems in Xiamen. Third, in some existing marine management legislation, the responsibility of line agencies was not clearly spelled out, culminating in inter-agency conflicts over the implementation of a piece of legislation. Fourth, since law enforcement in Xiamen was implemented by various government departments, the lack of coordination left violators much room for manipulation (Table 3). As a result, the incidence of sea use conflicts increased particularly between aquaculture and port construction, between eel fishing and navigation, between coastal construction projects and nature conservation, between coastal manufacturing industries and aquaculture, between the salt industry and pond culture of fish. The marine environmental quality was also degraded. Exploitation of natural resources remained unchecked.

Table 3. Ocean Management-related Agencies in Xiamen, their Relations with the Central Government and the Basis for their Law Enforcement Responsibilities.

Central Government	Xiamen City Government	Law Enforcement Responsibilities
State Oceanic Administration	Xiamen Marine Management Division, SOA*	Marine environment protection law; regulation on ocean dumping
	Marine Management Division, City Government of Xiamen**	Ocean management responsibilities granted by city government
State Environmental Protection Agency	Department of Environment Protection, Xiamen City**	Marine environment protection law; Xiamen regulations on environmental protection
Ministry of Agriculture	Department of Aquatic Products, Xiamen City**	Fisheries law; environmental protection law
Ministry of Communications	Xiamen Branch of Maritime Safety Control *	Maritime traffic safety law; maritime law
	Xiamen Navigation Management Division *	Regulations on seaport pilotage, Ministry of Communications
	Xiament Port Office, Xiamen City**	
	Trading Port Office, Xiamen City**	Regulations on port management of Xiamen City
General Administration of Customs	Xiamen Customs*	Customs law
Ministry of Health	Xiamen Branches of Plant and Animal Quarantine *	Sanitation and quarantine law
Ministry of Public Security	Xiamen Coast Defence Commission *	Frontier inspections regulations
State Administration of Commodity Inspection	Xiamen Branch of Commodity Inspection	Import and export commodity inspection law

* Subordinate relation
** Operational relation

By 1993, the total sea area west of Xiamen had been reduced by 50%. Coastal erosion and sedimentation had moved the delta area of the Jiulongjiang River eastward toward the Xiamen Port, rendering the navigational channel narrower, shallower and curved. Seawater intrusion and soil salinization were reported. The number of lancelet, Chinese dolphin and Chinese king crab were greatly reduced. Marine environmental quality had deteriorated further and the recreational beaches were seriously polluted by various floating debris. New laws were required to address these emerging problems in coastal management, particularly the use conflicts.

The new ocean legislation in Xiamen enacted by the concerned legislative bodies is not only a reflection of the basic principles of the Constitution and other national laws and regulations on ocean development and environmental protection, but also a reflection of the practical need, as well as the aspirations of the scientists, experts and the general public. The establishment of this legislation demonstrates the political will of the government to balance marine resources development with environmental protection, fulfilling the objectives of sustainable development.

Harmonization of National Legislation

How to make the ocean legislation effective for resource and environmental management is the question put squarely before the city government of Xiamen when it decided and committed to join the GEF/UNDP/IMO Regional Programme. One challenge of the city government is how to harmonize the national legislation and marine management system with those of the local government.

An advantage to the city government is the legislation power of the Xiamen People's Congress entrusted by the National People's Congress in March 1994. This was granted to Xiamen due to its status as a Special Economic Region, with the condition that this power should be exercised in general conformity with the Constitution and not in contravention of the general principles of the existing national laws, regulations and administrative orders. The National People's Congress also entrusted the city government to implement the laws and regulations thus promulgated within the administrative boundary of Xiamen.

From January 1994 to 1998, Xiamen enacted a number of marine laws and regulations of various levels with sea use management as the basis. This legislation was accompanied by a series of other legislation on the development and utilization of marine resources and the protection of marine environment (Tables 4a and 4b). This paved the way for the establishment of an integrated coastal management legal regime incorporating coastal land and marine resources management.

There already existed a provisional national Regulation on Management of Sea Area Use promulgated by the Ministry of Finance and the State Oceanic Administration. Its adoption and effective implementation were rather limited at the local level, as the regulation did not receive the approval of other national agencies such as the Fishery and Environment Departments. Therefore, the legal effect and practical efficiency were very limited in Xiamen. However, taking advantage of the legislation power granted to Xiamen, a new regulation was promulgated by the Xiamen People's Congress—as the highest legislative body in Xiamen, replacing the one previously promulgated by the Ministry of Finance and State Oceanic Administration. The newly established Regulation on Management of Sea Area Use has not only helped to harmonize the national legislation with local legislation, but also made the national legislation more effective in the local context—an innovative legal action taken in integrated coastal management.

The Regulation on Management of Sea Area Use has a number of important objectives. The first is to establish in the government of Xiamen a unified mechanism with overall coordination responsibility. Since there was no national mechanism for marine affairs coordination, marine laws and regulations in Xiamen were basically sectoral in nature and implemented by various sectoral departments based on sectoral interest. The city government, through its regulation, established a coordinating mechanism, the Marine Management Coordinating Office, with a view to strengthening the sea use management on the one hand, and more effectively coordinating and balancing relevant agencies on the other. According to the regulation, the Office is responsible for organizing and coordinating the integrated law enforcement activities in the management of sea area uses. At the same time the regulation also provides that the existing law enforcement agencies should be responsible for implementing the national and local laws within the scope of functions granted to them. Thus, a new integrated coastal management regime integrating existing law enforcement arrangements was established.

The second objective is to redefine the responsibilities of various government departments involved in ocean management within the new ocean management regime. As a result of the new Regulation on Management of Sea Use Area, the former ocean management departments have changed their previous sectoral approach to integrated management approach and begun to coordinate their actions in the interest of all agencies.

The third objective is to establish licensing, charging and penalty systems for the use of sea areas. In view of the previous unclear property rights in some of the sea areas, the regulation clearly states that the ownership of the sea areas belongs to the State and, therefore, any use of any part of the sea areas is subject to government licensing. It is also stipulated that any use of the sea areas is subject to

Table 4a. A List of Ocean-related Legislation in Xiamen in Chronological Order, 1994-1998.

Year	Title	Type of Legislation	Responsible and Enforcement Organ
1994	Regulations on land management	Adopted by the Xiamen People's Congress *	Department of Land Management
	Regulations on environmental protection	Adopted by the Xiamen People's Congress	Department of Environmental Protection
1995	Regulations on city planning	Adopted by the Xiamen People's Congress	Department of City Planning and Management and specifically City Construction Supervising and Inspection Detachment
	Regulations on the management of sand, soil and gravel	Adopted by the Xiamen People's Congress	Commission on Urban and Rural Construction, and specifically the Construction Supervising and Inspection Detachment
	Measures on the management of nature protected area for white egret in Dayu Island	Adopted by the Xiamen People's Congress	Department of Environmental Protection
	Regulations on the management of waterway transportation	In form of rules promulgated by the government	Department of Communications, and specifically the Division of the Management of Waterway Transportation
	Measures on the management of the city environmental sanitation	In form of rules promulgated by the government	Department for the Management of Public Affairs, and specifically by the Division of Environmental Sanitation, the Construction Detachment
	Public notice on the reinforcement of management of sea eel fishing in the sea areas around Xiamen	In form of government document	Division of Fisheries Management and Ocean Surveillance
	Public notice on removal of households engaged in aquaculture from the location of the new shipyard	In form of government document	Office of the Leading Group for Coordination of Ocean Management, Coordinating Xiamen Harbor Superintendence, Division of Fisheries Management and Fishing Port Superintendence and Branch of Police on Water-related Activities
1996	Regulations on the protection and management of the marine environment	In form of rules promulgated by the government	Department of Environmental Protection Xiamen Harbor Superintendence, Division of Fisheries Management and Fishing Port Superintendence, Ocean Surveillance and Department of the Military
	Regulations on aquaculture management in the shallow seas and intertidal zones	In form of rules promulgated by the government	Fisheries Department
	Regulations on the use and management of sea area	In form of rules promulgated by the government	The Integrated Ocean Management Office, coordinating all relevant departments involved in ocean management
1997	Measures on management of charging sea area uses	In form of document of the Department of Finance of the City of Xiamen	The Municipal Ocean Management Office and Fisheries Department
	Regulations on the management of nature protected areas for Chinese white dolphin	In form of rules promulgated by the government	Fisheries Department
	Measures on the management of Beidang Lake Region	Adopted by the Xiamen People's Congress	Department of General Affairs of the City Government
1998	Regulations on the coastline planning and management	Planned for submission for legislation	Department of City Planning and Management

Table 4b. A List of Ocean-related Legislation in Xiamen by Category.

DEVELOPMENT AND UTILIZATION

- Regulations on Land Management
- Regulations on City Planning
- Regulations on the Management of Sand, Soil and Stone
- Regulations on the Management of Waterway Transportation
- Public Notice on Removal of Households Engaged in Aquaculture from the Location of the New Shipyard
- Regulations on Aquaculture Management in the Shallow Seas and Intertidal Zones
- Regulations on the Use and Management of Sea Areas
- Measures on Management of Charging Sea Area Uses
- Regulations on the Coastline Planning and Management

ENVIRONMENT PROTECTION

- Regulations on Environmental Protection
- Measures on the Management of Beidang Lake Region
- Regulations on the Management of Nature Protected Areas for Chinese White Dolphin
- Measures on the Management of Nature Protected Area for White Egret in Dayu Island
- Public Notice on the Reinforcement of Management of Sea Eel Fishing in the Sea Areas Around Xiamen
- Measures on the Management of the City Environmental Sanitation
- Regulations on the Protection and Management of the Marine Environment
- Measures on the Management of Lancelet Nature Protected Area

payment except for public purposes. The regulation also provides for the selling, leasing and subleasing and mortgaging of the sea areas through licensing by the government. This provides flexibility for activities that promote economic development. However, given the lack of experience in this respect, the provisions are very general in content, leaving much room for improvement with time. With regard to the issue of penalties, the regulation does not repeat the penalty provisions of the existing laws and regulations. It imposes penalties only on those who violate the regulation on the illegal use of sea areas. Thus, the regulation has successfully clarified issues pertaining to ownership and dispute settlement. This regulation has also solved the long existing problems of free access and uncontrolled use of the sea areas.

The fourth and last objective is to set up an effective law enforcement mechanism. Taking full consideration of the existing sectoral marine management systems, the regulation provides for a clear division of work between the Marine Management Office and the sectoral law enforcement agencies already established under other laws and regulations. The Marine Management Office is not responsible for all law enforcement, but only for the Regulation on the Use and Management of Sea Area while other sectoral ocean management and law enforcement responsibilities are brought into full play.

In summary, while the overall objectives of the State regulation on the use and management of sea area promulgated by the Ministry of Finance and State Oceanic Administration and the corresponding regulation of Xiamen are the same, the following are the major differences:

a. The State regulation includes internal waters, the territorial sea, including the sea surface, water body, sea bed and its subsoil within the area of jurisdiction; the Xiamen regulation specifically defines the landward boundary from the average high tide line;

b. The State regulation does not provide for any specific government agency to implement the regulation although it states that the regulation shall be implemented by the responsible administrative department of the local government including and above county level; the Xiamen regulation specifically assigns to the Municipal Marine Management Office the responsibilities for integrated management, coordination and organization of the implementation and enforcement of the regulation, while other government agencies are to closely cooperate with the Marine Management Office in the enforcement of the regulation;

c. While the State regulation does not impose any conditions for sea use activities, the Xiamen regulation specifies cases in which sea use activities are forbidden, including such cases as failing to conform to the functional zoning scheme and the marine economic development plan; damaging the environment, resources, landscape and ecological balance; silting up of the navigation route resulting in coastal erosion and hampering navigation, fire fighting and rescue;

d. The State regulation only provides for licensing for sea area use, while the Xiamen regulation provides for both licensing for sea area use and aquaculture; it also specifies that if any sea area licensed is not used after one year, the right to that sea area use will be cancelled;

e. The sea area use charging system provided for in the State regulation includes sea area leasing and transfer fees, while the Xiamen regulation provides for only the sea area use fees. Fees with regard to leasing and transfer will be charged separately. The Xiamen regulation also provides that sea area uses for public interests, scientific research and education are exempted from fees but they are subject to sea area use licensing by the government. The Xiamen regulation strictly and specifically provides that bids, auction and agreement be conducted through the same process as selling of sea areas;

f. The Xiamen regulation provides for 30 days in which the decision of the government has to be made, which is apparently more effective and practical; and

g. Following the general guidance of the State regulation, the Xiamen regulation provides for a specific sum of penalty.

The above provisions of the Xiamen regulation, given that it is more specific and easy to manipulate, turned out to be effective and well-implemented.

Lessons Learned

Xiamen is a unique case demonstrating the experience in harmonizing the national legislation with local legislation so as to effectively implement the integrated coastal management for sustainable development of marine resources. In retrospect of the process, a number of important experiences may be shared with other countries or regions of similar situation where legislation related to integrated coastal management is needed.

a. The catalytic role of international efforts

Through the above analysis, it is evident that 1994 serves as the turning point in Xiamen's marine legislation experience whereby most of the current effective legislation, including particularly the Xiamen Regulation on Management of Sea Area Use have been promulgated and put into effect. Two factors played a key role in this respect. First, was the initiation of the Xiamen Demonstration Project by the GEF/UNDP/IMO Regional Programme, which required as one of its objectives and indicators of success, the strengthening of the legislation for integrated coastal management. This project helped combine the then already existing research work on marine legislation with the actual management of the city government of Xiamen so that the contribution of science in the management was significantly accelerated. Second, comes the legislation power granted to Xiamen by the National People's Congress which enabled the city government enough legal flexibility and capability to enact the Regulation on Management of Sea Area Use—the cornerstone in Xiamen's legislation on integrated coastal management. The catalytic role of the GEF/UNDP/IMO Regional Programme is evident.

b. A success for the top-down approach

China is a nation which, for cultural and historical reasons, tends to believe and obey the government. This provides an ideal ground for applying the "top-down" approach in contrast to "bottom-up" or "partnership" approaches. The integrated coastal management, as a new approach to sustainable development of coastal resources and protection of marine environment, requires a fundamental change in philosophy, way of mind, as well as government structure and management system. Without the understanding and involvement of the major leaders of the government, it might be extremely difficult, if not impossible, to realize the goal. In the case of Xiamen, many ocean management organizations are often the subordinate bodies of the central government with very high administrative levels having their own law enforcement resources. Some agencies even doubt the effectiveness of the legislation on the use and management of the sea area. The personal involvement and leading role of the Mayor of Xiamen and his major deputies played a decisive role in making the legislation on the use of the sea area and coordinated law enforcement possible. It goes without saying that the increasing public awareness for environmental protection has also created a sound environment for the government actions.

c. Establishing an appropriate legal framework—the basis for ICM

Sectoral laws and regulations are often proven to be creating obstacles/difficulties rather than facilitating the implementation of integrated coastal management. An appropriate integrated legal framework is extremely necessary as basis for practicing integrated coastal management. In countries or regions where sectoral legislation is already in place, an over-arching legal framework such as the Regulation on the Use and Management of Sea Area provides an effective mechanism for harmonizing the existing laws and coordinating management of resources. It is equally important that in places where sectoral law enforcement forces are existing, it is more effective to coordinate these law enforcement groups through establishing an integrated coordination and management agency led by a high ranking official, rather than granting the coordinating responsibility to one of the existing management agencies.

d. The input of science

Marine legislation should be based on sound scientific work. In the case of Xiamen, the Regulation on the Use and Management of Sea Area is well-based on the result of the sea use functional zoning. Since the sea use functional zoning has incorporated various factors of geography, resources, environment and socio-economic factors with very serious scientific evaluation, it not only helps ensure a good order in coastal development, but also makes clear the division of responsibilities in sea area management. The sea use functional zoning also plays an important role in planning the development and utilization of marine resources in a comprehensive manner.

e. Combination of management practice with legislation

In drafting the Regulation on Management of Sea Area Use, there were several cases where the Marine Management Coordinating Office organized and coordinated law enforcement actions toward eel fisheries, with emphasis on issuing licenses to eel fishing and fishing grounds. The participating law enforcement agencies included the fisheries department, fisheries administration, fishing port superintendence, port and harbor superintendence, department of public safety and navigation department. These actions provided a model for coordinated law enforcement, which later was codified into the regulation.

f. Harmonization of national legislation with local needs

In drafting the Regulation on Management of Sea Area Use, the city government of Xiamen was confronted with several problems to which national laws and regulations were not able to provide an answer. First, at the national level, there was no lead agency to coordinate various existing law enforcement efforts. For the purpose of effective implementation of the Regulation on Management of Sea Area Use, the local regulation provided for the establishment of an integrated Marine Management Coordinating Office. Second, with regard to the issue of which department should be responsible for charging user fees, the city government faced two problems. One was that several sectoral departments claimed that they should be responsible for this according to existing laws and regulations. Another problem was that this provision of the regulation contradicted the policy of the Central Government on alleviating the financial burden of the farming communities and, therefore, whether this provision should be put in the regulation gave rise to a lot of doubts. However, the city government still decided to keep the provision of charging the sea area use and granted the responsibility of charging the sea area use to the newly established Marine Management Coordinating Office. Third, in the process of drafting the regulation on the sea area use, questions were raised with respect to the lack of legal basis for promulgating the Regulation on Management of Sea Area Use since there was then no corresponding national legislation to follow. Despite this, the city government proceeded with the drafting of the regulation making full use of the legislation power granted to Xiamen. By harmonizing the national legislation, Xiamen has now a system of marine legislation at different levels, e.g., laws, regulations, rules, measures and government orders, satisfying the various needs for effective implementation of an integrated coastal management program.

Conclusion

The Xiamen Demonstration Project is the first internationally funded pilot project for the application of integrated coastal management in China. Its success demonstrates that through the application of the integrated coastal management approach, the city can avoid the old and costly model of "pollution first, management second" and keep the economic development and environmental protection hand in hand. This is extremely valuable for all developing countries that are now confronted with the problem of how to balance economic development and environmental protection.

The success of Xiamen is dependent on many factors: political, economic, legal, cultural, managerial and so on. But a very important reason is that the city government has rightly chosen marine legislation, particularly the promulgation of the Regulation on Management of Sea Area Use as the breakthrough to providing the generic legal framework for implementing the integrated coastal management program. The success of Xiamen can also be attributed to the effective harmonization of the national legislation with the local conditions, and has innovatively created new legislation that effectively coordinates national as well as other local legislation. Most importantly, the city government was extremely sober-minded about what they are able to do and what they are not, and has wisely taken advantage of the legislative power granted to Xiamen and used it to the fullest extent possible.

On the eve of the successful termination of the first phase of the GEF/UNDP/IMO Regional Programme, the Standing Committee of the National People's Congress of China has taken note of the experience in Xiamen in integrated coastal management and requested that the experience in Xiamen be summarized and shared nationwide.

Session IV

Application of Science and Technology

A Review of the Effectiveness of Environmental Impact Assessments (EIAs)*

John S. Gray

Section of Marine Zoology and Marine Chemistry
Biological Institute, University of Oslo
P.O. Box 1064 Blindern, 0316 Oslo, Norway

GRAY, JOHN S. 1999. A review of the effectiveness of environmental impact assessments (EIAs), p. 375-386. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Law in most countries in the world requires environmental impact assessments (EIAs) when developments of coastal areas are planned. For example, the European Union has a legal requirement for such studies that operated throughout the nine countries of the Union. Too often, however, EIAs are poorly designed and do not predict the effects found, and more often than not, they are not tested afterwards to see whether or not the predictions of environmental effects were accurate. EIAs typically involve one or more baseline surveys before the activity begins, and from this, predictions are made on the effects of the activity on the environment. At this phase, there are many pitfalls that are often not considered. The coastal environment is dynamic and a single survey cannot (a) assess the scales of natural changes over time nor (b) make adequate predictions of future changes, both natural and man-made. A second failing often is that proper control sites, with which to compare the predicted impact area, are not considered. Without proper controls, it is not possible to make assessments of the scales of impact. New ideas on experimental designs (Before-After-Control-Impact, BACI designs) are discussed.

* *A fully illustrated version of this paper is available at http://www.uio.no/~johnsg.*

INTRODUCTION

Environmental impact assessments (EIAs) are required by law in most countries when activities are planned which may affect the coastal environment. Kass and McCarroll (1997) state that more than 150 countries require some form of EIA. In Europe, there is a European Union Directive (EC, 1985) that lays down the basic requirements. In the revised European law (EC, 1997) the requirement for EIA is stated as follows: "member States shall adopt all measures necessary to ensure that, before consent is given, projects likely to have significant effects on the environment by virtue, *inter alia*, of their nature, size or location are made subject to a requirement for development consent and an assessment with regard to their effects." The directive then lists the activities where an EIA is required.

The World Bank has played an influential role in developing EIA procedures (Kass and McCarroll, 1997) and has an operational directive (OD 4.00) which gives three major types of environmental assessments that are required for bank projects (World Bank 1989, 1991). National legislation can, however, differ from international legislation. For example, Gilbert (1998) states that in the United Kingdom the procedure "is based on the legal tradition of prosecutor versus defendant, with the Planning Authority acting as judge and jury." Clearly, this is not a satisfactory framework for making an objective and unbiased assessment.

Given all the international interest, one could perhaps expect that there were common ways that EIAs were used yet this is not the case. The results of a review of how EIAs are used are shown in Box 1.

Box 1. Common Failures of EIAs.

1. Often merely paper exercises to comply with the national laws.
2. EIAs usually done by companies for themselves rather than presenting a balanced view of how best the environment can be protected.
3. Predictions made in the EIA were rarely tested.
4. Seldom were feedback loops that stop undesirable effects incorporated in the process.
5. No mechanisms exist to learn from predictions made that were wrong.
6. Usually there were no consequences (economic or other) for the developer if the predictions made by the EIA were entirely wrong.

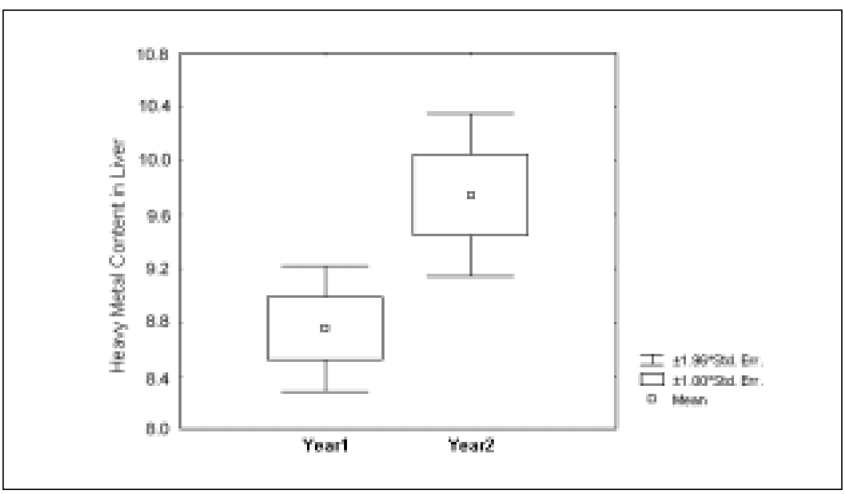
These criticisms are important and need to be addressed if one is to make full use of the potential of EIAs. In this paper, rather than review the failures, an illustration is made of how one can design EIAs that address these problems and lead to taking better care of the environment.

A Modern Framework for an EIA

An EIA should predict the effects of a planned human-induced disturbance of the marine environment. This should cover the spatial and temporal extent of these effects. Based on the EIA, the environmental authorities give approval of the planned activity and impose conditions to mitigate environmental damage. Yet, these basic ideas are rarely used.

First, the prediction of effects should be considered. Too often, the ethical basis is not considered in assessing environmental impacts. Schrader-Frechette and McCoy (1993), in their book on environmental ethics, state that, "It is more important to protect the public from not rejecting a seriously harmful environmental impact (type-II errors) than to protect it from rejecting harmless impacts (type-I errors)." While this sounds a logical approach, in fact, it is not what one is taught to do. A type-I statistical error is accepting a pollutant is harmful when it is not, whereas a type-II error is accepting a pollutant is not harmful when it is. One deals with these by using a 95% certainty criterion and allowing 5% due to chance, the $p=0.05$ criterion. Type-II errors are rarely measured but usually use an 80% certainty criterion. To use a simple theoretical example, Figure 1 shows the mean concentrations of heavy metals in the liver of fish.

Figure 1. Mean Concentrations of Heavy Metals in the Liver of Fish.



A 't' test showed that there was no statistically significant difference between mean heavy metal concentration between years at $p=0.05$. If one concludes therefore, that there is no difference a type-II error would be committed. In fact, there were only 6 fishes sampled in year 1 and 7 fishes sampled in year 2. Using a power analysis (Cohen, 1988) the ability to detect a change with so few samples and given the variance shown is only 0.55. This means there is a 45% chance of committing a type-II error. A power analysis shows that in order to detect a difference of 0.5 ppm in heavy metal concentration, one would need to sample 45 fishes each year. The lesson here is that type-II errors are highly important in environmental monitoring and need to be used in assessing the ability to detect change. They need to be incorporated in EIAs on a regular basis but are rarely used.

Nicholson et al. (1997) have used the long-term monitoring data available on contaminants of fish in the North Sea and have done power analyses taking account of analytical variability and sampling variability and asked the question how many years will it take to detect a trend of ± 0.5 ppm with 90% power. Table 1 shows the results.

Table 1. Number of Years It Will Take to Detect a Trend of 0.5 ppm with 90% Power.

Sampling Variability	Analytical Variability		
	Low	Medium	High
Low	10	12	16
Medium	17	18	20
High	25	>25	>25

Source: (Nicholson et al., 1997).

The results are surprising and not at all what the politicians and managers who initiate and run the program expect. It is assumed that change can be detected and that it is an easy task to monitor change. This is often not the case. Taking care of type-II errors and using power analyses as integral parts of the initial planning phase of EIAs is essential. Below is an example, where both power analyses and feedback monitoring have been used to good effect in the building of the Øresund Link, between Copenhagen, Denmark and Malmø, Sweden.

The Øresund Link EIA

On 23 March 1991, the Governments of Denmark and Sweden signed an agreement to build a fixed link across the Sound (Øresund) connecting the metropolitan areas of Copenhagen and Malmø by a 4-lane motorway and a 2-lane railway link. This agreement was ratified by the Governments on 24 August 1991. In making the agreement the Governments made the condition that the link should not cause changes in the water flow in the Øresund as well as in the oxygen and salt supply to the Baltic Sea, the so-called "zero-solution."

The requirements for the approval of the environmental aspects were very different in the two countries. The Danish Public Works Act of March 1991 required the Minister of Transport to approve quality objectives, as well as a monitoring and control program for the link. During the reading of the Bill, it was decided to hold a public hearing prior to such approval. The Danish public hearing on the detailed design of the link and the construction of the link was a political "hot potato" since there were loud protests from the green movements who highlighted the possible negative effects on both the Øresund and more importantly on the Baltic Sea. The Baltic is particularly vulnerable in that it is atidal with limited water exchange with the North Sea and has shown increased signs of eutrophication with large areas of the deep basins lacking oxygen. In addition, the important cod fisheries in the Baltic Sea are dependent on salty water entering from the North Sea. Thus, there were fears that any reductions in water or salt flow might upset the delicate balance of the Baltic Sea ecosystems.

In October 1992, the two Governments appointed an International Expert Panel to evaluate the environmental consequences of such a link. The mandate for the Panel was to advise the two governments on how the "zero-solution" criterion could be achieved and to evaluate and advise on the monitoring programs of the effects of the link on the biota of the Sound.

As part of the EIA, a baseline survey was conducted which:

1. Surveyed all the biological communities in the area; and

2. Made predictions about the area likely to be affected by sediment spillage.

These data were then submitted to the environmental authorities. The environmental authorities then:

1. Set the target of a "zero-solution", i.e., no changes in water or salt flow to and from the Baltic Sea;

2. Accepted that there could be a 25% reduction in eelgrass and mussels in the "inner impact zone";

3. Accepted that there could be effects on the flora and fauna of up to 5 years in the Øresund; and

4. Set up an International Expert Panel to evaluate all the environmental aspects.

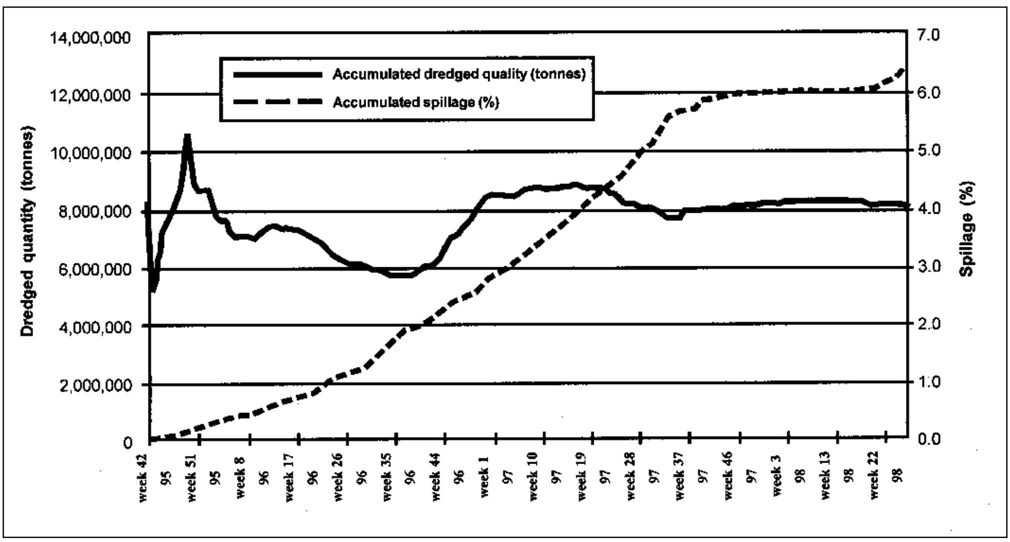
The Governments had defined an inner impact zone, 500 m on either side of the link trajectory where extensive effects could be expected and an outer impact zone, 7 km on either side of the link where temporary effects could be accepted. The criteria of impact for the inner zone was a 25% reduction in eelgrass cover, blue mussel cover and biomass of other fauna at depths greater than 6 m. The Panel reviewed the EIA and recommended that a power analysis be done to see whether or not the 25% criterion could actually be measured or not. The consultants reported back that none of the chosen environmental variables could measure a 25% reduction with the sampling effort used in the baseline survey. As a consequence, the Panel recommended a five-fold increase in the number of replicates and that a number of the measured variables be dropped altogether. Thus, by using a power analysis and taking care of type-II statistical errors the monitoring program done by the Konsortium became efficient and cost-effective.

The Panel's other major recommendation made at the second meeting was that the most serious environmental concern for the biological systems was the amount of sediment spilled into the water during dredging operations. The EIA had shown that the shallow Øresund contains extensive eelgrass and mussel beds that are used as food by birds, notably ducks and geese that use the island of Saltholm. Saltholm is a protected area for birds and of international significance defined as containing over 1% of the European population of a given species. The Panel considered carefully the advice given by the consultants and constructors and recommended that a spillage limit of 5% over the whole project be used. It was felt that if such a limit could be achieved, there would be no measurable effects on the biological systems. The spill limit was much below than what the constructors were used to at of 25%. When the Danish and Swedish Governments eventually agreed on the environmental conditions in 1995, they had incorporated the Panel's recommendations into law.

Such a tight environmental requirement for spillage required a complex system of monitoring to ensure that the conditions were upheld and equally important was the tight control on the dredging operations. The Panel recommended that acoustic monitoring of spillage be used and this was incorporated in the monitoring program. In addition, the Panel recommended that the artificial island (where the tunnel goes over to the bridge) should be constructed by first building retaining walls to contain spillage. The Øresund Konsortium drew up tight controls over the dredging operations, that required dredgers to report on the type of sediment being dredged and amounts of spillage on a daily basis (Øresundskonsortiet, 1997). That these recommendations were taken seriously can be judged during the winter of 1996 when most dredging was being done. This winter was severe with much ice. The dredgers utilized one of the largest dredgers in the world, "Chicago" which could easily break through the ice and continue operations. Dredging was not allowed for a 10-day period since the control program measuring the actual spillage could not be done. Since the dredger was costing about $50,000 a day, measuring compliance with the environmental conditions was not a trivial exercise.

Figure 2 shows that the criterion of a maximum 5% spillage imposed has been met. This has been achieved by the use of sophisticated monitoring systems giving direct feedback to the dredging operations and by detailed and carefully controlled management of the excavation processes.

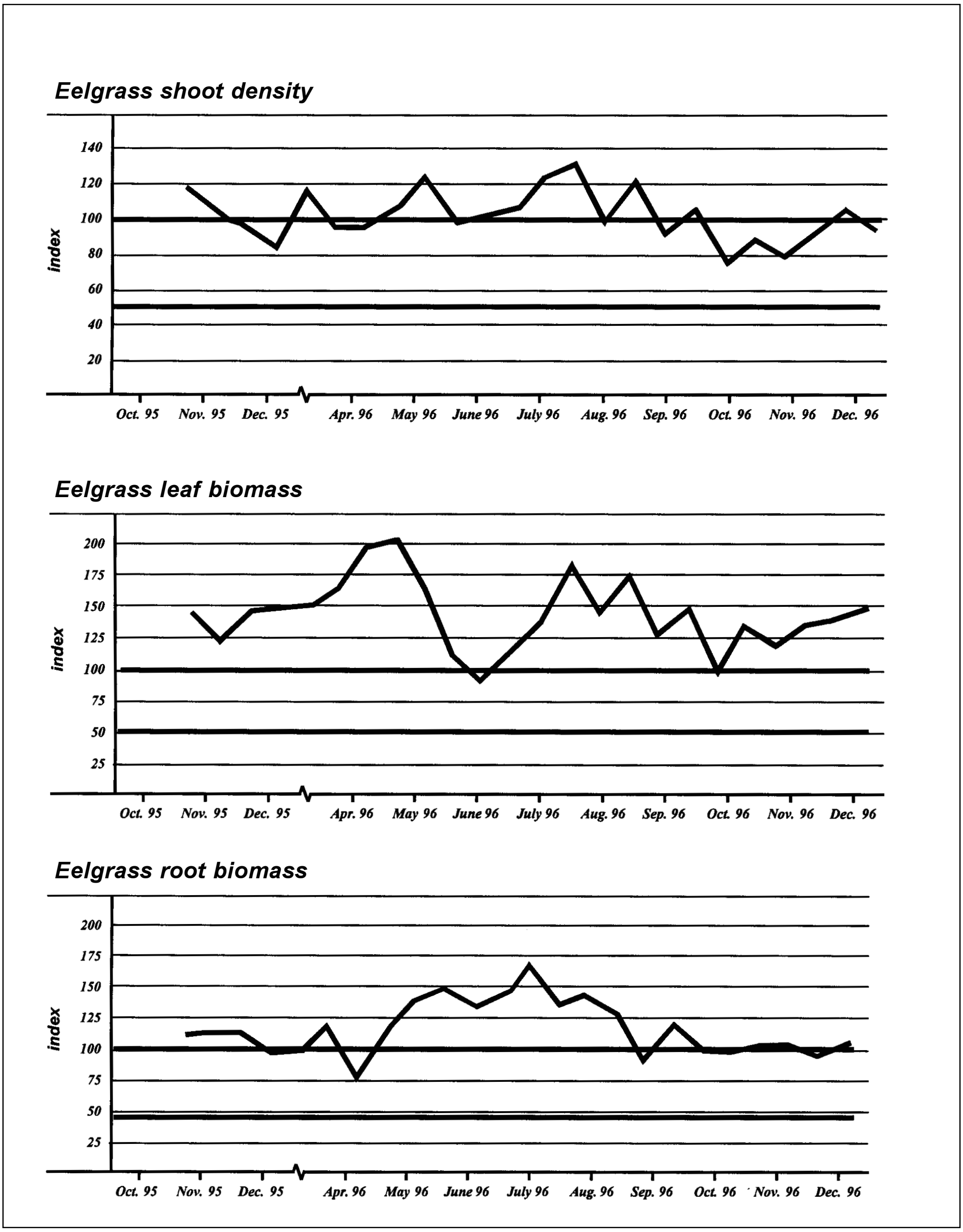
Figure 2. Amounts of Material Dredged and Spillage Rates.



Yet, it is important that the EIA leads to a system being in place to guard against unexpected effects being found. While the Panel believed that if a 5% spill limit was imposed no negative effects would be found, there was the risk that: (a) this prediction may in fact be incorrect; and/or (b) the 5% criterion could not be met. The basis of feedback monitoring is that if the EIA predictions turned out to be wrong, then there needs to be a mechanism in place to ensure that any potentially damaging effects are determined rapidly so that the construction can be altered (Gray and Jensen, 1993). A sound system based on eelgrass was developed. The idea was that sediment spillage would increase turbidity and/or lead to sedimentation on the blades of the eelgrass which may reduce shoot density, leaf biomass and root biomass. Figure 3 shows the results with the various criteria for operation of the feedback loop which would have prevented further spillage and damage to the biological systems.

Figure 3. Eelgrass Monitoring in Feedback Mode.

Jagged line represents monitored index during excavation. Upper solid line represents baseline survey index, lower solid line criterion for operation of feedback loop, stopping dredging activities.

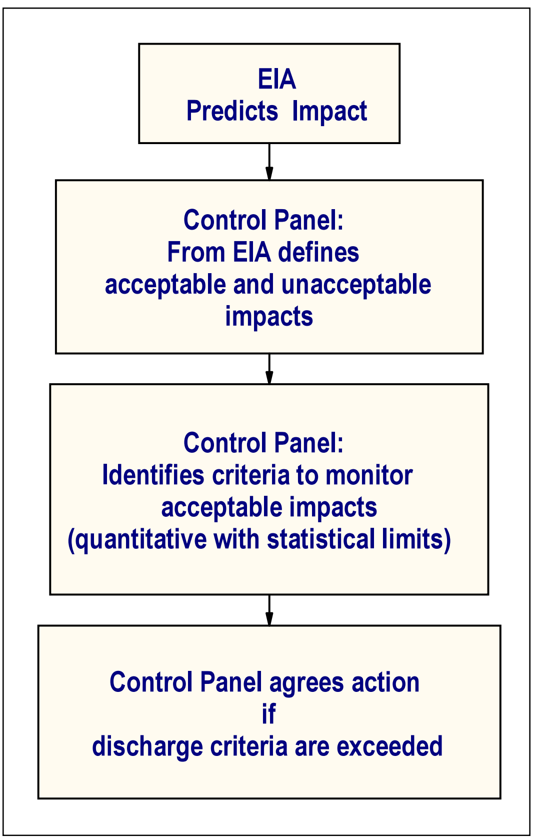


In fact, the feedback loop did not operate because the spillage rates were controlled and no unexpected effects were found.

Not all of the biological systems can be monitored in a feedback mode so the Konsortium had basic monitoring to ensure that other important biological systems were not affected by the link. Since part of the Øresund is defined as a key breeding site of birds in Europe under the Ramsar Convention, monitoring of the numbers of breeding birds was a key element. The Panel advised on this program, which was regarded as one of the best-designed and executed studies of its type. No negative effects on the breeding birds have been found to this date, even though the Danish authorities accepted that a 15% reduction in the numbers was acceptable.

Now that 95% of the dredging has been done, the biological monitoring program has shown clearly that there are no negative effects on the biota. Thus, use of power analyses (taking care of type-II statistical errors) ensured that the baseline survey was accurate enough to be able to detect the criteria set by the environmental authorities. The environmental authorities were bold enough to support the recommendations of the independent scientists in imposing a limit of 5% spillage. This criterion was sufficiently strict to mitigate any environmental effects. Yet only by careful monitoring to ensure that the 5% spillage rate was upheld and the dredging activities were controlled could the damaging effects be mitigated. A biological feedback system is also essential to make sure that the development does not lead to negative effects.

Figure 4. A Generalized Model of Followup of an EIA.

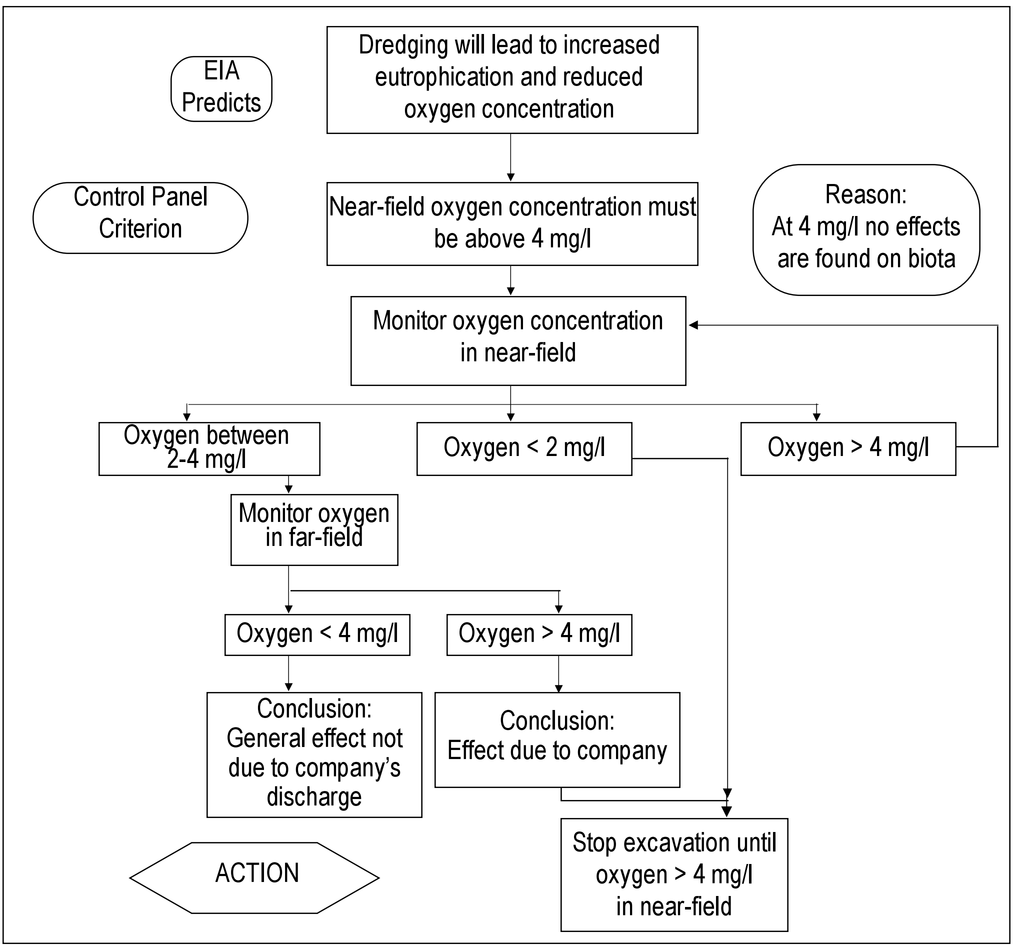


The general outline for the followup of an EIA is shown on Figure 4.

The key factors for success are that the EIA makes quantitative predictions of what effects are likely from the activity. These need to be statistically rigorous and testable. An independent panel comprised of experts, environmental authorities, stakeholders and nongovernment organizations (NGOs) then considers carefully the predictions and defines what are acceptable and unacceptable impacts. In the case of the Øresund, a 25% reduction in eelgrass cover and mussels was acceptable within 500 m of the link.

The Control Panel's next concern is to make sure that there are adequate ways of monitoring to uphold the criteria. Here, feedback systems are needed so that action can be taken to ensure there are no negative effects of the activity that are not predicted and that the activity stops if the criteria are exceeded. The eelgrass

Figure 5. Feedback Loop based on Oxygen Concentration Used at Great Belt Link, Denmark.



loop has been described but in Figure 5, another feedback system based on oxygen concentration in the water column is shown. This was used during the building of the Great Belt Link in Denmark (Gray and Jensen, 1993).

Oxygen levels are critical in the area where the Great Belt Link was built, the Kattegat, since the area is eutrophic and suffers from low oxygen during summer. It was important to ensure that excavation did not lead to reduced oxygen concentration. The feedback loop was not trivial since stopping excavation leads to large cost increases.

A final and important part of the testing of the EIA is that remedial action is planned and agreed *a priori* in case the EIA predictions are (as often happens) wrong! In the case of the Øresund, plans are made to replant eelgrass should they be destroyed by the construction. Again, this is not a trivial exercise and experiments are needed and timeframes had to be calculated as well as cost. Too often however, this step is ignored and if the predictions of the EIA are wrong, there are no consequences for the developer. This must not occur if we are to protect and conserve the coastal environment.

In conclusion, developing a realistic EIA that makes quantitative predictions of effects which can be tested and analyzed in a proper statistical framework and with feedback loops to ensure that during the activity no negative effects are found is the way forward for EIAs.

References

Cohen, J. 1988. Statistical power analysis for the behavioural sciences. Lawrence Erlbaum Associates, New Jersey. 567 p.

EC. 1985. Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment. http://europa.eu.int/eur-lex/en/lif/dat/en_385L0337.html

EC. 1997. Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment. http://europa.eu.int/eur-lex/en/lif/dat/en_397L0011.html

Gilbert, N. 1998. Using environmental impacts in the planning process. http://www.susx.ac.uk/Units/gec/pubs/briefing/brief-10.htm

Gray, J.S. and K. Jensen. 1993. Feedback monitoring: A new way of protecting the marine environment. Trends Ecol. Evol. 8: 267-268.

Kass, S. and J.M. McCarroll. 1997. The World Bank's environment impact Assessments Part 1. http://www.ljx.com/practice/intrade/1024wbank.html

Nicholson, M.D., R.J. Fryer and C.A. Ross. 1997. Designing monitoring programmes for detecting temporal trends in contamination in fish and shellfish. Mar. Pollut. Bull. 34: 821-826.

Øresundskonsortiet. 1997. The environment and the fixed link across Øresund. Øresundskonsortiet, Copenhagen, Denmark.

Schrader-Frechette, K.S. and E.D. McCoy. 1993. Methods in ecology: Strategies for conservation. Cambridge University Press. 328 p.

World Bank. 1989. Environment assessment, Annex A. World, Bank OD. 4.00 (October 1989).

World Bank. 1991. Environment Department. World Bank. Technical Paper No. 139. Environmental Assessment Sourcebook 140.

Red Tide Management in Hong Kong: Success? Failure? and Way Forward

Patsy S. Wong

Agriculture and Fisheries Department
Hong Kong Government
Hong Kong SAR, China

Rudolf S.S. Wu

Centre for Coastal Pollution and Conservation
Department of Biology and Chemistry, City University of Hong Kong
83 Tat Chee Ave., Kowloon, Hong Kong SAR, China

WONG, PATSY S. and RUDOLF S.S. WU. 1999. Red tide management in Hong Kong: Success? failure? and way forward, p. 387-399. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The major impact of red tide in Hong Kong is on marine fish farming and public health. In 1983, Hong Kong formulated a red tide management strategy. The strategy comprises of an Action Scheme and a Supportive Scheme. The Action Scheme involves the establishment of a reporting network and a contingency plan. Onsite identification of causative species and toxicity testing are carried out, to assess risk and determine corresponding actions to minimize loss and safeguard public health. The Supportive Scheme involves the collection of necessary data and development of educational programs for fish farmers and the general public, for further improvement of the understanding of red tide and for better management of the problem. This strategy appeared to be able to cope with the red tide problems in Hong Kong for more than one and a half decades. In 1998, a major bloom of a Gyrodinium *species killed over 80% of fish in most fish culture zones and caused great economic loss. A number of new measures and technologies was suggested by various sources, including the use of remote sensing and telemetry to forecast and monitor red tide, and the use of chemical and physical treatments to remove toxic dinoflagellates from water. The applicability and cost-effectiveness of these suggestions were critically reviewed. None of these suggestions, however, can forecast red tide occurrence in Hong Kong nor provide a cost-effective and practical solution to the problem. Various ways to improve the present management strategy are discussed.*

INTRODUCTION

Red tide occurrence became more frequent in Hong Kong waters in the late 1970s. In the early 1980s, a few red tide incidents caused fish kills at several fish culture areas. This attracted the Government's major attention on red tide problems. In 1983, a red tide management strategy was formulated to address the issues involved (Wong and Wu, 1987). This strategy appeared to be able to cope with the red tide problems in Hong Kong for one and a half decades. In 1998, a major bloom of a *Gyrodinium* species killed off over 80% of fish in most fish culture zones. The impact was so serious that the public doubted the adequacy of the management strategy. Some criticized the Government for not adopting new technologies for monitoring and control. A review was then carried out to assess the applicability of the various suggested measures and to identify areas where improvements could be made. This paper outlines the red tide management strategy adopted since 1983, its application during red tide outbreaks from 1993 to 1998 and reports on the review for its improvements in the light of the 1998 episode.

THE RED TIDE MANAGEMENT STRATEGY FORMULATED IN 1983

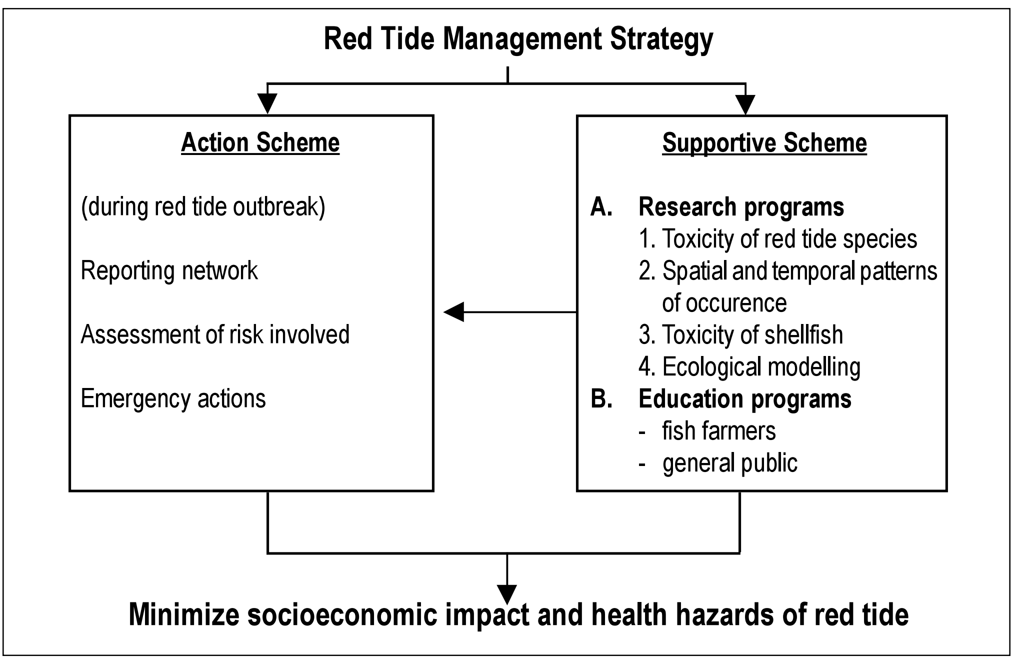
In Hong Kong, the major impact of red tide is on the mariculture industry. Marine fish cultures are carried out in cages suspended from anchored wooden rafts with floats located in 26 fish culture zones designated under the Marine Fish Culture Ordinance. Annual production of this industry in recent years is around 3,000 tonnes* , valued at over US$30 million and providing employment for about 4,500 people. Live fish are sold at a price significantly higher than chilled fish. Most fish culture zones are located in sheltered bays with limited water circulation, therefore, are prone to red tides either through oxygen depletion or toxins produced. Any serious fish kill will indeed have substantial social economic impact. This impact is further amplified by the general avoidance of seafood consumption by the general public, which may last over an extended period after a red tide.

* *1 tonne = 1 metric ton*

Another issue is the potential health risk involved with consumption of fish or shellfish contaminated with red tide toxins. Fish killed by oxygen depletion, if fresh enough are safe for human consumption and can be marketed to reduce economic loss to the fish farmers. Local shellfish production is very limited (production was 830 tonnes, valued at US$7 million in 1983 and decreased since then). There is no record of human intoxication due to local red tide outbreaks thus far. However, the risk still exists since many toxic red tide species are occasionally found in Hong Kong waters in low concentrations. Toxic red tides have also been reported to cause irritations to eyes, skin and respiratory system of beach swimmers.

The Hong Kong red tide management strategy formulated in 1983 is designed to achieve effectiveness and efficiency through existing available systems with limited resources and manpower. Key issues and problems associated with red tides are first identified, their impact and importance assessed and all possible options (both temporary and long-term) are reviewed exhaustively. The management strategy consists of an Action Scheme and a Supportive Scheme. The Action Scheme is designed to organize and coordinate immediate action to be taken by various government departments and fish farmers during red tide to minimize impacts. For problems that cannot be solved immediately, programs are designed

Figure 1. Schematic Diagram of the Red Tide Management Strategy in Hong Kong.



Source: Wong and Wu (1987).

and incorporated into the Supportive Scheme in order to improve input for improving the Action Scheme over time (Figure 1).

Under the Action Scheme, a red tide reporting network is established to allow prompt collection of information of any red tide outbreak. The network calls upon fish farmers and staff of all government departments conducting routine work around the coastal waters of Hong Kong [(e.g., Agriculture and Fisheries Department (AFD), Environmental Protection Department (EPD), Marine Department, Marine Police, Government Flying Services, Urban Services Department (USD) and Regional Services Department (RSD)], to report any sighting of discolored water to AFD. To enable red tide samples to be collected for identification as soon as the sighting is made, simple sampling kits (each consisting of two plastic vials, a small dropper bottle with Lugol preservatives and a simple instruction sheet with the reporting phone number) were issued to fish farmers representing the 26 fish culture zones (FCZs) as well as the government staff involved in the network. Samples collected promptly are delivered to AFD for analysis. Such an arrangement has proven to be extremely useful in identifying the causative species in all red tide incidents.

Upon receiving a red tide report and based on the information and causative species in the sample collected, AFD will assess the risk involved and alert the relevant government departments as well as the fish farmers in the nearby FCZs, advising them to take necessary precautions (e.g., aeration or raft relocation) to minimize loss. AFD will also carry out further investigation as necessary. When fish kill occurs and the toxicity of the causative species is unknown, a 'mobile squad' will be sent to carry out the identification of the causative species and conduct toxicity tests (mouse bioassay) onsite. This will enable the risk assessment to be completed within a few hours during emergency.

As most shellfish consumed in Hong Kong are imported from various sources, the Department of Health (DH) carries out routine surveillance of shellfish from the market. On receiving AFD's notification of red tide, DH will step up its routine seafood surveillance program as necessary. USD/RSD will take necessary action to warn swimmers with regard to red tides found in gazetted beaches.

The Supportive Scheme consists of research and education programs mainly to provide further information and support to improve the efficiency of the Action Scheme and the overall management strategy. Information on spatial and temporal patterns of occurrence, toxicity of various red tide species and toxicity of shellfish has been collected over time. Such information provides input to the education program of fish farmers (e.g., design of aerator) and the public on red tide and in the long-term ecological modelling for red tide prediction.

Occurrence of Red Tides, 1983-1997

Records of red tide incidents in Hong Kong from 1983 to 1997 showed that during the past 15 years, there were a total of 457 red tide incidents, averaging about 30 incidents each year. Majority of the red tide causative agents were harmless, and only 8 incidents were associated with fish kills. Most of these were due to oxygen depletion affecting only a few fish farms in a FCZ. The Action Scheme appears to be adequate for coping with impacts of red tide outbreaks for the past 15 years. The Supportive Scheme has also provided useful information to the understanding of red tides.

During this period, there were two major events which attracted public attention: (1) the 1987 fish loss of 120 tonnes valued at US$0.5 million; and (2) the 1989 high levels of paralytic shellfish poisoning (PSP) toxin. These two incidences served to show how effective the red tide management strategy functioned.

In the dawn of 29 July 1987, fish farmers at Yung Shue Au FCZ reported a red tide occurrence and serious fish kill. The mobile squad was sent out to assess the toxicity of the red tide. Results of onsite mouse test demonstrated that the red tide was not toxic. Dissolved oxygen level of the surface water that morning was only around 2 mg/l. The recorded phytoplankton density of the water was up to 525,000 cells/ml. Fish farmers also reported that two cages of fish aerated by high pressure water jet survived without any loss. As the fish were still very fresh, they were harvested and sold as chilled fish to reduce loss. A press release was immediately made to assure the public that the fish kill was caused by oxygen depletion and the fish were fit for human consumption. Although it was estimated that at least 120 tonnes of fish valued at US$0.5 million were killed, the fish farmers managed to sell some 50 tonnes at a much lower price with a net loss estimated at US$0.4 million.

It should be noted that the impact of red tide incidents could be reduced if reported earlier and fish farmers would be reminded to aerate the water. Fish farmers admitted that the water at the FCZ was already discolored about a week earlier. However, as the culture stock was not affected, the farmers did not see the urgency to report to AFD, and even though they were told, they did not realize that large-scale oxygen depletion could occur. Owing to the heavy loss, the fish farmers became more receptive to AFD's advice. Followup action was taken to make use of the opportunity to train fish farmers in monitoring dissolved oxygen level and effective aeration technique. As a result, the fish farmers in this zone were the first to carry out dissolved oxygen monitoring and to install aeration system in the farms. Since then, no more fish kill due to oxygen depletion occurred in this FCZ. This demonstrates the importance of continuous education program in the Supportive Scheme in enhancing the efficiency of the Action Scheme.

In March 1989, a red tide sighting was reported in the inner Junk Bay. Mariculturists in the FCZ nearby confirmed no red tide and no fish kill occurred at the FCZ. Subsequent analysis of the water sample collected by EPD showed that the causative species was *Alexandrium catenella*, a species blooming for the first time in Hong Kong and documented to contain the PSP toxin. Followup investigation revealed that the mussels found near the FCZ contained high level of PSP (10,226–23,645 MU/kg). Later on, mussels collected from the northern waters of Hong Kong and Lamma Island where no red tide was sighted were also found to contain unacceptable PSP levels (4,779–9,871 MU/kg). Public announcement was made. DH advised fish farmers in these sites not to harvest shellfish and to surrender any shellfish harvested. The fish farmers were very cooperative and no PSP in humans occurred.

A study carried out by the EPD in the late 1980s showed an increase in PSP level in mussels, although the toxin level was still within the World Health Organization (WHO) limit (Lam et al., 1989). With the 1989 *Alexandrium* bloom and subsequent identification of other toxic *Alexandrium* species (*A. excavatum* and *A. tamarense*), there was good indication of increased potential health risk from consumption of local shellfish. AFD, therefore, took the initiative to check for PSP causative species in water samples collected for other monitoring programs. If PSP causative species are detected (even at low numbers), DH will be informed immediately so that necessary actions can be taken to step up shellfish toxicity surveillance including those from the production sites where the PSP causative species was present.

The above demonstrated that the red tide management strategy appeared to function cost-effectively. Staff resources involved were minimal and yet the strategy allowed for gradual improvement in response to situation changes over time.

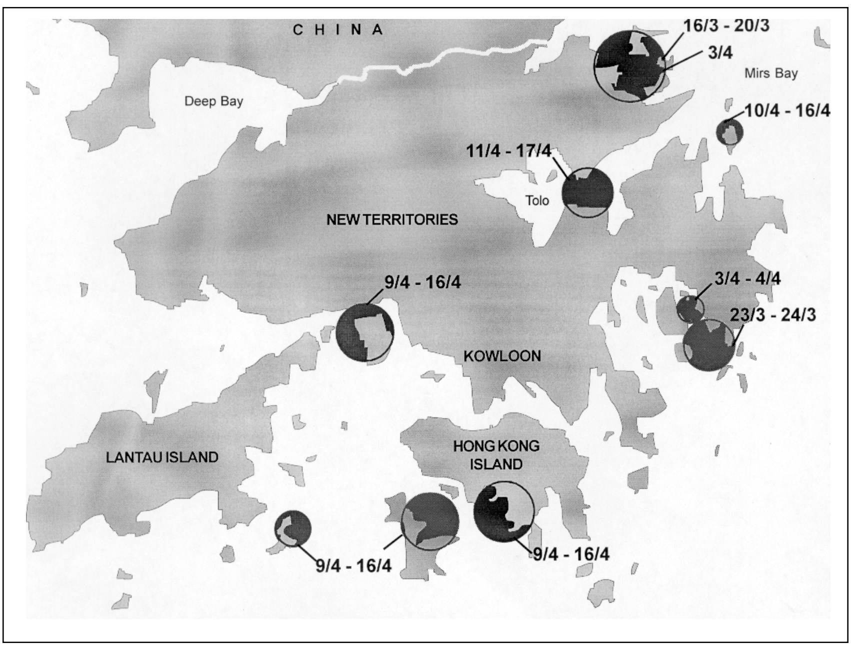
The 1998 Red Tide

Unlike the past blooms, the 1998 major red tide bloom was an unusual event in terms of pattern, scale and impact in Hong Kong waters. The event involving about seven outbreaks lasted from 18 March 1998 to 18 April 1998. A total of 20 out of the 26 FCZs were reported to be affected with various proportions of fish stocks killed. The total estimated fish loss claimed by fish farmers was about 3,500 tonnes valued at US$40 million (equivalent to over 80% of the total stock in Hong Kong). The causative species was initially identified by AFD as

Gyrodinium aureolum but Japanese taxonomists consider it to be a new species called *Gyrodinium* sp. HK-98 (Hodgkiss, pers. comm.). Toxicity test for PSP following the AOAC method with a concentrated red tide sample showed that this red tide species did not carry PSP toxin. The fish kill was not caused by oxygen depletion as dissolved oxygen level of water during the fish kill was around 9-10 mg/l. However, active fish species (e.g., cobia, purple amberjack, goldline sea bream) were affected first. It appears that the fish died as a result of asphyxia caused by the gills being covered up with copious mucilages produced either by the *Gyrodinium* or the fish itself in response to the irritation from the red tide. As to how the fish were killed, it is still not very clear. HD could not confirm whether the dead fish were suitable for human consumption on that day. This generated serious criticism from the media and overreaction from the public who chose not to eat seafood for a prolonged period.

The sequence of incidents can be seen in Figure 2. The event started on 18 March 1998 in the northern waters near Kat O. The red tide spread gradually throughout the northern waters in the following two weeks and caused intermittent fish kills in a number of FCZs. A dense bloom was found in the outer Port Shelter on 23-26 March 1998 and then in the inner Port Shelter on 3-4 April

Figure 2. Sequence of Events in the Occurrence of the Major Red Tide Outbreak in Hong Kong, March/April 1998.



Source: Wong and Wu (1987).

1998. On 9 April 1998, the *Gyrodinium* blooms spread throughout the southern waters of Hong Kong from Tung Lung Chau FCZ in the east to Cheung Sha Wan FCZ in the west. The most serious fish kill occurred on 11 April 1998 at Lo Tik Wan FCZ where the highest cell density of 225,500 cells/ml was recorded. The red tide also appeared in Long Harbour on 10 April 1998 and later in Tolo Harbour on 11 April 1998. All *Gyrodinium* blooms subsided after 17 April 1998.

It should be noted that with the exception of two to three days, the weather for the whole period was cloudy and overcast. Water temperature was 17°C to 20°C. There was no *Gyrodinium* bloom for two to three days when the weather was clear and surface seawater temperature increased up to above 22°C. It was also observed that fish kill usually happened when the red tide first came up to the surface at noon or in early afternoon even if cell density was not very high.

According to the established red tide Action Plan, warnings had been given to fish farmers in advance (i.e., when red tide affected Kat O). All FCZs in the northern region were alerted. Most fish farmers, however, did not heed the warning until the fish were dying which was already too late. Fish farmers in the Ma Wan FCZ on receiving the red tide warning however, organized themselves together using high pressure water jets and boat propellers to drive away the incoming red tide. As a result, the Ma Wan FCZ suffered the least fish loss.

In view of the heavy losses suffered by the fish farmers, the public heavily criticized the Government for not being able to forecast the coming of such a red tide and to stop or control it from spreading. The media, the academe and commercial firms made various suggestions to improve the red tide management strategy in Hong Kong. The following is an evaluation on the various suggestions and measures:

1. Remote sensing using satellite images

It was suggested that the Government should employ satellite remote sensing to detect red tide outbreak and forecast bloom dynamics. Literature review has shown that remote sensing of ocean color has been demonstrated to be feasible for established, nearly mono-specific red tides (Tester and Steidinger, 1997). However, this technique has been constrained by the inability of the sensors to discriminate phytoplankton populations at species level (Garver et al., 1994). In Hong Kong, past red tide record revealed that red tide species are numerous and vary greatly from year to year. Moreover, cloud cover is a major obstacle. A retrospective checking of available satellite images during March to April 1998 showed that these techniques are not workable since images have been seriously attenuated by thick cloud cover.

Remotely-sensed sea surface temperature (SST) has been used to follow movement of coastal current which dominates the dynamic of *Alexandrium tamarense* in the Gulf of Mexico (Keafer and Anderson, 1993). In Hong Kong, SST during March to April 1998 again did not show significant temperature differences of water masses around Hong Kong.

2. Telemetry

Integrated water monitoring system (e.g., SEAWATCH) has been used for monitoring oil pollution in Indonesia and for typhoon forecasting in Vietnam (Sϕras et al., 1998). The use of such system for monitoring algal dynamics has been described by Johnsen et al. (1997) and Tangen (1997), but still needs to be verified. Spatial patchiness of red tide may render the use of this system ineffective unless the whole area is affected. Stel and Mannix (1996) estimated that annual cost is US$3 to $4 million for 10 buoys. The capital investment as well as cost-effectiveness must, therefore, be seriously considered in relation to the total production value of mariculture in Hong Kong.

3. Hydrodynamic filtration system

The proposed system consists of a chamber with gyro valves inside. The red tide water when forced through this chamber will form a gyre which spins the heavier particles towards the outer part of the chamber. The chamber leads into an inner pipe and an outer pipe so the heavier particles go into the outer pipe while cleaned water comes out of the inner pipe. Results of a field trial show that, while this device may be effective in separating large particles, the efficiency of this design is not satisfactory for small particles ($< 30\ \mu$) such as dinoflagellates.

4. Chemical control

Various substances including ozone, hypochlorite, bacteria culture and enzyme preparation have been claimed to be effective in killing the red tide organisms. However, there are major concerns on the potential impacts these substances may have on the ecosystem when applied in the sea in large quantity. The cost-effectiveness of these methods is also questionable.

Japan (Shirota, 1989) and China (Yu et al., 1994) have studied the use of clay as a flocculent to bind the red tide organisms in water. Koreans have used clay to control blooms of *Cochlodinium polykrikides* in the vicinity of a large mariculture industry and have found clay to reduce fish mortality to less than 1% that of the previous year (Anderson, pers. comm.). The use of clay in Hong Kong, however, would require further study due to the shallow depth and poor flushing at the FCZs.

Other Mitigatory Measures

Other suggestions to mitigate the impact of the red tide include fencing off fish cages from red tide and setting up holding tanks to keep the fish temporarily during red tides. The former has been tested but found to be impractical, as red tide does not always remain in the upper water layer. The latter suggestion was not also practical in Hong Kong as land is expensive and in acute shortage. It would neither be practical nor economical for fish farmers to acquire sufficient land and keep as emergency holding facilities nearby for such purpose.

The Way Forward

It can be seen from the above that there are new technologies and new ideas proposed for the detection, control and mitigation of red tides. So far, very few methods are practical. In reviewing the existing red tide management strategy, the following areas for improvement have been identified.

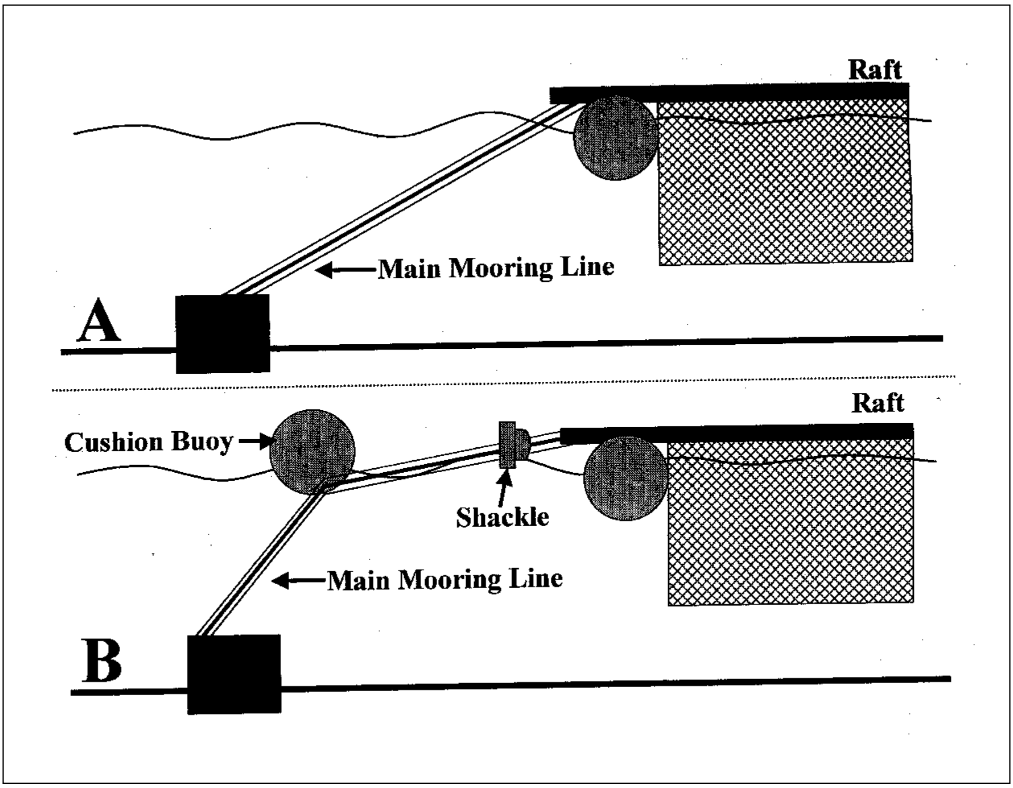
First, to be able to give warning to fish farmers before red tides are sighted, the phytoplankton composition of the water has to be monitored. A phytoplankton monitoring program has been implemented since May 1998. Water samples are collected twice weekly at 13 FCZs and once every two weeks at 3 outer stations for phytoplankton analysis. If harmful species is detected, monitoring frequency will be stepped up. If there is indication of red tide development, warning will be given to mariculturists in nearby FCZs. This has proved to be fairly effective. So far, about all the red tide incidents located at FCZs (79% of all red tide incidents) since May 1998 have been detected by the established phytoplankton monitoring program. In January 1999, the *Gyrodinium* sp. HK-98 was found in low concentration in the northern waters again. Monitoring was immediately stepped up, however, the species disappeared after about two weeks. This operation requires heavy staff resources and the frequency of monitoring will be reviewed in the near future.

Second, based on the 1998 experience, there is an urgent need to educate the fish farmers on the potential risk of red tide and to enhance communication and cooperation among them. AFD collaborated with the Federation of Hong Kong

Aquaculture Association to form the red tide liaison and support group. Each FCZ nominated a representative as a contact point for AFD. When red tide alert is issued by AFD, the representative raises a flag to disseminate the red tide information to fellow fish farmers. Yellow flag indicates a non-toxic red tide, which requires close monitoring of the situation and preparation to start aeration. Red flag signals a toxic red tide, and actions have to be taken to relocate the raft if necessary. The support group also helps to coordinate and liaise with fish farmers in raft relocation and disposal of dead fish during emergency. Fish farmers have expressed difficulties in raft relocation in emergency. Studies are therefore carried out to design a quick method to facilitate raft detachment. A simple design with buoy and shackle has been proven to be efficient and acceptable to the fish farmers (Figure 3).

A number of hydraulic models have been developed for predicting water movement in the coastal waters of Hong Kong. Such models have been used to

Figure 3. A: Existing Design Buoy and Shackle Used by Fish Farmers in Hong Kong.
B: Improved Design Buoy and Shackle for Efficient Raft Relocation.



predict the movement of oil slicks during major oil spills. It may therefore be possible to adopt these models to predict the movement of red tide after its sighting, to provide early warning to fish farmers in other FCZs. Research is being carried out to investigate the feasibility of adapting these models for use in conjunction with geographic information systems (GIS), with a view to forecasting the movement of red tides.

In addition to the above, a consultancy study was commissioned to conduct an overall review and to make recommendations on cost-effective measures to improve the red tide monitoring and management strategy. The unprecedented red tide outbreak in Hong Kong last year is a valuable experience for future occurrences. It appears unlikely to forecast and control most red tides in the near future, but with a well-planned management strategy, the impact of red tides can be minimized. Sharing the success and failure among countries within the region is essential to achieve this goal.

References

Garver, S.A., D.A. Siegal and B.G. Mitchell. 1994. Variability in near-surface particulate absorption spectra: What can a satellite ocean color imager see? Limnol. Oceanogr. 39: 1349-1367.

Johnsen, G., Z. Volent, K. Tanger and E. Sakshaug 1997. Time series of harmful and benign phytoplankton blooms in Northwest European waters using the Seawatch Buoy System, p. 113-141. *In* M. Kabru and C.W. Brown (eds.) Monitoring algal blooms: New techniques for detecting large-scale environmental change. Landes, Bioscience, Austin.

Keafer, B.A. and D.M. Anderson. 1993. Use of remotely-sensed sea surface temperatures in studies of *Alexandrium tamarense* bloom dynamics, p. 763-768. *In* T.J. Smayda and Y. Shimizu (eds.) Toxic phytoplankton blooms in the sea. Elsevier Science Publ. B.V., Amsterdam.

Lam, C.W.Y., M. Kodame, D.K.O. Chan, T. Ogata, Sato and K.C. Ho. 1989. Paralytic shellfish toxicity in shellfish in Hong Kong. *In* T. Okaichi, D.M. Anderson and T. Nemoto (eds.) Red tides: Biology, environmental science and toxicology. Elsevier, New York.

Shirota, A. 1989. Red tide problem and counter measures (2). Int. J. Aquat. Fish. Technol. 1: 195-293.

Søras, P.E., P. Sunaryo and T.A. Adibroto. 1998. The use of real-time ocean monitoring system in utilizing the marine coastal resources in Indonesia. ISASTIS' 98.

Stel, J.H. and B.F. Mannix. 1996. A benefit-cost analysis of a regional Global Ocean Observing System: Seawatch Europe. Mar. Policy 20: 357-376.

Tangen, K. 1997. Monitoring phytoplankton blooms continuously with SEAWATCH technology, p. 778. *In* J.H. Stel, H.W.A. Behrens, J.C. Borst, L.J. Droppert and J.V.D. Meulen (eds.) Operational oceanography: The challenge for European cooperation. Elsevier, Amsterdam.

Tester, P.A. and K.A. Steidinger. 1997. *Gymnodinium breve* red tide blooms: Initiation, transport and consequences of surface circulation. Limnol. Oceanogr. 42: 1039-1051.

Wong, P.S. and R.S.S. Wu. 1987. Red tides in Hong Kong: Problems and management strategy with special reference to the mariculture industry. J. Shorel. Manage. 3: 1-21.

Yu, J., A. Zou and X. Ma. 1994. Application of clays to removal of red tide organisms I. Congulation of red tide organisms with clays. Chin. J. Oceanol. Limnol. 12 : 193-200.

Online Information Management Tools for Technological and Management Interventions among ICM Sites

Donald O. Hodgins
Silvano S. Salvador

Seaconsult Marine Research Ltd.
8805 Osler Street
Vancouver, B.C., Canada V6P 4G1

HODGINS, DONALD O. and SILVANO S. SALVADOR. 1999. Online information management tools for technological and management interventions among ICM sites, p. 400-409. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (GEF/UNDP/IMO Regional Programme) began implementation of an integrated information management system (IIMS) for application to integrated coastal management (ICM) sites in late 1998. The IIMS is based on a relational environmental database, complemented by a geographic information system (GIS) for spatial analysis, and other programs for spatial/temporal data visualization, statistical analysis and econometric modelling. A second, fundamental component of the IIMS is a data recording specification document, which establishes standards for collecting information in eight different categories with a view to improving the quality and uniformity of the information entered into the IIMS. The design of the IIMS began in November 1998 based on information compiled during Phase I of the GEF/UNDP/IMO Regional Programme. The prototype IIMS will be implemented and tested using the dataset acquired for Batangas Bay, Philippines, in the first half of 1999, followed by extension of the IIMS to new ICM demonstration sites in late 1999 and in the year 2000.

Introduction

Pollution prevention management and intervention require comprehensive environmental information to make socially, economically and technically sound decisions. Viewed from an East Asian Regional perspective, there is a need for standardizing collection, updating, archiving, exchange and analysis methods for these data. In 1998, the GEF/UNDP/IMO Regional Programme began implementation of an integrated information management system (IIMS) for application to the demonstration sites.

The core element of the IIMS is a relational environmental database program. The relational database is complemented by geographic information system (GIS) tools for spatial analysis, spatial/temporal data visualization and query tools for hydrodynamic, water quality and oil spill model results, and a range of decision support, statistical and econometric modelling programs for summarizing and analyzing environmental data.

A second, fundamental component of the IIMS is a data recording specification document. This document establishes standards for collecting information in eight different categories, spanning social and economic data to physiographic and biological data, with a view to improving the quality and uniformity of the information entered into the IIMS.

The design of the IIMS began in November 1998 based on the information compiled during Phase I of the GEF/UNDP/IMO Regional Programme. The prototype IIMS will be implemented and tested using the dataset acquired for Batangas Bay, Philippines, in the first half of 1999. Extension of the IIMS to new demonstration sites for Phase II of the GEF/UNDP/IMO Regional Programme is planned for late 1999 and the year 2000. The purpose of this paper is to introduce the IIMS concept and describe its organization and function within the GEF/UNDP/IMO Regional Programme.

IIMS Objectives

Experience has shown that collection, quality control and synthesis of environmental information are difficult, slow and expensive components of assessing conditions at a given site. Problems include lack of key parameters, inconsistent units and terminology, inappropriate precision and lack of documentation on data sources and quality. These problems result in data that cannot be synthesized for analysis and must be treated in isolation, data that are insufficient to support modelling activities and generally low confidence in the conclusions based on the information. The IIMS has several key objectives, aimed at remedying some of the most obvious problems:

- Standardizing data collection, retrieval and archiving procedures by specifying parameters to be measured/compiled, their units, precision, geospatial and temporal attributes;

- Collecting sufficiently quantified data so that a range of decision support, econometric and environmental models can be applied;

- Speeding up access to the required information to allow rapid assessment of key pollution problem areas and priorities for management and intervention;

- Speeding up the synthesis and modelling of data to provide better information for management and intervention;

- Facilitating spatial analysis using GIS tools by ensuring that the necessary data have been collected and that spatial attributes are included;

- Preserving data and facilitating updating of information to protect the original investment in the data collection program, and provide for a regional analysis capability as opposed to a strictly site-by-site capability;

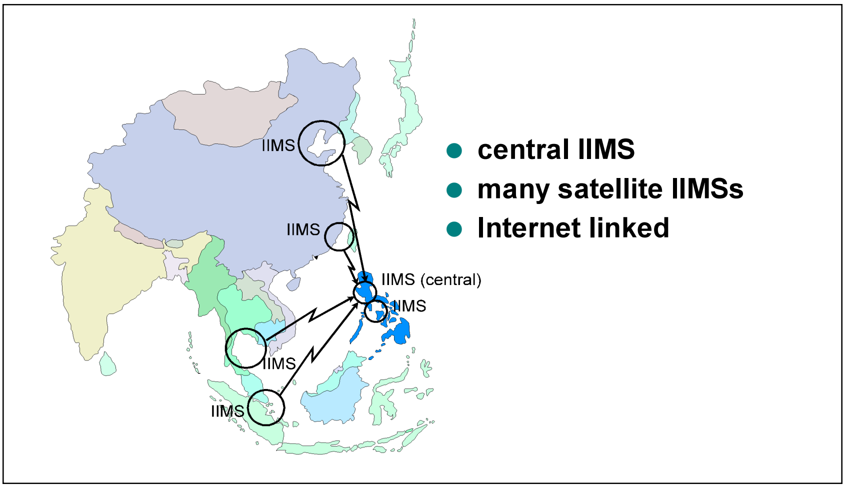
- Minimizing redundancy in data and supporting query and simple analysis of data through the use of relational database techniques; and

- Allowing efficient, rapid use of new software tools by storing data in a standard database format.

IIMS Concept

Figure 1 illustrates the regional IIMS concept: each separate demonstration site will maintain its own IIMS using the recording specification and software developed in this project. Information entered into the site-specific, satellite IIMSs will consist of the data that are relevant to the issues faced at that site, but will be coded such that it can be shared with a central IIMS site and, eventually, with other integrated coastal management (ICM) sites. A central IIMS will be maintained by the GEF/UNDP/IMO Regional Programme to facilitate regional analysis and intercomparison of conditions across several sites. Data transfer and sharing will be carried out using Internet file transfer. The central IIMS will contain all of the data collected at the satellite IIMSs.

Figure 1. Schematic Overview of the IIMS Organization.

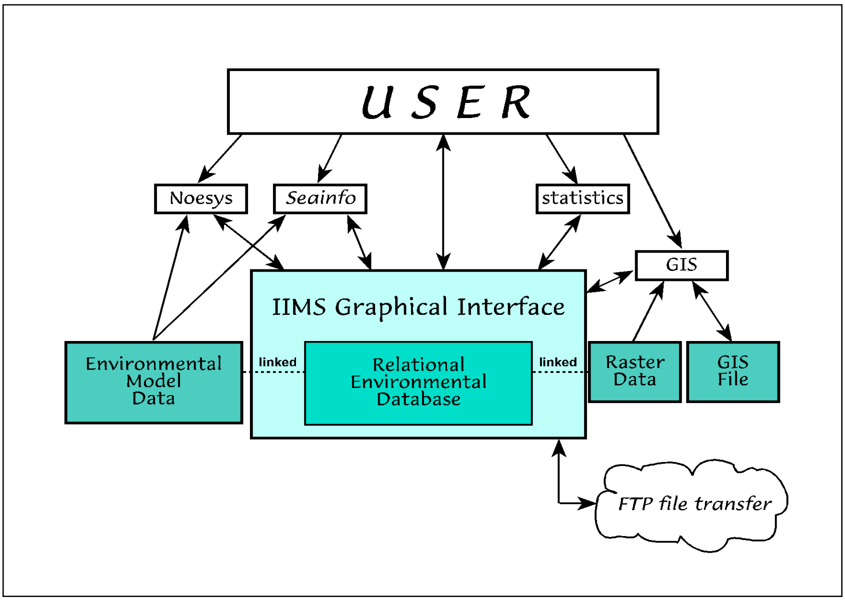


The structure of each IIMS, illustrated in Figure 2, is identical. The relational environmental database (REDB) contains primary environmental data in 2-D tables that are related through common attributes (or data elements). The data tables are normalized such that non-key data elements are dependent upon the primary key but are independent of the other non-key data elements. Normalization eliminates update, insertion and deletion anomalies as the database is maintained and provides the structure to view and save virtual tables that are constructed from several tables sharing a common attribute.

Users access the REDB through a graphical user interface (GUI) that provides control over data entry, file insertion, query and report generation, as well as data file transfer between IIMSs. The GUI also provides control over launching other key applications. The GIS is one such essential component of the IIMS which stands outside the REDB to provide spatial analysis capabilities. Raster data support and secondary data—those data which are derived from the GIS—are stored in the GIS-supported database. Primary data tables in the REDB can be imported into the GIS as data layers.

Environmental model data form another essential source of secondary information, derived from basic data stored in the REDB. Examples of model data in the IIMS context include results from hydrodynamic model output (marine water

Figure 2. IIMS Functional Structure.



properties, tides and currents), water quality models (contaminant distributions), ecological models (plankton dynamics, red tides) and oil spill models (trajectory/fate, damage assessment, risk analysis). Model data generally consist of large 3-D arrays that are incompatible with the relational data structure of the REDB; consequently, specialized tools are used to visualize, query and analyze these data (*Seainfo* and *NoeSys* as noted in Figure 2).

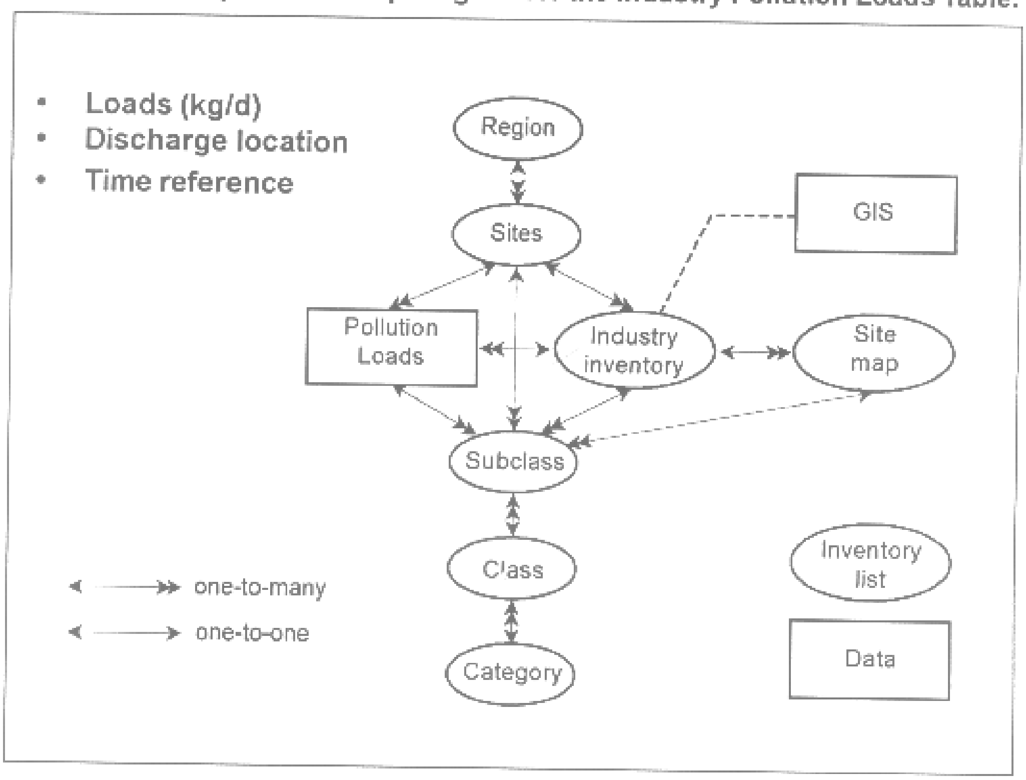
Data Categories

Data contained in the REDB are organized into eight categories: (1) regional and data codes, geospatial data; (2) social and economic data; (3) demographic data; (4) institutional data; (5) pollution source data; (6) monitoring data; (7) physiographic data; and (8) biological and bioresources data. Within each category, the data are further subdivided into classes and subclasses to provide a hierarchical organization. The regional and data codes in category (1) specify attributes linking data between sites and tables. Geospatial data contain position information common to several records/tables that can be used in the GIS to plot locations, transects or area boundaries relevant to certain types of data. For example, area boundaries for fisheries effort/landed value data surveys would be stored in category (1) data tables.

The recording specification document describes the information that must be entered into each subclass table, the type of parameter in each column, its data type, units and precision. Primary keys that link tables are indicated for each table.

Figure 3 illustrates the entity relationship for the one subclass of data table: industry pollution loads, which is located in the pollution source category, land-based loads class. The region and site designate the GEF/UNDP/IMO Regional Programme's demonstration site information that ties the loads data to a particular regional setting. The industry inventory is a listing of industries located within the ICM site boundaries, their geographic locations and information about ownership, ISIC type, and effluent treatment and disposal in text format. The industry loads data table is linked to the inventory by an industry number, and specifies the pollution load in kg/d for a wide range of contaminants that affect the marine environment (e.g., biochemical oxygen demand, nitrogen, heavy metals, suspended particulate matter, organic compounds), the date of the information and the source.

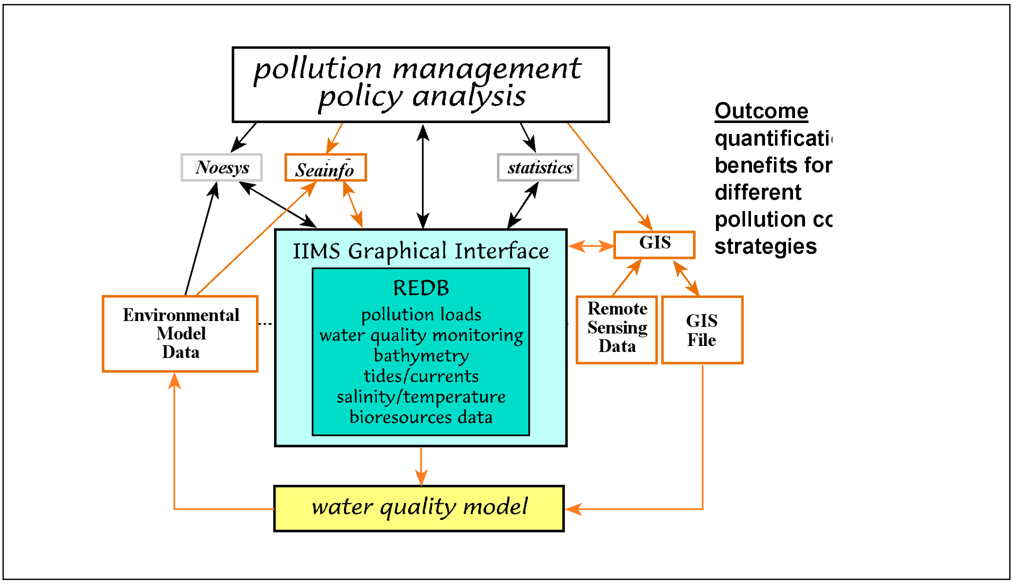
Figure 3. Entity Relationship Diagram for the Industry Pollution Loads Table.



Example of an IIMS Application

Continuing with the example of pollution loads, an illustration is made of how the IIMS will be used for assessing pollution control policy options (Figure 4). The industry pollution loads data, along with other primary information contained in the REDB and the complementary analysis tools, are linked together for this purpose.

Figure 4. IIMS Components Used for Pollution Management Policy Analysis.



In this case, the environmental database will contain the data tables that specify the contaminant loads and their discharge points for industries, sewage disposal sites and rivers. These tables will also contain changes to those pollutant loads derived from management options that may range from legislative or incentive-based plans to treat industrial effluents, wastewater collection and treatment options, or changes to agricultural practices that reduce river-borne contaminant loads. Water quality monitoring data together with information on salinity, temperature, tides and bathymetry would be used to specify background contaminant levels and basic oceanographic properties that are necessary to operate a water quality model. Finally, biological information could be used to evaluate potential impacts from contaminants on valued biological resources in the study area. Such impacts could then, for example, be expressed in an economic risk framework using fisheries economics data in the REDB.

It is often found that maps of coastal areas are out-of-date, and that the type of information needed to implement a hydrodynamic water quality model, such as the geography of mudflats and estuaries, is inaccurately represented on the charts that are available. Remote sensing data now provide the resolution, coverage and schedule control to obtain valuable information to supplement conventional charts. These raster data are used in the GIS to create georeferenced maps with spatial resolution and feature definition suitable for setting up and calibrating numerical models. An example of this process is illustrated in Figure 5. Here, multiple RADARSAT images collected at high and low tides were combined with conventional chart data in a GIS to delineate dry land, intertidal mudflat (flood-dry portions of the hydrodynamic model) and the permanently wet areas of Ha Long Bay in Vietnam (Corbley, 1998).

These data would then be used with a numerical water quality model to simulate the dispersion and concentration of contaminants for a series of scenarios presenting different management options. The contaminant output files, denoted as environmental model data files in Figure 4, would be examined with software tools such as *Seainfo* that are designed specifically to access the large binary files generated by numerical models. Figure 6 shows an example of two concentration fields modelled for Ha Long Bay using the spatial coverage and bathymetry shown in Figure 5, for land-based pollution entering the bay at point sources distributed all along the coast and from the rivers.

Figure 5. Example of the Use of RADARSAT Imagery with Conventional Charts and Maps in a GIS to Derive Map Data Required to Define a Numerical Water Quality Model for Ha Long Bay, Vietnam.

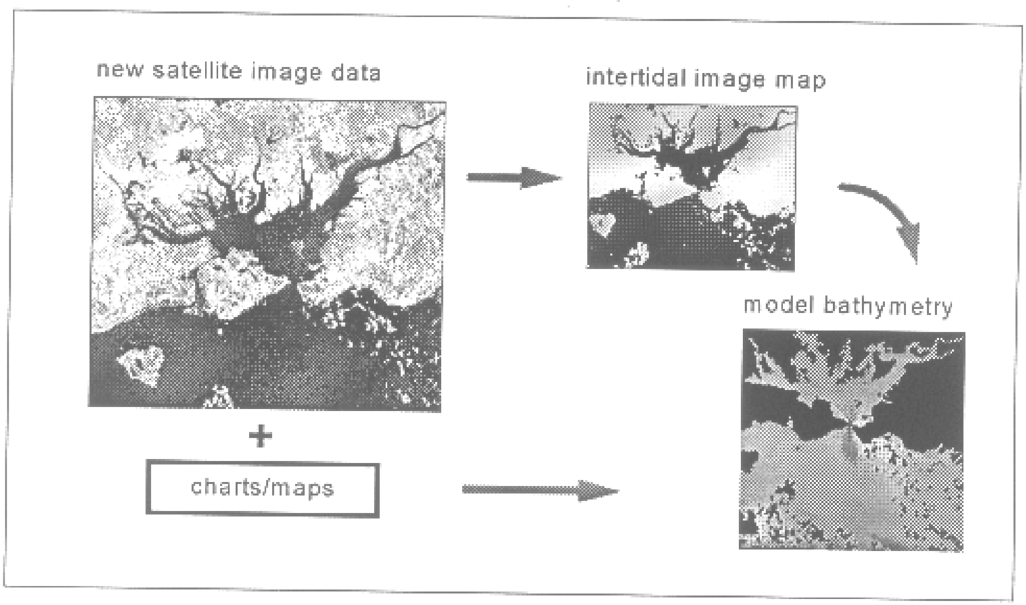
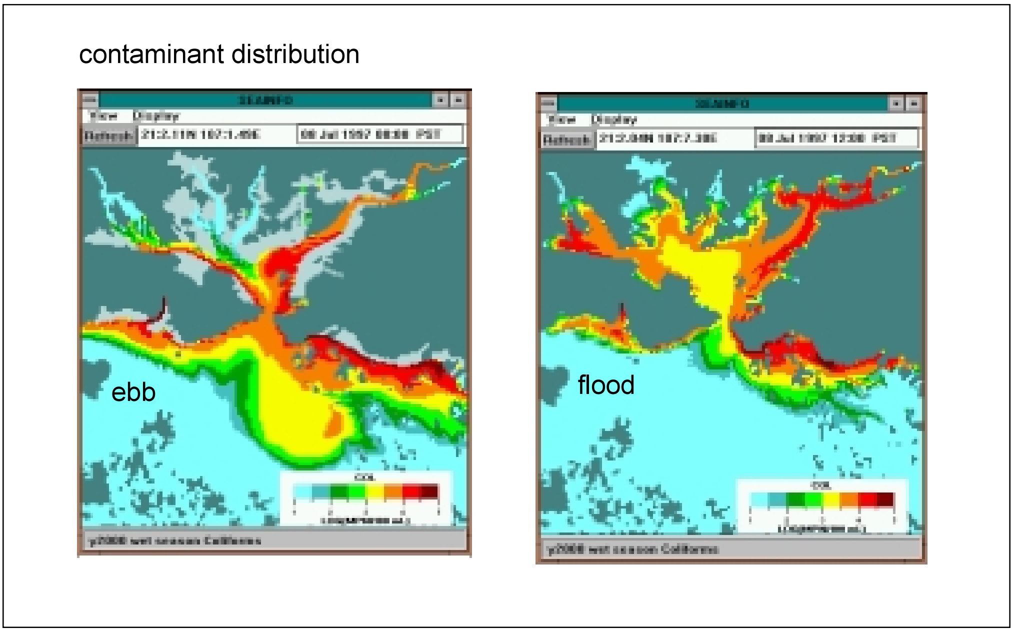


Figure 6. Example of Modelled Contaminant Distributions (ebb and flood tides) in Ha Long Bay, Vietnam, for Multiple Point-Source Discharges from Land-based Pollution Sources.

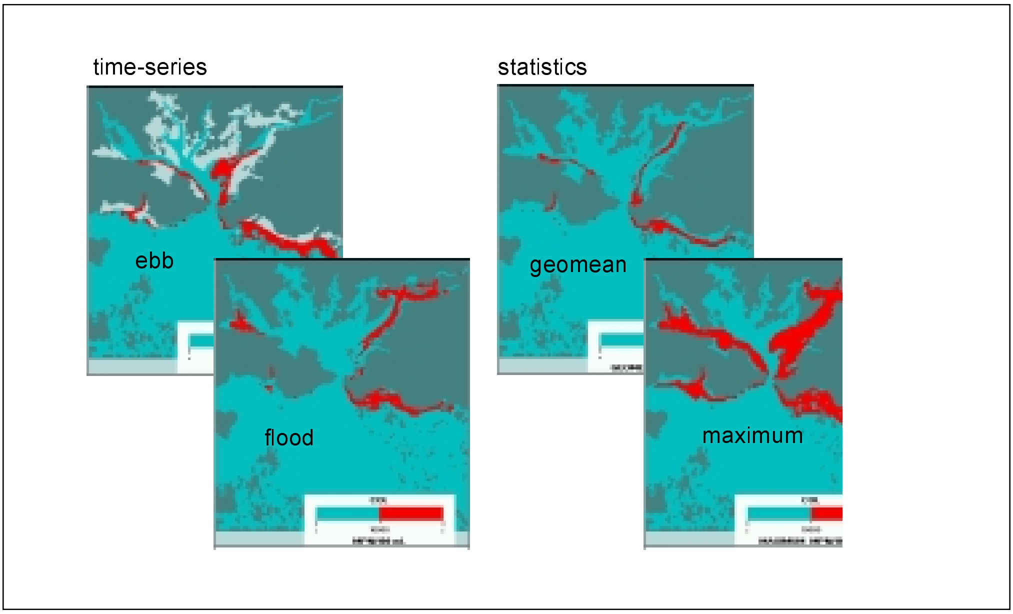


The data are fully georeferenced and date/time labeled. Query functions allow the user to interrogate the fields at any location and read the concentration levels. The assessment of the benefits for a particular pollution control strategy, in terms of meeting water quality objectives, for example, can be determined through simple geospatial displays of the areas that meet or exceed a criterion (Figure 7).

The modelled concentration fields can also be combined with toxicological endpoints to delineate regions of potential biological effects. When blended with the biological resources as data layers in the GIS, it will then be possible to model impacts in a relatively quantitative manner.

The outcome of this type of modelling process is a quantification of the benefits associated with a particular management strategy, in terms of preserving water quality and habitat or in terms of economic benefits. Then, it is possible to compare benefits across the range of options available and set realistic goals and priorities.

Figure 7. Examples of Spatial Data Displays Showing Areas that Exceed a Water Quality Criterion for Time-series Output (left hand panels) and for Mean/Maximum Output (right hand panels).



Implementation

At the time of this conference, the prototype IIMS is reaching the first stage of development and will be tested at the end of March 1999 with a limited dataset from Batangas Bay. As software requirements and the data recording specifications are refined, the IIMS will be fully implemented for Batangas Bay with a view towards an operational system by mid-1999. These developments will pave the way for additional implementations in late 1999 and in the year 2000 at the ICM sites for Phase II of the GEF/UNDP/IMO Regional Programme.

Reference

Corbley, K.P. 1998. Preserving Ha Long Bay. GIS Asia Pacific, August/September 1998: 34-38.

Developing Ecotoxicity Tests for Coastal Protection and Management in Hong Kong

Paul K.S. Lam and Rudolf S.S. Wu

Centre for Coastal Pollution and Conservation
Department of Biology and Chemistry
City University of Hong Kong
83 Tat Chee Ave., Kowloon, Hong Kong SAR, China

LAM, PAUL K.S. and RUDOLF S.S. WU. 1999. Developing ecotoxicity tests for coastal protection and management in Hong Kong, p. 410-418. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Ecological risk assessment is a set of procedures that can be used to assist in decision-making processes so that potential harm to ecological systems arising from anthropogenic activities may be minimized. An important component of these risk assessment procedures involves setting the acceptable level(s) of impacts to a particular system. This is usually achieved through ecotoxicological tests performed under controlled laboratory conditions. This paper examines the approaches and methodologies used in developing these tests in North America and Europe, and argues the desirability of establishing similar tools for the Southeast Asian Seas to ensure long-term sustainable use of our marine living resources. The recent development of lethal and sublethal tests for Hong Kong marine waters serves as an example in this endeavor.

Introduction

Coastal developments in Hong Kong and South China are occurring on a grand scale. The region will continue to experience pressures from increased economic activities in the coming decades. The population in Hong Kong is expected to rise from 6.2 million to more than 8 million people in the next 10 years. At present, about 80% of Hong Kong's domestic wastewater is being discharged into the coastal water with no biological treatment. Enormous quantities of waste, wastewater and contaminated mud are being disposed into the coastal environment. For example, the multibillion Port and Airport Development Scheme has caused severe damage to fisheries resources, corals, seagrasses and marine mammals. In addition, the Strategic Sewage Disposal Scheme will discharge the wastewater from some 3.5 million people into the South China Sea, although the impact of this discharge on the coastal environment is virtually unknown. As a world-leading container port, coastal pollution problems are being further exacerbated by the discharges from thousands of vessels, let alone the high risk of major oil spill. The protection of the coastal waters of Hong Kong is not only extremely urgent, but also of critical importance, as the food supply, domestic economy, public recreation and tourism industry of Hong Kong depend very much on the health of our coastal ecosystems. In order to protect and manage our coastal resources for future sustainable use, it is essential for the government to properly assess the risks to our coastal environments, such as those arising from development projects or toxic discharges, so that unacceptable impacts can be avoided, minimized or mitigated.

An important component in assessing ecological risks is the determination of critical stress levels for a biological system below which no adverse effect would be expected—often referred to as the predicted no effect concentration (PNEC). The determination of PNEC generally relies heavily on laboratory ecotoxicological investigations where test organisms are exposed to various levels of toxic stressors, and their responses observed and quantified under controlled conditions. Endpoints measured typically include lethality in the case of acute tests, while biochemical and physiological criteria are often used for chronic assessments. The protocols for these ecotoxicity tests are comparatively well-established in developed countries, and indeed, some of these protocols have been written into local environmental protection legislation. It is tempting for environmental regulators elsewhere to adopt the test protocols, either in full or in part, for use in their own countries. The arguments for taking such an action are manifold, but the main ones are that the protocols developed in these countries have been tried and tested, and thus should provide relatively reliable and repeatable test results for use in a regulatory context. More importantly, the development of tests tailor-made for particular systems is time-consuming and costly both in terms of labor and other resources. Over and above this, the readily available tests will allow immediate action to arrest any further deterioration of valuable coastal resources. Indeed, the paucity of scientific data on local marine organisms has made it necessary for Hong Kong to rely on data and ecological criteria derived from developed countries in the temperate regions in its previous assessments of fisheries and marine ecological impacts.

It is noteworthy that the ecotoxicological testing protocols developed in Europe and North America tend to use species from a list of selected test organisms. A list of fish and invertebrate species commonly used for toxicity tests is given in

Table 1. Here, it is argued that the type of ecotoxicological information obtained from laboratory observations based on a few selected test species may only be useful in providing a "general" protection to ecological systems in a non-site-specific risk assessment exercise, but cannot afford protection to specific ecological systems. For example, these non-site-specific assessments are regularly used in estimating the ecological risks of new and existing chemicals as the precise information on their receiving environments is usually not available. In this case, well-established tests with relatively high reliability and repeatability would have a significant role to play in the control and regulatory context.

Table 1. Fish and Invertebrate Species Commonly Used for Toxicity Tests in Marine Systems (Rand, 1995).

Fish	Invertebrate
Sheepshead minnow (*Cyprinodon variegatus*) Mummichog (*Fundulus heteroclitus*)	Copepods (e.g., *Acartia* spp.) Shrimp (e.g., *Penaeus* spp.) Mysid shrimp (e.g., *Mysidopsis bahia*) Crab (e.g., *Cancer* spp.) Oyster (e.g., *Crassostrea virginica*) Polychaetes (e.g., *Capitella capitata*, *Neanthes* spp.)

Can We Use Exotic Species for Toxicity Tests?

In some cases, however, the objective of an ecological risk assessment may be site specific, e.g., for the protection of a bay, a mangrove swamp or a coral reef in a particular country or region. Under these circumstances, it is vital to determine the tolerances and responses of local target species that one wishes to protect, to anticipate changes in the water quality parameters in question and to ascertain precisely what level of these parameters is required to sustain fisheries and other marine resources.

The importance of gathering ecotoxicological information using local species is underlined by the fact that there are fundamental differences between different biogeographic areas, in terms of the physical environment (e.g., temperature and salinity, etc.) and biological attributes (e.g., species composition, community structure, trophic relationships, fisheries resources, susceptibilities, targets and priority for protection, etc.). All these factors will significantly affect the tolerances and responses of marine organisms. In the case of Hong Kong, this problem is further complicated by the typically large spatial and seasonal variations of hydrographic parameters (Morton and Wu, 1975). Thus, data and criteria derived from overseas may not be applicable to local marine life, and may not afford adequate protection to Hong Kong's fisheries and marine ecosystems. It is for the same reason that most developed countries have developed their own toxicity tests for ecological risk assessment. For example, a review of the species selected for testing oil spill dispersants in seven countries reveals that all the countries examined have developed their own tests using local species that are ecologically or commercially important (Table 2).

Table 2. Species Selected for Testing Oil Spill Dispersants in Various Countries.

Country	Test species
Australia	Yellow-eyed mullet fish
Canada	Rainbow trout *(Salmo gairdneri)* fingerling
Italy	Mullet *(Liza aurata)*
France	White shrimp *(Palaemonetes varians)* or brown shrimp *(Crangon crangon)*
Singapore	Glass fish *(Chanda gymnocephalus)*
Norway	Unicellular alga
United Kingdom	Brown shrimp *(Crangon crangon)* and the common limpet *(Patella vulgata)*
USA	Silverside *(Menidia beryllina)* and mysid shrimp *(Mysidopsis bahia)*

Laboratory Ecotoxicological Tests in Hong Kong

Against such a background, attempts have been made in recent years to develop ecotoxicological tests for use in Hong Kong and its nearby regions. Table 3 summarizes the selection criteria for the candidate species.

Table 3. Selection Criteria Used in Choosing Candidate Species for Ecotoxicological Testing in Hong Kong.

Test organisms should be:

- Of ecological/fisheries importance in the local environment.
- Abundant and widely distributed in Hong Kong (and preferably in the region).
- Relatively sensitive to changes in water quality parameters.
- Reasonably abundant most of the time throughout the year.
- Representative of different trophic levels and occupy different niches in the local marine ecosystem.
- Amenable to testing under laboratory conditions.

Based on the above selection criteria, the following five local species have been selected as test organisms. Correspondingly, a suite of ecotoxicity tests has been developed for each of these five species:

1. Fish *(Lutjanus argentimaculatus)* 48-hr LC_{50} test

   The mangrove snapper, *Lutjanus argentimaculatus*, is a common species used for the local mariculture industry and has a wide geographic distribution in Hong Kong and Indo-Pacific.

2. Amphipod *(Melita longidactyla)* 48-hr LC_{50} test

   The amphipod, *Melita longidactyla*, is a benthic detritus feeder found in great abundance in local marine waters. This species plays a significant ecological role in nutrient recycling and serves as an important food source for many fish species at higher trophic levels.

3. Barnacle *(Balanus amphitrite)* larvae 48-hr LC_{50} test

   Larvae of the barnacle, *Balanus amphitrite*, represent one of the most abundant zooplankton found throughout Hong Kong and Asia Pacific.

4. Shrimp *(Metapenaeus ensis)* 48-hr LC_{50} test

   The shrimp, *Metapenaeus ensis*, is an important commercial species both in Hong Kong waters and Indo-Pacific. This species is also being cultured in Hong Kong.

5. Diatom *(Skeletonema costatum)* 7-day growth inhibition (LC_{50}) test

   The marine diatom, *Skeletonema costatum*, is a cosmopolitan phytoplankton species which is abundant both locally and worldwide.

The five species proposed above, therefore, not only represent important nekton, benthos, zooplankton and phytoplankton species in the marine environment of Hong Kong, as well as in the region, but also represent species of ecological and fisheries significance. Fish is sensitive to changes in dissolved oxygen, suspended solids, cyanide and ammonia (Wu and Woo, 1985; Russo et al., 1988). Barnacle larvae and diatoms are sensitive to heavy metals and phenol (Wu et al., 1997a), while shrimps and amphipods are generally sensitive to a range of toxic chemicals. Fisheries and marine ecological criteria developed based on tolerances and responses of these five species will, therefore, provide a sound scientific basis for assessing the water quality requirements of, as well as the impact of, water quality changes on the local fisheries resources and marine ecosystem. So far, these tests have been used satisfactorily for assessing the toxicities of cooling waters, oil dispersants, as well as raw and partially treated domestic sewage (Wu et al., 1997a).

Sublethal Bioassays

It is worth pointing out that the tests described above depend largely on the short-term (acute) responses of organisms to a toxic exposure. Despite the usefulness of these tests in screening for toxicity, there is a need to further ascertain that the chemical in question will not cause any deleterious, chronic effect on the marine biota, especially chronic effects that may affect their long-term sustainability (e.g., through an impairment of future reproductive output, reduced growth rate or post-exposure survival). An assessment of these chronic sublethal effects is important in providing an early warning to prevent irreversible damage to biological systems.

Parallel to the development of the acute tests described above, efforts have also been made in developing sublethal bioassays using local marine invertebrates in Hong Kong. To date, the following sublethal bioassays have been developed and adopted for use by regulatory agencies and local industries:

1. Assay based on the phototactic response of the stage II nauplii of the barnacle, *Balanus amphitrite* (Wu et al., 1997b).

2. Assay based on the swimming speed and patterns of the stage II nauplii of the barnacle, *Balanus amphitrite*, as measured by computerized image capturing and analysis (Wu et al., 1997c).

3. Assay based on the moulting success of the stage II nauplii of the barnacle, *Balanus amphitrite* (Lam et al., in press).

4. Assay based on the percentage settlement of the cyprid larvae of the barnacle, *Balanus amphitrite* on an artificial substrate (Wu et al., 1997a).

5. Scope for growth (SfG) assay using an intertidal marine gastropod, *Nassarius festivus*. This assay estimates the amount of energy available to growth and reproduction as an integrative measure of the energy status of an organism at a particular time. Three critical components (food consumption, egestion and respiration) are required in order to calculate the overall SfG (Wo et al., in press).

Although these bioassays are available, it is anticipated that it will be some time before these protocols are adopted for routine use by regulatory authorities in Hong Kong and the region.

Should Sensitive or Tolerant Species be Used?

In Hong Kong, the recently enacted Environmental Impact Assessment Ordinance (Cap. 499) makes it a statutory requirement that environmental impacts resulting from development projects must be fully considered before the grant of environmental permits. In the EIA processes, scientific data on the water quality requirements, tolerances and responses of the local marine biota are not only essential in the evaluation and prediction of specific, cumulative and residual impacts, but are also important in devising cost-effective mitigatory measures, evaluating and choosing alternatives, as well as setting standards in the subsequent monitoring and audit programs.

It is worth noting that even phylogenetically related species may have very different sensitivity or tolerance to the same chemical/stressors (Wu, 1981, 1990). Table 4 shows the acute cadmium toxicity values for larvae of certain marine and estuarine crustaceans used for toxicity tests. The large variations in their tolerance towards the same chemical (i.e., cadmium) highlights the potential difficulties involved in deciding which species to use in a particular test.

Table 4. Acute Cadmium Toxicity Values for Larvae of Marine and Estuarine Crustaceans (data from Wright and Frain, 1981; Thorpe and Costow, 1989; Ward, 1989).

Test species	Time (hr)	LC_{50} (µg/L)
Mysidopsis bahia	96	30
Homarus americanus	96	78
Eurytemora affinis	96	150
Cancer magister	96	247
Cancer irroratus	96	250
Paragrapsus quadridentatus	96	490
Marinogammarus obtusatus	96	3,500

The use of sensitive species in ecotoxicological assessment may result in "over-protection" of the environment (i.e., increasing the chance of making a type-I error), while the use of tolerant species may lead to "under-protection" (a type-II error). The former may result in wastage of valuable resources which should be better targeted to protecting genuinely vulnerable systems, while the latter will lead to inadequate protection and, hence, damage of ecological systems and deprive society of important ecosystem services. Because of the above difficulties, Wu (1981) advocated that selection of test species should be based on their ecological/commercial importance in the receiving environment rather than availability.

Conclusion

Although in recent years significant progress has been made in developing ecotoxicological tests as part of a suite of environmental management tools for the marine environments in Hong Kong and the region, much more efforts are required to make explicit the applicability, limitations and value of these tools to environmental managers, as well as other stakeholders. There is clearly still a long way to go in the development and implementation of a truly integrated approach and strategy for coastal management in the region. A concerted regional effort is required to achieve this important goal.

References

Lam, P.K.S., K.T. Wo and R.S.S. Wu. Effects of cadmium on the development and swimming behaviour of barnacle larvae *Balanus amphitrite* Darwin. Environ. Toxicol. (In press)

Morton, B. and R.S.S. Wu. 1975. The hydrology of the coastal waters of Hong Kong. Environ. Res. 10: 319-347.

Rand, G.M. 1995. Fundamentals of aquatic toxicology: Effects, environmental fate, and risk assessment. 2nd ed. Taylor & Francis, London. 1125 p.

Russo, R.C., D.J. Randall and R.V. Thurston. 1988. Ammonia toxicity and metabolism in fishes, p. 159-173. *In* R.C. Ryans (ed.) Protection of river basins, lakes and estuaries. Special publication. American Fisheries Society, Bethesda, Maryland.

Thorpe, G.J. and J.D. Costow. 1989. The relation of the acute (96-h) uptake and subcellular distribution of cadmium and zinc to cadmium toxicity in larvae of *Rhithropanopeus harrisii* and *Palaemonetes pugio*, p. 82-94. *In* U.M. Cowgill and L.R. Williams (eds.) Aquatic toxicology and hazard assessment. Vol. 12. ASTM STP 1027. American Society for Testing and Materials, Philadelphia.

Ward, S.H. 1989. The requirements for a balanced medium in toxicological experiments using *Mysidopsis bahia* with special reference to calcium carbonate, p. 402-412. *In* U.M. Cowgill and L.R. Williams (eds.) Aquatic toxicology and hazard assessment. Vol. 12. ASTM STP 1027. American Society for Testing and Materials, Philadelphia.

Wo, K.T., P.K.S. Lam and R.S.S. Wu. A comparison of growth biomarkers for assessing sublethal effects of cadmium on a marine gastropod, *Nassarius festivus*. Mar. Pollut. Bull. (In press)

Wright, D.A. and J.W. Frain. 1981. Cadmium toxicity in *Marinogammarus obtusatus*: Effect of external calcium. Environ. Res. 24: 338-344.

Wu, R.S.S. 1981. Difference in toxicities of an oil dispersant and a surface active agent to some marine animals and their implications in the choice of species in toxicity testing. Mar. Environ. Res. 5: 157-163.

Wu, R.S.S. 1990. Environmental tolerance of some marine fish: Applications in mariculture management, p. 197-207. *In* R.C. Ryan (ed.) Proceedings of the International Symposium of Fish Physiology, Fish Toxicology and Fisheries Management. U.S. Environmental Protection Agency, Athens.

Wu, R.S.S., P.K.S. Lam and B.S. Zhou. 1997a. A settlement inhibition assay with cyprid larvae of the barnacle *Balanus amphitrite*. Chemosphere 35: 1867-1874.

Wu, R.S.S., P.K.S. Lam and B.S. Zhou. 1997b. A phototaxis inhibition assay using barnacle larvae. Environ. Toxicol. Wat. Qual. 12: 231-236.

Wu, R.S.S., P.K.S. Lam and B.S. Zhou. 1997c. Effects of two oil dispersants on phototaxis and swimming behaviour of barnacle larvae. Hydrobiologia 352: 9-16.

Wu, R.S.S. and N.Y.S. Woo. 1985. Respiratory responses and tolerance to hypoxia in two marine teleosts, *Epinephelus akaara* (Temminck & Schlegel) and *Mylio macrocephalus* (Basilewsky). Hydrobiologia 119: 209-217.

Management Atlas Preparation and Applications

James N. Paw

Subdivision for Pollution Response and Technical Co-operation
Marine Environment Division
International Maritime Organization
4 Albert Embankment
London SE1 7SR, United Kingdom

PAW, JAMES N. 1999. Management atlas preparation and applications, p. 419-437. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

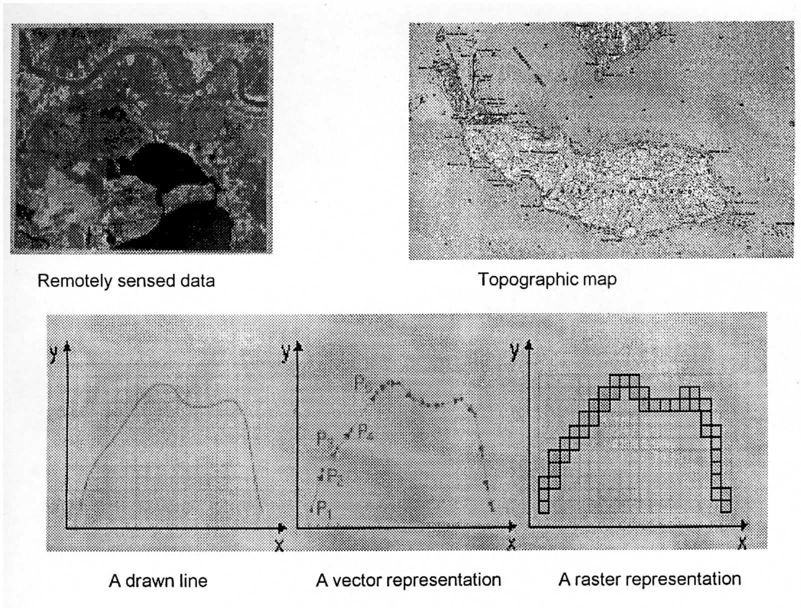
Abstract

Environmental management atlases are thematic information packages in printed or electronic formats consisting of spatial information of a planning or target area structured to respond to a given set of environmental management objectives. These atlases are highly visual and portable documents/systems which can be utilized for analytical and educational purposes. Electronic atlases, in particular, can be highly interactive and analytical with the integration of simulations and multimedia. Salient aspects of preparation and production of printed and electronic atlases are discussed including comparison of their features. Existing and potential applications are also covered, as well as potential development trends.

Introduction

Planning and management of human affairs and the environment require information that will provide the knowledge to address the problems, constraints and challenges facing them, as well as to chart the direction of development. To be effective, information needs to be managed in a manner that will allow timely access and use and ensuring quality control and relevance. Computers have a tremendous impact on information management by making it possible to use and manipulate various information types in a common platform. This is specially true for geo-referenced information such as digital maps.

Figure 1. Various Presentations of Spatial Information—Maps and Digital Format.



Maps are important reference materials and tools for the proper planning and management of land and water resources including awareness of one's location and geographical understanding of the environment. Maps represent the abstraction of real world objects and phenomena in paper form. With the advancement in information technology, maps are also available in digital format through the process of digitization or scanning apart from those generated by other means (e.g., remotely sensed data) (Figure 1). Because of varying scales and projections, it is often difficult to compare maps without first transforming them into a common system. With computers, this comparison is relatively easy, particularly with the use of geographic information system (GIS) and digital cartography.

GIS has greatly revolutionized how spatial information (i.e., maps and attribute information) is used, making it possible to combine various datasets through modelling and query including area analysis. Ideally, spatial information resides best in GIS. However, GIS requires substantial capital outlay that includes data acquisition, maintenance and training. Oftentimes, where such system is in place, access to the database can be restricted because of proprietary or similar considerations, as well as the learning curve to use the system requires technical training of the user. To offset these constraints and to disseminate spatial information to a wide range of users, it is possible to package the spatial data generated by the GIS into thematic information systems without the technical sophistication of

GIS. These thematic information systems are generally called atlases, which can be generated in printed and electronic formats. The purpose of this paper is to present the experiences and lessons learned in packaging spatial data into a management atlas for environmental management, the process involved, its applications and potential direction of development. In this paper, the atlas in both the printed and electronic formats is covered but emphasis is given to the latter and oriented towards environmental management.

Management Atlas

There is actually no acceptable definition of a management atlas. Generally, a compilation of maps is known as an atlas whether or not there is a definitive structure (Kraak and Ormeling, 1996). In this paper, a management atlas is defined as a compilation of maps of a planning or target area (e.g., region, body of water, country or district) with relevant text and graphics and structured to respond to a given set of environmental management objectives. In electronic atlases, analytical and mathematical models are sometimes hyperlinked to enable users to interactively undertake assessment that will generate various scenarios for a particular problem. On the other hand, the link between an atlas and GIS is indirect. GIS generates most of the data in the atlas and at the same time, it can be used to refine the output of the atlas. While it is possible also to incorporate some of the functionalities of GIS into the atlas, some computer programming may be required. Many electronic atlases are not closed systems where certain information is stored in another program like a relational database management system or GIS.

While this approach allows the user to have online or real-time access to data, there is also the likelihood that datasets can be tampered. In this paper, an electronic management atlas is designed as a closed system to minimize unauthorized revision or changes on the datasets. Although spatial data are available in the Internet and structured like an electronic atlas, such system is distinct from the management atlas referred to in this paper. It is important that electronic environmental management atlases are closed systems because information generated from them will be used for decision-making, training and enhancing perception or acceptability by the public with respect to certain environmental management issues. As such, the output has legal, institutional and behavioral implications.

Environmental management is obviously a very broad topic. Hence, environmental management atlases need to be more specific in their objectives and target users. Objectives can respond to integrated coastal management (ICM), environmental impact assessment (EIA), risk assessment and risk management, environmental and socioeconomic interactions, environmental monitoring, physical framework planning, critical or special area management, environmental sensitivity mapping, resource allocation, marine pollution management and prevention, facility site evaluation and public awareness, among others. Target users range from students to decision-makers, field technicians to planners and resource managers. Both the objectives and the target users determine in part the contents and design of the atlas.

PREREQUISITES TO PREPARING THE ATLAS

The preparation of an atlas should be considered as a project in itself. Technical staff involved in the atlas preparation should have sufficient background in cartography and GIS. A programmer may be included depending on the level of computer programming required. Although inputs (e.g., spatial information) to the atlas can be prepared by a variety of techniques, this paper stresses the linkage with GIS as the major source of spatial data. The objectives and target users of the atlas generally determine staff composition. Subject specialists should be recruited either on a part-time or full-time basis to provide guidance on what information to include and how to assess data quality and presentation, among others. The rest of the technical staff will be responsible for the production of quality output (digital or paper maps, text, graphics) and the atlas. Production of the atlas can also be contracted out to companies or printeries, especially if in-house technical expertise and capability are limited.

The advantages of GIS-generated spatial data are: 1) datasets are in a common scale, projection and platform, 2) regular updating of data is relatively easy including conversion, 3) datasets can be further analyzed in the GIS providing value added information for the atlas, 4) datasets can be converted to other format and exported to other program, 5) quality control is possible, and 6) datasets can be configured to meet specific objectives of the atlas.

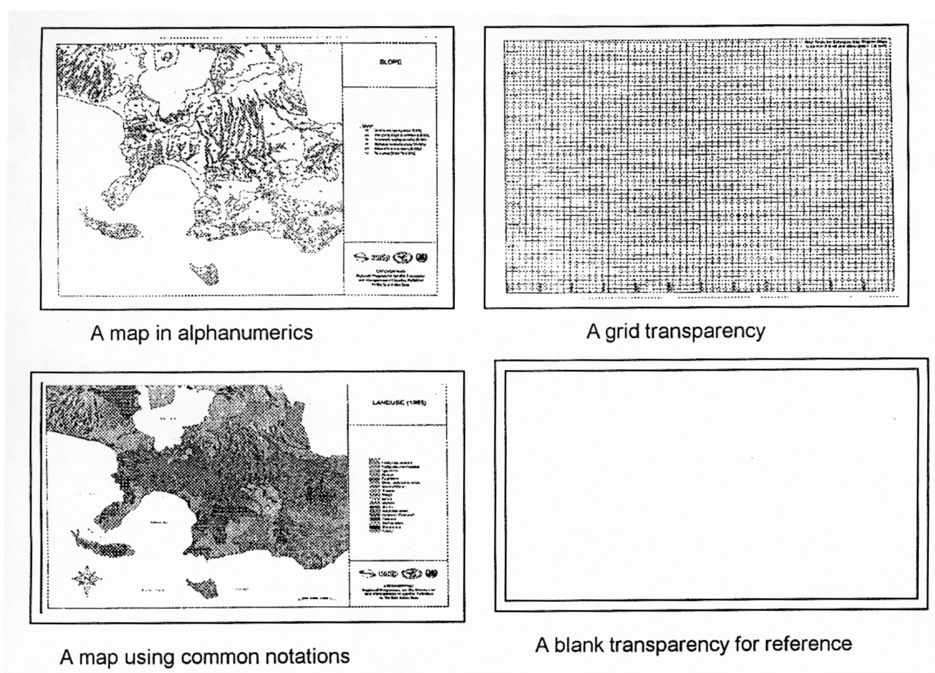
Source materials for the atlas are maps, hydrographic charts, printed and electronic documents, databases and remotely sensed data, among others, which have proprietary or copyright conditions. If atlases are to be distributed free of charge except mailing cost, it is important to secure permission from copyright owners early on in the project timetable to waive license fees or to avoid legal entanglements on the use of the source materials and their information contents. Acknowledgment of individuals and institutions who have made contributions and provided assistance to the project should be included in the citation section of the atlas.

Designing the Atlas

The design of the atlas is dependent on the objectives and target users as well as cost (level of programming required, contents, analytical and presentation functionalities, among others). Printed atlases are relatively easy to prepare as the design is simple and straightforward. Electronic atlases range from view-only to analytical types (Kraak and Ormeling, 1996).

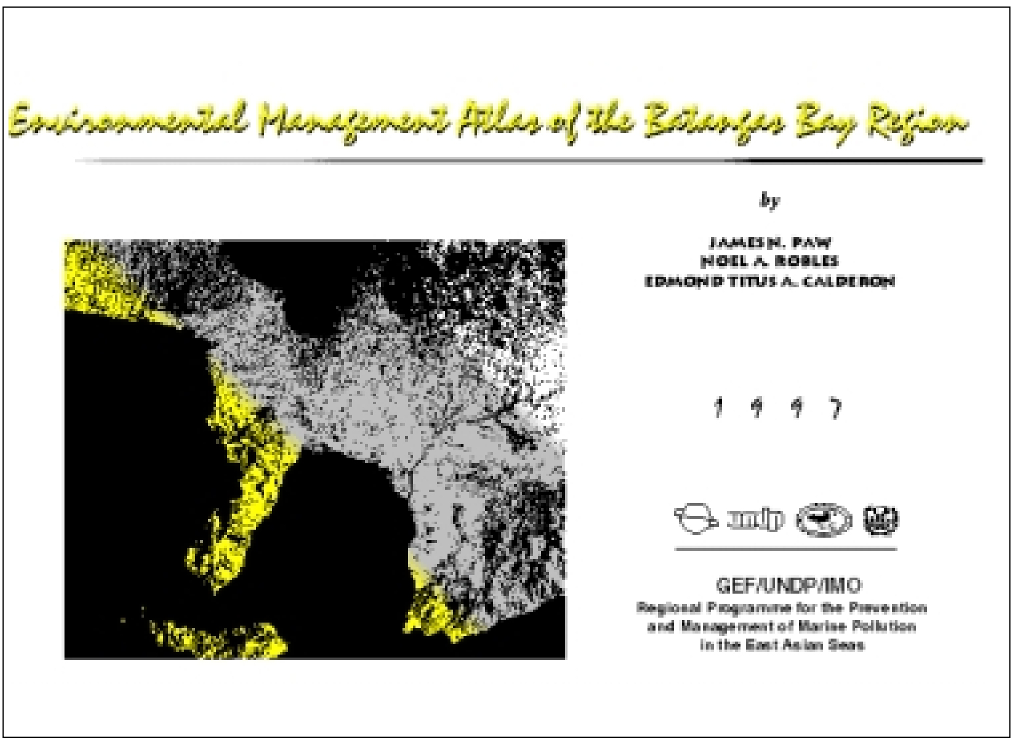
Printed atlases. The design of a printed atlas can be simple without text and graphics. In certain types, text and graphics are included in an introductory chapter and the rest are purely maps. Functional printed atlases should have a technical description of each map alongside it and should include technical data and graphics. Grid and map transparencies should be incorporated as tool kits to enable users to undertake a simple two-map overlay, measure distance and area and locate a geographic entity in the map (Figure 2).

Figure 2. A Simple Tool Kit for a Functional Printed Environmental Management Atlas.



Maps in the atlas should be arranged in a manner that will provide an overview of the planning or target area, especially the resources found therein (e.g., soil, land use, slope, water bodies, etc.), the socioeconomic and institutional characteristics (e.g., population profile, water use patterns, distribution of infrastructure and economic activities like industries and commercial establishments) and the major issues of spatial concern. The latter topic provides a multiuser and multidimensional perspective of the planning or target area directed at major management issues affecting it. The maps categorized under this latter topic should be the result of modelling, synthesis of spatial information that respond to certain environmental management concerns, proposed or potential spatial use patterns such as zoning and specific environmental management concerns that have spatial impacts (Figure 3). The maps to be included in the atlas will of course vary depending on the objectives. For example, if the atlas will cover mainly chemical pollution on land and water, there is no need to include maps like land use and biodiversity. In certain situations, however, it is necessary to alter the context of a given map to be of relevance (e.g., maps showing land use units that can be correlated with pollution or maps showing biomes that are vulnerable to certain type of pollutants).

Figure 3. The Batangas Bay Region Management Atlas.



For printed atlases, it is important to determine the level of analysis that will be required as this has bearing on the details of geographic entities and the scale of the map to be printed relative to paper size. Generally, an A3 paper size (297 x 420 mm or 11.7 x 16.5 inches) is suitable and besides, very limited printers can accommodate paper of larger size. With A3 paper size, the scale of the map can range from 1:50,000 to 1:300,000 depending on the level of subarea partitioning required. It is not advisable to print maps larger than 1:50,000 if the scale of the source maps in the spatial database is mostly 1:50,000, especially the base map. With respect to the level of analysis to be performed on the maps, the geographic entities should be visually detectable or measurable when two or more maps are overlaid and with the use of grid transparency. Certain environmental issues need to be assessed at larger scale. Hence, the atlas should have maps on specific areas covering such issues (e.g., a particular community or bay). In subarea partitioning, it is important that the scale of the map to be printed should not exceed the base map scale. It should also be thematic to allow analysis.

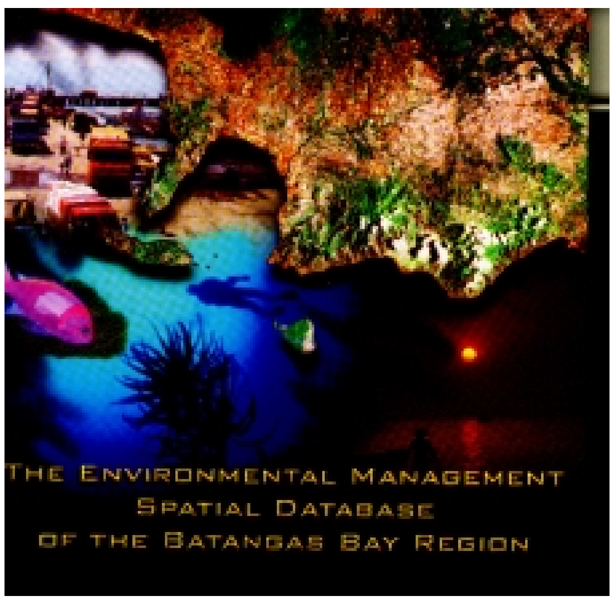
Colored maps have better visual impact than maps in greyscale. The disadvantages of using colored maps, however, are high cost in production, information cannot be transferred readily because most cost-effective copying or transmitting equipment are monochromatic (greyscale) and there is a limitation in the number of colors that can be used to represent spatial entities (note that varying tones or hues can expand the range of colors that can be used but are difficult to capture when doing a reproduction of the map).

Icons and symbols are important elements in maps. It is important to use them where appropriate, particularly for point data like lighthouses, buoys and buildings. To illustrate or identify geographic entities that are obviously area-based, using icons and symbols is generally not visually effective and can be confusing unless such entities are well dispersed or limited in distribution. Otherwise, such entities are shown as polygons or may be transformed in the GIS as interpolated zones. In the text, icons and symbols must be described in detail. An extension of symbols is the use of alphanumerics, especially to describe area-based geographic entities like a land use unit or an administrative boundary. The character string should be short, concise and unique (no duplication). The alphanumerics are very useful when doing overlays which allow geographic entities to be discerned with clarity unlike shaded polygons.

Electronic atlases. In general, electronic atlases require some computer programming to construct the atlas shell. Programming can be time-consuming and expensive. As yet, there is no commercially available electronic atlas authoring system so that most atlases produced so far have been developed independently (Smith and Parker, 1995). An emerging trend which is very much influenced by

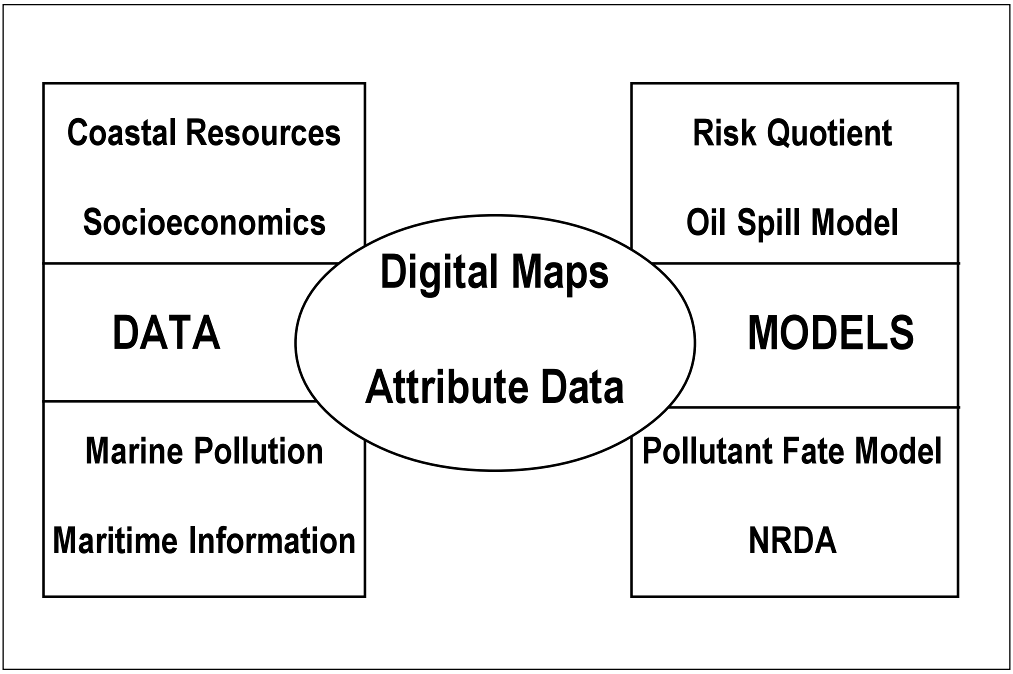
GIS is the use of visualization or presentation software to display, print and query spatial data. Such software is often marketed by the company which developed the GIS that is used to produce the digital maps. The advantage of this approach is that data need not be converted to another format and the whole system can be customized. However, certain software require a key (plus license) and fees, and therefore, are costly for mass dissemination (assuming they are not for sale). Shareware can also be used but payment is still needed except for distribution. Freeware do not require a key and fees. These software are interactive and have certain GIS functionalities like spatial search, editing and distance measurements. They can be customized but multimedia add-ons are limited. An example of a GIS-based freeware atlas is the CD-ROM Environmental Management Spatial Database of the Batangas Bay Region (Paw et al., 1998) (Figure 4).

Figure 4. The CD Jacket of the Batangas Bay Region Spatial Database.



Highly interactive atlases with graphics, videos, sound, animation and model simulations require programming and may take months to complete (Kraak and Ormeling, 1996). Target users of these atlases, however, may be more specialized. Also, these atlases are costly to prepare and datasets can easily be dated. It is important that such atlases have provisions for updating but it should not be costly. Atlases are meant for wide distribution and the integrity of the datasets should be safeguarded. Thus, the editing component of the electronic atlases

Figure 5. Straits of Malacca Environmental Information System.



should be limited to onscreen manipulation (e.g., changing palette or classification), the save file function should be directed outside of the system (e.g., another drive/directory) and returns the system to default (i.e., to the original datasets) when operation is terminated.

It is important to distinguish various electronic atlases based on data manipulation and data editing. Some electronic atlases produced are open systems, especially those using shareware although these can be configured to be closed systems. Open systems can allow data manipulation onscreen and editing of the database (e.g., saving new changes) while in a closed system, onscreen manipulation is possible but no editing of the database (i.e., saving outside of the system may be possible, thus, maintaining the integrity of the database). With respect to an electronic environmental management atlas, it must be a closed system. Similar but open systems should either be called simply as electronic atlases or information systems. A schematic representation on the difference between an electronic environmental management atlas and similar systems is shown in Figure 5.

Computer platform is an important consideration. Windows NT and Windows 95/98 command a very big market. Macintosh and UNIX are also popular. It is possible to program the atlas to make it portable for different platforms but it will depend on the target users and budget.

CONTENT, PRESENTATION AND PREPARATION OF THE ATLAS

Basically, atlases should be partitioned into sections covering an overview to integrated concerns (in the case of printed atlases and view-only electronic atlases) or specific analytical modules (for analytical/interactive electronic atlases). Text, graphics, videos, animation and music should be used whenever possible to enhance visual/audio impact, quality and relevance. To reach a wider audience, the preferred language is English. However, it is sometimes necessary to use local dialect or other languages to reach specific target users. Whenever possible, the atlas should be produced in other languages/dialects, especially if the target area cuts across boundaries of countries and regions and are non-English speaking countries.

Printed atlases. Maps to be printed should have some of the basic elements found in topographic maps and navigational charts such as the North arrow icon, scale bar, frame, graticule, coordinates, legend, title/labels, source and date. Map and grid transparencies should have special labels to match them with the paper maps or transparencies during the overlay process. Lithographic printing of the maps will provide a better quality output than by photocopier and plotter. Laser printers also produce quality maps but paper size and texture can be a problem. For colored atlases, the geographic entities in the map transparencies should be streamlined by depicting few classes (1 to 9 classes) so that information is easier to discern and transfer, especially during map overlay. The number of classes to be shown will depend on the size and number (density) of polygons in each class. More classes can be displayed if polygon size is small and density is low. The logo of the institutions preparing and sponsoring the publication of the atlas should be included alongside the legend serving as marker of ownership/copyright of the map.

The number of maps to be used in the atlas will depend on the relative importance of each of the digital map in the database as well as the cost. More maps would be good as long as they are useful, not costly and difficult to produce and will not make the atlas bulky. A 250-page atlas would be a manageable document.

The legend should be described in detail in the text that accompanies each map. Text is a very important component of a functional printed atlas for it provides the technical description of the map together with supplementary information that is not readily displayed as geographic entities (Paw et al., 1997). The text can consist of the following sections:

- Relevance - highlights the importance or usefulness of the map for the given objectives;

- Description - describes the contents of the map, the characteristics and importance of the geographic entities and provides additional quantitative or technical information derived from technical reports and publications, census and analysis of spatial data in the GIS;

- Data source and quality - describes how the map was constructed, the source and form (or type) of data used, the technique of map construction, particularly derived data (model result) and the reliability of the data used in the map; and

- Reference - cites the reports and documents used in the construction of the map and the sources of the information provided under the section on description.

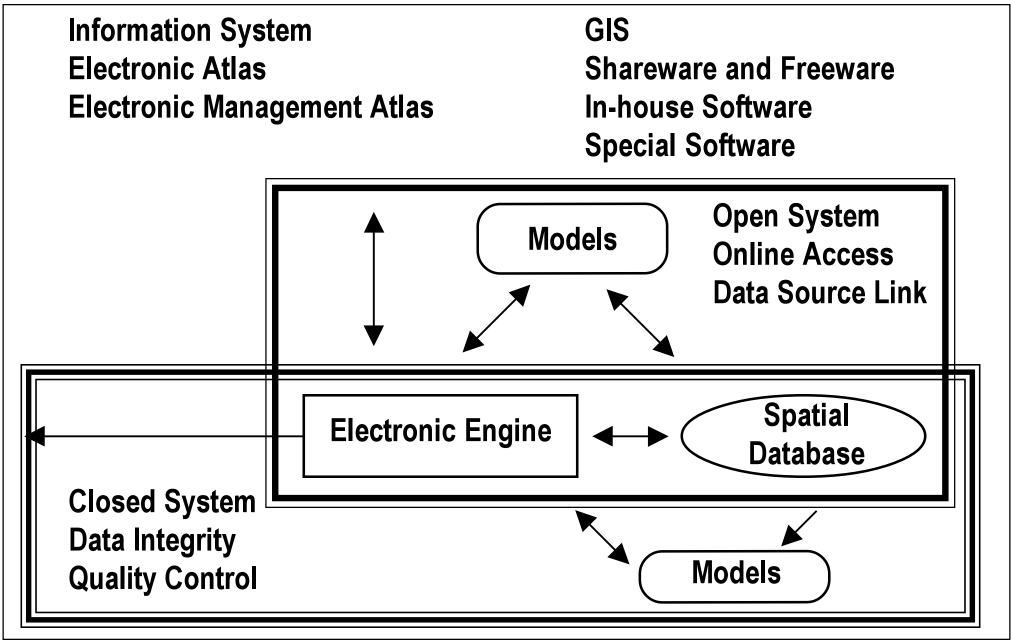
Graphics like charts/bars, drawings and photographs should be included to enhance information and visual impact. Placement of the text is effective if alongside the corresponding map, that is, on the left side if the binding is on the left as in conventional books and documents. The text can be constructed using word processors capable of integrating images and graphics.

Apart from text that explains the map, a brief profile of the planning or target site should be provided including acknowledgment, citations and index (optional), as well as foreword and title page.

Map transparencies need not have all the basic elements found in the paper map except the title/labels, frame and the North arrow icon. These elements should be included in the paper map so that map transparencies will not be cluttered thereby enhancing clarity during the overlay process. Map and grid transparencies should be labelled properly by subject and scale to avoid mixup during overlay.

<u>Electronic atlases.</u> Information in the electronic atlases can be much larger and better in presentation than in printed atlases. Electronic atlases can have dynamic and non-linear features that allow better visual and audio impact through incorporation of sound/music and animation (multimedia), as well as perform simulation as in the case of the Malacca Straits marine pollution atlas which includes models like oil spill trajectory, risk assessment and natural resource damage assessment (MPP-EAS, 1999) (Figure 6). The integration of multimedia into the atlas

Figure 6. A Schematic Diagram on the Difference Between an Electronic Atlas and an Electronic Environmental Management Atlas.



also allows for user interaction with the system. Some electronic atlases start operation by showing a map which enables the user to zoom or pan for detailed view (Kraak and Ormeling, 1996). However, information in management atlases is best presented in a series of chapters and sections based on topic. The interactiveness among the components of the atlas will depend on the software (if one uses a shareware or freeware) or the level of programming required and ultimately, the budget.

Most electronic atlases do not have a map overlay capability but it is possible to incorporate a simple two-map overlay. The animation aspect provides a sequential viewing of spatial and temporal changes over a given area including flow (e.g., pollutant discharge). The text can be verbalized alongside video and graphics display. One of the important features of electronic atlases is the comparison of datasets over time, across geographical boundaries and thematic concerns. For example, changes over time on a particular theme such as population or income can be displayed all in one screen for easier visual comparison. Of course, it can also be visualized through animation. A similar procedure can be done for scenarios generated by electronic atlases that have built-in analytical models. The operation of analytical models or standard procedures (e.g., for planning) should allow the user to have the feeling of participation as if it is an actual situation similar to simulations used in training pilots (Kraak and Ormeling, 1996; MPP-EAS, 1999). Such interaction not only provides the user with the information required, it also serves as a training tool.

In the case of the Batangas CD-ROM which used a freeware as the core system, a multimedia was built around it (Paw et al., 1998). The multimedia served as the launching system of the freeware and does not have direct link/interaction with the spatial database. The salient features of the Batangas CD-ROM are shown in Table 1. The interactiveness of the Batangas CD-ROM is limited by the freeware. It was not possible to configure the freeware because of proprietary reasons other than making minor adjustments like changing the drive of the directory and suppressing certain functions which were undertaken with the consent and assistance of the freeware developer.

Table 1. Salient Features of the Batangas Bay CD-ROM (Paw and Robles, in press).

System Component	Features
Freeware	• File format of the datasets is compatible with the freeware so there is no need for data format conversion • Does not require key to operate and can be widely distributed as a stand alone system (generally free of charge) • Meets requirement for visualization (onscreen display, zoom, pan and query) and presentation (recomposing map, printing) • Amenable for configuration and linkage to multimedia
Multimedia	• High graphics with music • Menu and submenu buttons • Text is scrollable • Launches the freeware-spatial database
Spatial Database	• Onscreen display of maps and attribute information including text describing each map • Digital maps can be printed as graphic files • Attribute information tagged to each map • Query function such as measure distance and associate attribute information with the corresponding map/area • Map overlay can be performed indirectly using the printed maps (in transparencies)

Production of the Management Atlas

Most of the components and features required in the preparation of a management atlas have been described earlier. The next stage will be the layout of the atlas. For printed atlases, this is quite straightforward but for electronic atlases, closer interaction with the programmer is required.

Printed atlases. Maps and text should be individually prepared. It would be good to have a dummy version as a reference to prepare the actual atlas. For offset printing, one can use an electronic version to print quality maps and text directly but many printeries do not have this capability. An alternative is to print a master copy using special printers. Manual adjustment and intervention may be necessary like printing some portions of the map and text separately and manually pasting them but this procedure can also be done during offset printing. It is important that there is close coordination between the atlas project staff and the printery to ensure accuracy and quality output.

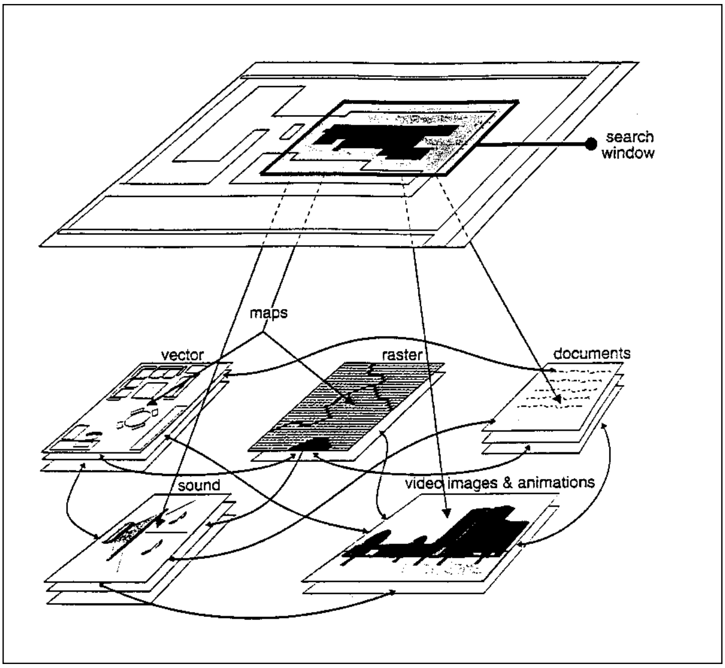
Electronic atlases. Once all the materials for the atlas have been prepared, a programmer will then write the atlas shell and put the components into the proper form. Close interaction and coordination among the project staff and the programmer are necessary. Testing and debugging phases will be required until the system is running smoothly. A master CD-ROM is then produced. Aside from the CD-ROM, the CD face and packaging should be prepared. A manual on how to use the system is also an important item to produce.

Unlike shareware and freeware which do not need conversion of digital maps, programming to create the atlas shell requires some configuration of the digital maps as loss of topology is possible. This can be achieved by using hypermaps which enable the geo-referencing of all the components in the system allowing spatial and thematic navigation around the data (Kraak and Ormeling, 1996) (Figure 7).

Comparison Between Printed and Electronic Atlases

The choice to produce either a printed management atlas or an electronic version is dependent on many factors but is largely influenced by the need for spatial information, cost and time factors. Table 2 provides a comparison between printed and electronic atlases.

Figure 7. Principles of Hypermap in Electronic Atlases.



Source: Kraak and Ormeling (1996).

Application of the Management Atlas

Management atlases are self-contained and stand alone systems. Outputs from these systems are generally for presentation and are very rarely to feed other systems. For example, maps produced from an electronic atlas can be exported to graphics or word processing software which are mainly for display. Data generated from atlases are seldom used as direct inputs to analytical software (usually, the transfer is by manual encoding) and maps generated will not easily fit into GIS.

As a stand alone system, an atlas has the advantage of providing geographic information to a wide range of users and can be accessed by different platforms and from different locations (i.e., portability). Thus, one can bring the atlas to the field (i.e., in the planning or target area) and be able to generate accurate information (or a first stage approximation) that will respond to some issues or problems being addressed. Validation of the result of the atlas can be done using GIS or other analytical software where such facilities are available.

Table 2. Comparison Between Printed and Electronic Atlases.

Features	Printed Atlas	Electronic Atlas		
Information content	Limited	Large	Large	Very large
Visual impact	Good, especially colored	Good, may be enhanced with high graphics	Good, may be enhanced with high graphics, videos and animation	Good, may be enhanced with high graphics, videos, animation and simulation
Cost	Relatively inexpensive to expensive (colored)	Relatively inexpensive to expensive (data sets)	Relatively inexpensive to expensive (multimedia and programming)	Expensive
User friendliness	Yes	Dependent on programming	Dependent on programming	Dependent on programming
Portability	Yes, but not easy to handle	Yes, particularly using laptop computers	Yes, particularly using laptop computers	Yes, particularly using laptop computers
Preparation	Relatively not difficult and not time consuming	Can be difficult and require at least 6 months	Can be difficult and require at least 6 months	Difficult, require 6 months to 1 year
Programming required	None	Intensive	Intensive to very intensive	Very intensive
Target users	General	General	General to specialized	General to specialized
Information query	Linear	Linear/Hierarchical	Dynamic and non-linear	Dynamic and non-linear
Navigation	Linear	Dynamic	Dynamic	Dynamic
Printing/save file function	Not applicable	Program and hardware dependent	Program and hardware dependent	Program and hardware dependent
Analytical functionality	Very limited	Limited	Yes, interactive query	Yes, simulation possible
Multimedia	None	Yes	Yes	Yes
Data alteration	Possible	Dependent on programming	Dependent on programming	Dependent on programming
Comparison of geographic entities	Indirect	Yes	Yes	Yes

A management atlas can cover a wide range of applications like ICM and risk assessment, as well as specialized ones such as facility site selection and critical area/special area management. Some existing and potential applications of environmental management atlases are shown in Table 3.

CONCLUSION

Environmental management atlases are specially packaged spatial information which are stand alone systems. The functionality of management atlases can be enhanced through the integration of analytical models whereas the use of multimedia, especially animations like 3-D representations can significantly improve visual impact and user understanding of the topics being covered (Kraak and Ormeling, 1996). Because it is a self-contained system, the contents of the atlas, particularly certain spatial information, can easily be outdated. Revision is relatively simple for printed and view-only atlases. However, interactive and analytical atlases that have been developed (that is, no definite atlas shell) may not be easy to update and upgrade. Depending on the long-term strategy with respect to packaging of spatial information, an institution tasked to develop and distribute it needs to make some provisions to update and/or upgrade the atlas. In developing the atlas shell, therefore, some algorithms to allow system update and/or upgrade at a fraction of the cost of development should be incorporated. This setup will enable the management atlas to maintain its viability over a longer time period.

Linkage of electronic atlases with other analytical systems (as source of information) has not been demonstrated except those developed using shareware (e.g., ARC View) which in most cases, are ported-down versions of GIS (Rystedt, 1995; Cauneau et al., 1998). A potential use of electronic management atlases would be in that direction quite similar to electronic navigational charts (ENCs) displayed by an electronic chart display and information system (ECDIS). The ECDIS is being used in the maritime industry which will eventually replace manual charting for route planning and monitoring (Riggs, 1998; Tashereau, 1998). In this context, the electronic management atlas will be used as a data/information source that could be plugged-in to, for example, onboard systems (like transport), decision-support systems, educational programs and environmental monitoring systems (e.g., to provide information on the probable direction of a given phenomenon or a pollutant based on simulation). Such direction of potential development for electronic management atlases, however, will have implications on data quality, accuracy, cost, performance standards and legal considerations.

Table 3. Examples of Existing and Potential (P) Applications of Management Atlases in the Coastal and Marine Environments.

		Electronic Atlas		
Application	**Printed Altas**	**View-only**	**Interactive**	**Analytical**
Integrated Coastal Management (Planning and Management)	Batangas Bay Management Atlas (Paw et al., 1997)		CD-ROM Batangas Bay Spatial Database (Paw et al., 1998)	P; Inclusion of multicriteria evaluation techniques (MCE), benefit-cost analysis (BCA)
Marine Pollution			Atlas for Oil Pollution Response in the Event of Marine Accidents (Cauneau et al., 1998)	P; Inclusion of pollutant fate model and natural resource damage assessment (NRDA)
Ecology/Marine Science			P; Multimedia and 3-D animation	P; Inclusion of biodiversity models, resource and damage assessment methods
Environmental Impact Assessment				P; Inclusion of statistical methods with high visual impacts, BCA
Risk Assessment and Risk Management				Malacca Straits Atlas (MPP-EAS, 1999)
Socioeconomic Impact Assessment				P; Inclusion of MCE, NRDA, BCA, statistical methods
Public Awareness			P; Multimedia with 3-D	P; Simple simulation models
Marine Biodiversity			P; Multimedia with 3-D	P; Simulation models on effects to environment and climate, NRDA, BCA, MCE
Critical Area/Special Area Management Environmental Sensitivity Mapping			P; Multimedia with 3-D	P; Inclusion of assessment techniques, management and monitoring procedures with high visual impact
Resource Allocation				P; Inclusion of econometric models
Facility Site Assessment				P; Inclusion of MCE, BCA, 3-D simulation
Environmental Monitoring			P; Inclusion of multimedia with 3-D to illustrate trends and findings	P; Inclusion of statistical analysis with high visual impact
Marine Environment			P; Inclusion of multimedia with 3-D animation	P; Inclusion of various models on marine pollution, resource assessment, monitoring, statistical analysis with high visual impact

References

Cauneau, F., J. Denis, L. Kerambrun and M. Serbaji. 1998. Atlas pour la preparation a la lutte et pour la lutte contre les pollutions marines accidentelles. Application a la region de Sfax (Tunisie). UNEP and IMO. France.

Kraak, M.J. and F.J. Ormeling. 1996. Cartography: Visualization of spatial data. Addison Wesley Longman, England.

MPP-EAS. 1999. SMEIS (Straits of Malacca Environmental Information System). GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Paw, J.N., N.A. Robles and E.T.A. Calderon. 1997. Environmental management atlas of the Batangas Bay region. MPP-EAS Technical Report No. 14, 144 p. plus 20 transparencies. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Paw, J.N., N.A. Robles and E.T.A. Calderon. 1998. CD-ROM Environmental management atlas of the Batangas Bay region. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Paw, J.N. and N.A. Robles. An electronic atlas for environmental planning and management: The spatial database of Batangas Bay region, Philippines. Cartographic Perspective. (In press).

Riggs, N. 1998. S-57 ENC's and updating service now available in Canada. Maritime 11: 67-68.

Rystedt, B. 1995. Current trends in electronic atlas production. Cartographic Perspective 20: 5-11.

Smith, R.M. and T. Parker. 1995. An electronic atlas authoring system. Cartographic Perspective 20: 35-39.

Tashereau, A. 1998. Impact of the introduction of ECDIS on flow of marine transportation in the Saint Lawrence River. Maritime 12: 86-89.

THE APPLICATION OF SCIENCE AND TECHNOLOGY IN MARINE ENVIRONMENTAL MANAGEMENT

Helen T. Yap

The Marine Science Institute
University of the Philippines
Diliman 1101, Quezon City, Philippines

YAP, HELEN T. 1999. The application of science and technology in marine environmental management, p. 438-446. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

ABSTRACT

Marine environmental problems worldwide have achieved a level of urgency. Concerted efforts to address such problems matured as early as the 1960s with the establishment, for example, of the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), an independent advisory body to several agencies of the United Nations system. Even then, however, approaches to marine environmental problems tended to be fragmented and sometimes too academic to find immediate practical application. Nowadays, there are attempts to revitalize the whole approach to marine environmental management by creating active interfaces among the natural sciences, the social sciences, economics and politics. The tendency, however, still seems to exist of different sectors talking "at" rather than "to" each other. In the agenda of marine environmental management, societal goals have to be properly articulated and then comprehended by the scientists themselves! Once mobilized in the right direction, scientists can put to good use a whole suite of modern technological tools. The rest of society, especially political leaders, for their part must learn to accept prescriptions of scientists as the best possible products of objective assessment and evaluation, and which should serve as the basis for the formulation of policies and strategies for a sustainable world.

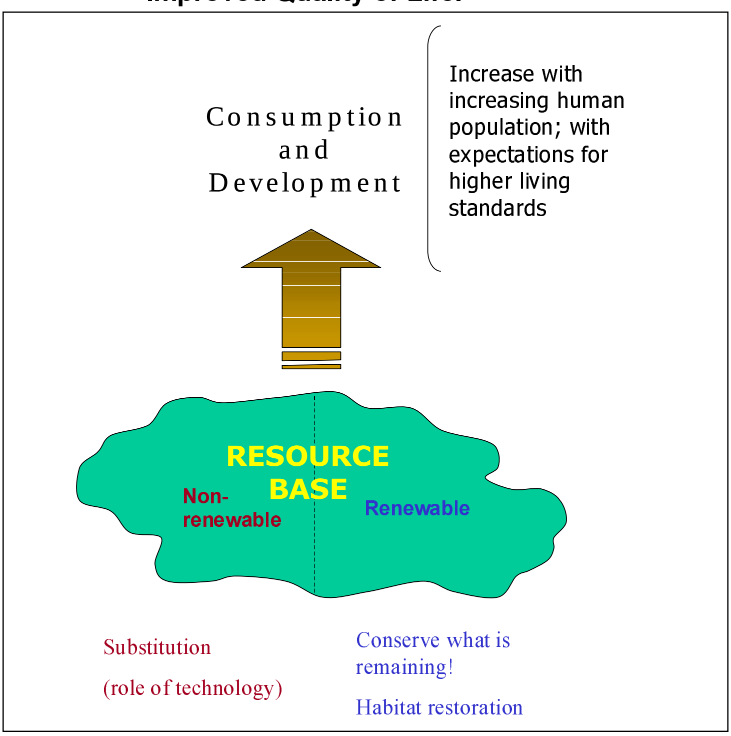
INTRODUCTION

There is a general consensus among many ecologists that their science has come of age. In other words, ecology is much less of a "guessing game" (i.e., relying for the most part on "what if" scenarios with relatively low statistical confidence levels); ecology is now ready to provide hard, precise answers to difficult questions with relatively good chances of success (see, for example, discussions by Ehrlich, 1989; Christensen et al., 1996; Botsford et al., 1997). The questions referred to are, in this context, those posed by managers of the use of natural resources. The focus will be on the marine environment.

Unfortunately, many scientists, despite their excellent repertoire of scientific tools and knowledge, still are unable to communicate effectively with managers. The term "manager" refers not to a single type of individual, but to people invested with a range of functions, from top-ranking political leader, to a town mayor, a barrio captain, or even the head of a nongovernment organization (NGO). And there are a whole variety of NGOs! This inability to communicate effectively surfaces as one reason why many initiatives at integrated coastal management (ICM) are not as effective as they should be (Yap, 1996).

The goals of ICM should be formulated by the people themselves (and not dictated by scientists). If such goals are articulated at the societal level, then they generally express a desire for a certain *quality of life* (Figure 1). They should not

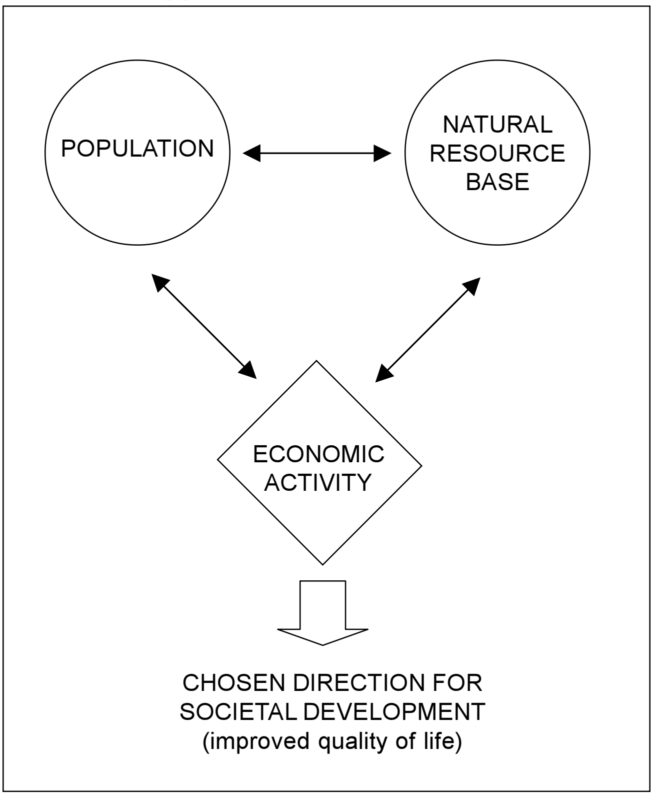
Figure 1. Basis of Societal Decisions Towards an Improved Quality of Life.



be piecemeal or fragmented. They would not center on conservation alone, or cleaning up polluted bodies of water only, although such elements are certainly essential in an overall management strategy. They would address environmental protection, but in a broader context of improving food production, human health, general living conditions, as well as generating opportunities for further societal advancement. And to all of these, scientists *must listen!* (If people in the barrios are going to demand more cars or television sets, are conservation scientists going to oppose this? Otherwise, how should they go about dealing with this?)

One critical role of scientists is in the recognition that the natural resource base is limited and finite (Figure 2). This relatively fragile base is what humanity depends on for its continued survival. Added to this is an inexorable rise in human population growth, with concomitant increasing demands for better standards of living.

Figure 2. The Nature of the Resource Base that Sustains All Human Life, and How to Approach its Management.



The natural resource base can be divided into the renewable and the non-renewable components (Figure 2). The renewable component is made up primarily of the living resources which are the objective of conservation efforts. The non-renewable component consists basically of mineral ores and the like that are not replaceable after they are used up. However, technology exists to recycle these, or to provide *substitutes*. Another emerging role of science and technology is in the restoration of degraded habitats which enhances the renewable component of the natural resource base.

The Application of Science

For a scientist, the use of science in marine environmental management is obvious. This paper focuses largely on the role of the natural sciences.

Science must be applied in order to determine the scope and to comprehend a problem properly, if a problem exists. Since, in the ocean, the medium of interest is water, then the principles and tools of PHYSICAL OCEANOGRAPHY must be utilized in order to understand the properties of the medium, its movement, how it affects the delivery of energy and materials (e.g., transport of heat, recruitment of organisms), and how it acts to connect habitats.

MARINE CHEMISTRY is needed to identify and quantify components that are found in the water medium, and which would affect marine life. Pollutants such as certain organic compounds and heavy metals are measured using chemical techniques.

Since, in almost all cases of marine environmental management, the biota or living resources are of prime interest, then basic BIOLOGY is critical for the comprehension of the life history strategies, physiology, reproduction and genetic affinities of marine organisms. The science of ECOLOGY would then bring together findings from physical oceanography, chemistry and biology for a broad understanding of important organisms in the context of their environment, and how they relate to one another. Only then can resources be properly managed.

For all of the above, a suitable monitoring system is usually required to detect changes in the marine environment that may be due to adverse human impact against a background of natural variability. Results of monitoring would indicate to a manager whether there is improvement brought about by management intervention, or whether a different kind of intervention must be devised to effect positive change.

GESAMP

A major effort by scientists to consolidate state-of-the-art findings in a form suitable for management use is represented by the initiatives of the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP). GESAMP was established in 1969 (Pravdic, 1981) originally as the Joint Group of Experts on the Scientific Aspects of *Marine Pollution* [italics mine]. In order to reflect expanding needs and concerns, the name of the group was changed in the early 1990s to the present one. To date, it is still the only INDEPENDENT scientific body providing advice to a number of United Nations agencies which serve as its joint sponsors. The advice of the Joint Group is published in a reports and studies series, and a list of pertinent titles is provided in Table 1.

THE APPLICATION OF TECHNOLOGY

Marine science has, in its repertoire, a whole suite of technologies which are continually improved on (in addition to being regularly invented) in order to serve the fields of physical oceanography, marine chemistry, biology and ecology. In 1998, the Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF) convened a workshop to explore the applicability of certain classes of emerging technologies to marine environmental problems in developing countries (STAP, 1998). The technologies examined by the STAP workshop experts fall into the following categories: remote sensing, autonomous instruments (including buoys), analytical techniques (chemical), biological indicators, prognostic modeling, data assimilation, geographic information systems, expert systems and information highways.

Many of these technologies are already routinely operational in developed countries. Their active use is being advocated, for example, in the Global Ocean Observing System (GOOS) being administered by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Education, Scientific and Cultural Organization (UNESCO). Table 2 contains a selected listing of technologies which are appropriate for coastal oceanographic work, and hence are relevant in coastal management programs.

Finally, brief mention was made earlier of the possible use of technology to substitute for natural products that are becoming scarce due to overharvesting or irreversible exploitation. A terrestrial example is the use of wood substitutes in construction to alleviate the problem of diminishing tree cover all over the world. Possibilities of this or another nature also exist for the marine environment, but this is not the subject of the present paper.

SCIENTISTS AND MANAGERS MUST TALK "TO" AND NOT "AT" EACH OTHER

As mentioned earlier, the apparent failure of scientists to communicate effectively with managers is a problem which persists until now. In the author's own experience, scientists are perceived as arrogant even by the communities they

Table 1. GESAMP Reports and Studies.

No. 2:	Review of harmful substances (1976)
No. 17:	The evaluation of the hazards of harmful substances carried by ships (1982)
	• Revision (1989)
No. 22:	Review of potentially harmful substances. Cadmium, lead and tin (1985)
No. 28:	Review of potentially harmful substances. Arsenic, mercury and selenium (1986)
No. 29:	Review of potentially harmful substances. Organosilicon compounds (silanes and siloxanes) (1986)
No. 34:	Review of potentially harmful substances. Nutrients (1990)
No. 42:	Review of potentially harmful substances. Choosing priority organochlorines for marine hazard assessment (1990)
No. 46:	Review of potentially harmful substances. Carcinogens: Their significance as marine pollutants (1991)
No. 3:	Scientific criteria for the selection of sites for dumping wastes into the sea (1975)
No. 7:	Scientific aspects of pollution arising from the exploration and exploitation of the sea-bed (1977)
No. 16:	Scientific criteria for the selection of waste disposal sites at sea (1982)
No. 19:	An oceanographic model for the dispersion of wastes disposed of in the deep sea (1983)
No. 5:	Principles for developing coastal water quality criteria (1976)
No. 11:	Marine pollution implications of coastal area development (1980)
No. 30:	Environmental capacity. An approach to marine pollution prevention (1986)
No. 43:	Coastal modelling (1991)
No. 45:	Global strategies for marine environmental protection (1991)
No. 54:	Guidelines for marine environmental assessment (1994)
No. 55:	Biological indicators and their use in the measurement of the condition of the marine environment (1995)
No. 61:	The contributions of science to integrated coastal management (1996)
No. 62:	Marine biodiversity: patterns, threats and development of a strategy for conservation (1997)
No. 6:	Impact of oil on the marine environment (1977)
No. 12:	Monitoring biological variables related to marine pollution (1980)
No. 20:	Marine pollution implications of ocean energy development (1984)
No. 50:	Impact of oil, individual hydrocarbons and related chemicals on the marine environment, including used lubricant oils, oil spill control agents and chemicals used offshore (1993)
No. 24:	Thermal discharges in the marine environment (1984)
No. 40:	Long-term consequences of low-level marine contamination: An analytical approach (1989)
No. 32:	Land-sea boundary flux contaminants: Contributions from rivers (1987)
No. 47:	Reducing environmental impacts of coastal aquaculture (1991)
No. 52:	Anthropogenic influences on sediment discharge to the coastal zone and environmental consequences (1994)
No. 57:	Monitoring of ecological effects of coastal aquaculture wastes (1996)
No. 65:	Towards safe and effective use of chemicals in coastal aquaculture (1997)
No. 13:	Interchange of pollutants between the atmosphere and the oceans
	• Part I (1980)
	• Part 2 (1985)
No. 36:	Pollutant modification of atmospheric and oceanic processes and climate: Some aspects of the problem (1989)
No. 38:	Atmospheric input of trace species to the world ocean (1989)
No. 48:	Global changes and the air-sea exchange of chemicals (1991)
No. 59:	The sea-surface microlayer and its role in global change (1995)
No. 15:	The review of the health of the oceans (1982)
No. 39:	The state of the marine environment (1990)
No. 58:	The invasion of the ctenophore *Mnemiopsis leidyi* in the Black Sea (1997)

Table 2. Proven Technologies for Continuous/Automatic and *in situ* Measurements and for Routine Monitoring (Coastal GOOS; IOC, 1997).

Variable	Instrument/System/Platform (Satellite/Buoy)
Sea level/tides	Tide gauges (pressure and acoustic), seabed echosounder (inverted echosounder), satellite altimeter
Meteorological variables, e.g., air temperature, atmospheric pressure, humidity, wind velocity and direction, solar radiation	Land-based observation and data collection platforms, buoys and observation towers with telemetry using VHF, HF and satellites, ship-borne deck/bridge observations
Photosynthetically available radiation	*In situ* sensors
Wave period, height	Wave rider buoys, with telemetry, satellite-based synthetic aperture radar (SAR)
Wave direction, frequency spectra	Shore-based radar, wave directional buoys with telemetry
Sea surface temperature	*In situ* sensors, satellite radiometers, drifting buoys
Surface currents	Shore-based high frequency radars (e.g., OSCR, CODAR), wind-sea coupled models, ADCP, moored and drifting buoys
Vertical profile of currents	ADCP, current meters
Salinity	*In situ* sensors, discrete samples, buoy-mounted sensors
Dissolved oxygen	*In situ* sensors, discrete samples, buoy-mounted sensors
Ocean color (surface chlorophyll)	Ocean color scanner
Turbidity and suspended sediments	*In situ* sensors, bottom mounted acoustic instruments, satellite optical sensors, moored buoys
Reflectance (oil spill detection)	Satellite-based radiometers
Precipitation	Radar

hope to serve, whether this is conscious on their (the scientists') part or not. Even worse, many stakeholders still believe that scientists tend to put their own agenda above everything else, even if the efforts concern resource conservation. Hence, even psychological and sociological barriers must be surmounted for an effective application of science and technology in marine environmental management.

Another way of looking at it is to view science as just another sector of society. (It is the belief of many a scientist that the power to save the world is in their hands, but surely this is true also for a politician, a religious leader, etc.) Hence, different sectors of society must talk "to" one another in the hope of pursuing a common goal.

On the part of the scientist, an important step would be to DELIBERATELY formulate scientific questions around an appropriate management template (see, for example, Table 3). This should ensure that results of scientific investigations are directly useful and applicable in the solution of marine environmental problems.

Table 3. Scientific Questions Relevant to the Degradation, Management and Restoration of Coastal Habitats (modified from GESAMP, 1996).

What is the scale of habitat destruction?

- Logically first question to be addressed
- Perceived magnitude of problem dictates subsequent scientific and management action
- Aided by technological tools such as remote sensing, acoustic surveys of sediments
- Refer to historical records and anecdotal evidence

What are the natural processes that maintain habitat integrity?

- For example, productivity; trophic relationships; and competition and predation

What are the dynamic linkages among habitats that need to be considered in maintaining sustainable use of their resources?

- For example, recruitment and migration of organisms; upstream-downstream movement of materials and/or energy

Can the links between habitat degradation and human activities be quantified?

- For example, changes in patterns of resource use; application of technology to exploit resources; and pollution

How many species are actively dependent on the habitats concerned?

Are all species equally important for conservation purposes?

What are the spatial and temporal scales of natural habitat recovery?

- Affects decisions on necessity of management intervention
- Needs insights into natural processes underlying recovery

Which species play a key role in natural recovery processes?

- For example, in productivity; nutrient cycling; competition; and predation

REFERENCES

Botsford, L.W., J.C. Castilla and C.H. Peterson. 1997. The management of fisheries and marine ecosystems. Science 277: 509-515.

Christensen, N.L., A.M. Bartuska, J.H. Brown, S. Carpenter, C. D'Antonio, R. Francis, J.F. Franklin, J.A. MacMahon, R.F. Noss, D.J. Parsons, C.H. Peterson, M.G. Turner and R.G. Woodmansee. 1996. The report of the Ecological Society of America committee on the scientific basis for ecosystem management. Ecol. Appl. 6: 665-691.

Ehrlich, P.R. 1989. Ecology and resource management — is ecological theory any good in practice? p. 306-318. *In* J. Roughgarden, R.M. May and S.A. Levin (eds.) Perspectives in ecological theory. Princeton University Press, New Jersey.

GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine environmental Protection). 1996. The contributions of science to integrated coastal management. Rep. Stud. GESAMP 61. Food and Agriculture Organization of the United Nations, Rome. 66 p.

IOC (Intergovernmental Oceanographic Commission) of Unesco. 1997. GOOS Coastal Module Planning Workshop Report, 24-28 February 1997, University of Miami. IOC Workshop Report No. 131. Unesco, Paris. 30 p. and 8 annexes.

Pravdic, V. 1981. GESAMP: The first dozen years. United Nations Environment Programme, Nairobi. 29 p.

STAP (Scientific and Technical Advisory Panel) of the Global Environment Facility. 1998. Report of the STAP Expert Group Workshop on Emerging Technologies in International Waters and Their Application to GEF Projects, 24-26 February 1998, the Marine Science Institute, University of the Philippines. United Nations Environment Programme, Nairobi. 9 p. and 3 annexes.

Yap, H.T. 1996. Attempts at integrated coastal management in a developing country. Mar. Pollut. Bull. 32: 588-591.

Hypoxia in Coastal Waters: Pressing Problems Worldwide and Their Scientific Challenges

Rudolf S.S. Wu

Centre for Coastal Pollution and Conservation
Department of Biology and Chemistry
City University of Hong Kong
83 Tat Chee Ave., Kowloon, Hong Kong SAR, China

WU, RUDOLF S.S. 1999. Hypoxia in coastal waters: Pressing problems worldwide and their scientific challenges, p. 447-460. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Large-scale hypoxia has become a major problem in coastal waters worldwide, which is likely to be exacerbated in the coming years. Progressive eutrophication and decreases in dissolved oxygen have been observed in many coastal waters and embayments, and many coastal areas are suffering from permanent or periodic anoxia/hypoxia. Large-scale hypoxia/anoxia has already led to major changes in structure and function of coastal systems and the mass mortality of fish and benthos. Both the severity and frequency of large-scale hypoxia in many coastal areas appear to be increasing. Most benthic fauna have adapted to hypoxia and can tolerate it (at least at 2.8 mg O_2/L) for prolonged periods without apparent adverse effects, while hypoxic tolerance of fish appears to be much more variable. While much is known about the biochemical and physiological responses to hypoxia, only scanty information exists on the effects of hypoxia on the ecology of natural populations and communities. Limited studies have shown that hypoxia may change the structure of benthic and fish communities and alter trophic relationships, which may have serious ecological and fisheries implications. Recovery of benthic community from hypoxia in temperate regions may take several years, while recovery may be quicker in the subtropics. Developing ***cost-effective*** *pollution control technologies will be one of the major challenges in the years to come. Deepsea disposal and wetland treatment appears to be cost-effective. To this end, the carrying capacity and no observable effect concentration (NOEC) of coastal waters and wetland systems to organic waste and nutrients need to be determined. The development of specific biomarkers may provide a more cost-effective technology for frequent monitoring of dissolved oxygen over*

large areas. Very few attempts have been made to relate hypoxia to Darwinian fitness traits, or to relate biochemical/physiological responses to significant ecological effects. Future research in this area is required for the better prediction of the ecological risks of hypoxia.

INTRODUCTION

Hypoxia is generally defined as dissolved oxygen levels below 2 mL/L (equivalent to 2.8 mg/L or 47.8 mmHg). Hypoxia may be a natural phenomenon caused by the formation of a thermocline, halocline or pycnocline in a water body. Paleological evidence indicates the occurrence of hypoxia in prehistoric ages (Tyson and Pearson, 1991a, 1991b). In fact, all marine sediments are anoxic a few millimeters below sediment surface. Under normal circumstances, bioturbation is the major mechanism for oxygen replenishment in sediment (Schaffner et al., 1992). Anthropogenic activities contributing to organic pollution and nutrient enrichment/eutrophication have led to large-scale hypoxia over large areas. Some marine systems (e.g., the bottom waters of the Black Sea) are permanently anoxic, while hypoxia or periodic hypoxia are common in many coastal systems (Diaz and Rosenberg, 1995).

Large-scale hypoxia has become a major problem in coastal waters worldwide, and this problem is likely to be exacerbated in the coming years for the following reasons. First, some 65% of existing cities of >2.5 million people are located along the coast at present. By the year 2000, 70% of the world's population (some 4.2 billion) will live within 60 km of the coastline (UNEP, 1991). The volume of wastewater generated by such a huge population is enormous. It should be noted that wastewater treatment (especially nutrient removal) is expensive. For example, the cost of secondary treatment (which removes approximately 90% biological oxygen demand [BOD] and 30 to 40% of N and P, respectively) is some 3 to 4 times more expensive than primary treatment. Due to the high capital and recurrent costs incurred, it is highly unlikely that construction for sewage treatment facilities can match population and gross national product (GNP) growths, at least in developing countries. This implies that an enormous amount of untreated wastewater and nutrients will be discharged into many coastal waters in the coming years.

Second, large-scale clearing of land vegetation and deforestation are occurring at an alarming rate in many parts of the world, and there is no good evidence to suggest that levels of these activities will decrease in the coming years (WRI, 1992). Runoff of nutrients from crop and farm lands are typically an order of magnitude greater than that of pristine forest, and such a large nutrient input from terrestrial runoff has already greatly altered the geological cycle (Gabric and Bell, 1993).

Third, intensive farming practices in the last few decades have added a significant load of nutrients into coastal waters. For example, marine fish farming activities have increased dramatically in the last two decades, and production of marine culture fish is expected to further increase to 1 million tons*/yr by 2025 (New and Csavas, 1995). It should be noted that some 80% of N input into the fish culture systems is lost to the environment, mainly through feed wastage and fish excreta (Gowen and Bradbury, 1987; Handy and Poxton, 1993), and the total nutrient input from increased mariculture activities is significant.

The problem of organic and nutrient enrichment is further augmented by the fact that many of the nutrient and organic inputs are derived from non-point sources. Atmospheric fallout of N is also significant (constituting some 10-50% of the total anthropogenic N input) and is expected to further increase in the coming years (Paerl, 1993). This means that control of discharges is much more difficult.

Global Situation and Trend

Since 1970, progressive eutrophication and decreases in dissolved oxygen have been observed in the Baltic Sea, North Sea, Adriatic Sea, along the Chinese coast and in the Japan Sea (GESAMP, 1990). For example, P and N in the coastal waters of Germany have increased 1.5 and 1.7 times, respectively over the last 25 years (GESAMP 1990); N and P in the Black Sea have increased 5 and 20 times, respectively from the 1960s to the 1980s (Gomoiu, 1992); levels of phosphate and nitrate in the Baltic Seas have increased some 1.5 to 4.5 times from 1970 to 1990 (HELCOM, 1996); P and N in the Dutch Seas have increased 4 times and 2 times, respectively, from 1930s to 1980s (GESAMP, 1990); and the input of N and P into coastal waters of Queensland, Australia has increased by 3 to 5 times in the last 65 years (Moss et al., 1992; Bell and Elmetri, 1995). It is, therefore, not surprising that decreases in dissolved oxygen have been reported in many coastal waters in the USA, Norway, UK, Sweden, Denmark, the Black Sea and the Adriatic Sea in the last 30 to 80 years (Mirza and Gray, 1981; Justic et al., 1987; Weigelt, 1990; Diaz and Rosenberg, 1995). Dissolved oxygen levels <4 mg/L were found in about 40% of 130 estuarine and coastal areas throughout the USA (Whitledge, 1985), and many coastal areas and embayments in Europe, Scandinavia, North America and China are suffering from permanent or periodic anoxia/hypoxia (Wu, 1982; Kuo and Neilson, 1987; Diaz and Rosenberg, 1995). Indeed, large-scale hypoxia/anoxia has already led to major changes in structure and function of coastal systems. Mass mortality of fish and benthos have also commonly been reported in coastal areas all over the world, and both the severity and frequency of large-scale hypoxia in many coastal areas appear to be increasing (GESAMP, 1990; Diaz and Rosenberg, 1995).

* *1 ton = 0.907 tonnes*

BIOLOGICAL AND ECOLOGICAL RESPONSES TO HYPOXIA

Since hypoxia occurs commonly in bottom waters, most benthic fauna have adapted, and can tolerate hypoxia (at least at 2.8 mg O_2/L) for prolonged periods without apparent adverse effects (Diaz and Rosenberg, 1995). However, oxygen concentration becomes critical to benthos at around 2 mg/L, and acute effects generally occur within a very narrow range (1 to 2 mg/L) (Rosenberg et al., 1992; Diaz and Rosenberg, 1995). Hypoxic tolerance of fish, however, appears to be much more variable. For example, the LT_{50} value at 1 mg O_2/L of the red snapper *Chrysophrys major* is only 60 minutes, while the seabass *Lates calcarifer* and the green grouper *Epinephelus tauvina* can tolerate the same level of hypoxia for more than 8 hours without any apparent behavioral changes (Wu, 1990). Active species and predators appear to be less tolerant than sessile species (Wu, 1982; Rosenberg et al., 1992; Diaz and Rosenberg, 1995).

Many studies have been carried out to investigate the biochemical, physiological and organismal responses to hypoxia. In general, several strategies have evolved to deal with hypoxia. Avoidance of hypoxic waters has been reported in fish and crustaceans under both laboratory and field conditions (Pihl et al., 1991; Diaz et al., 1992). For example, the shrimp *Metapenaeus ensis* has been shown to avoid hypoxic waters and move towards normoxic waters (Wu et al., in prep.). Animals may tolerate or adapt to hypoxia by reducing their activities and metabolism, so as to reduce their energy expenditure and hence oxygen requirements (Hill et al., 1991; Dalla-Via et al., 1994). Facing falling oxygen concentrations, animals may enhance oxygen uptake and delivery of oxygen to essential tissues. This may be achieved through increase in red blood cell production, increase in hemoglobin-oxygen affinity and increase in ventilation and oxygen transport. If hypoxia persists for prolonged periods, animals may resort to enhanced supply of oxygen from anaerobic sources (Holeton and Randall, 1967a, 1967b; Burggren and Randall, 1978; Woo and Wu, 1984; Dunn and Hochachka, 1986; Chew and Ip, 1992; Randall et al., 1992).

While much is known about the biochemical and physiological responses to hypoxia, limited studies have been carried out to determine the effects of hypoxia on natural populations and communities. Hypoxia may eliminate sensitive species, thereby limiting their natural distribution and changing the structure (species composition, dominance and diversity) of benthic and fish communities (Rosenberg et al., 1992; Diaz and Rosenberg, 1995). Persistent hypoxia over large areas has been shown to alter trophic relationships (Wu, 1982; Breitburg, 1992; Kimor, 1992), which may lead to major ecological consequences. Pihl (1994) related the shift from demersal to pelagic fish to hypoxia in bottom waters. Such a shift may be caused by elimination of sensitive demersal species or their natural prey items, or a combination of both. Occurrence of hypoxia appears to favor the dominance of small size prey with a shortened life cycle (opportunistic species), as well as small size fish (Harper et al., 1991; Diaz and Rosenberg, 1995). The above changes may have long-term fisheries implications. A decrease in dominance of predators, reflecting fundamental changes in trophic structure of a benthic community has been demonstrated along a gradient of decreasing oxygen levels (Wu, 1982). Various studies have reported the emergence of benthos from their burrows during hypoxia (Baden et al., 1990; Vismann, 1990; Tyson and Pearson, 1991b; Nilsson and Rosenberg, 1994). Weigelt and Rumohr (1986) reported mass catches of moribund polychaetes and migration of fishes into nearshore waters during oxygen depletion. Such behavioral changes may make animals much more vulnerable to their natural predators. Indeed, Breitburg et al. (1994) demonstrated an increase in predation on the goby *Gobiosoma bosc* by the sea nettle and a corresponding decrease in predation by the striped seabass and adult gobies. Likewise, Pihl et al. (1992) demonstrated a general shift of natural diet of demersal fish from crustaceans to polychaetes and echinoderms in a hypoxic coastal system. Effects of such dietary change on the structure and function of ecosystems and fisheries production, however, remained unknown.

Recovery

Recovery of natural communities from hypoxia is poorly known, although such information is obviously important from an environmental management point of view. Limited studies in Europe and Scandinavia have shown that recovery of benthic communities after hypoxia caused by algal bloom may take some 2-8 years (Diaz and Rosenberg, 1995). Macrobenthic communites in Gullmarsfjord did not reestablish 18 months after a major hypoxic event (Josefson and Widbom, 1988). Likewise, little or no recovery was found after two years in the Kathegat after benthic defaunation caused by hypoxia (Rosenberg et al., 1992), and the nematode community in Swedish waters did not return to its original state a year after complete defaunation caused by hypoxia (Austen and Wibdom, 1991). Studies carried out in the subtropics, however, provide evidence that recovery may be much quicker and may only take a few months to a year, although it is not sure whether the community has fully been restored to the original state (Wu, 1982; Gamenick et al., 1996; Lu and Wu, 1998; Wu and Shin, 1998). Diaz and Rosenberg (1995), however, are of the view that no large marine ecosystem has recovered after development of persistent hypoxia or anoxia.

Development of Cost-effective Pollution Control Technologies

There is little argument that the best way to prevent or minimize the occurrence of hypoxia is by source reduction of nutrients and organic inputs. To this end, substantial changes in current land-use and farming practices are required. Source reduction of nutrient and waste is, however, very expensive. For example, reduction of N by 50% from a population of 85 million people in the Baltic Region is estimated at US$20 billion (HELCOM, 1996). While there is no shortage of pollution control technology for removing organic waste and nutrients from wastewater, the main problems lie with cost-effectiveness, especially considering that the volume of wastewater required for treatment is enormous. No significant adverse effects have been found for deepsea disposal, thus far, and such disposal methods should remain a practical and cost-effective option. The same, however, cannot be said for disposing wastewater in coastal waters with limited carrying capacity. The trigger level of the Baltic Sea from oligotropy to eutrophy is estimated at somewhere between 0.05 to 0.25 g-P and 1 to 3.5 g-N/m^2/yr (Vollenweider, 1992). The trigger level of algal blooms in Hong Kong coastal waters is estimated at 1 mg-N/L (Wu et al., in press). While the concept of NOEC has been used extensively in ecotoxicology, there are few studies which apply such a concept to the determination of carrying capacity, and the NOEC of coastal waters to organic waste and nutrients.

Wetlands are effective means for removing organic waste and nutrients from wastewater. It has been shown that natural wetland can remove some 70-90% BOD, 94% of P and 77% of N from wastewater (Patruno and Russel, 1994; Hiley, 1995; and Thomas et al., 1995). The major limitation of this treatment method is the long retention time and low loading rate, and the long-term viability of using wetland for treating large volumes of wastewater has yet to be firmly established. Nevertheless, the use of wetlands for nutrient and organic waste removal may be an attractive option for developing countries where construction of treatment facilities may not be affordable.

Development of Cost-effective Monitoring Techniques

Regular monitoring of dissolved oxygen levels is essential to provide an early warning and to protect the health of coastal systems. Currently, this is done by regular measurement of dissolved oxygen in water (using oxygen electrodes or chemical methods such as Winkler titration). Since daily variations of oxygen levels are typically large, and hypoxic events are unpredictable over a large area, it is not cost-effective to monitor oxygen frequently over a large region and over a long period. Recently, biomarkers have been developed to provide time-integrated information on the levels of contaminants (mainly trace metals and xenobiotics such as polycyclic aromatic hydrocarbons [PAHs], organophosphates and organochlorines) in the aquatic environment (Peakall, 1992; Depledge, 1993). The use of biomarkers as an early warning system in pollution monitoring not only alleviates the difficulties of frequent and large-scale sampling, but also provides information on biological effects. Although there have been many studies of the responses of fish to hypoxia (e.g., Holton and Randall, 1967a, 1967b; Burggren and Randall, 1978; Wu and Woo, 1985; Dunn and Hochachka, 1986; Val et al., 1995), only limited attempts have been made to identify possible biomarkers for hypoxia in aquatic systems (Foerlin et al., 1996). Field transplantation experiments carried out by Wu and Lam (1997) indicated that activities of glucose phosphate dehydrogenase (G6PDH) and lactate dehydrogenase (LDH) in adductor muscles of the green lipped mussel *(Perna viridis)* showed a significant, negative correlation with dissolved oxygen levels at the transplantation sites.

To be useful in environmental monitoring, biomarkers should be specific, reasonably long lasting and easy to determine (Peakall, 1992). Although many physiological and biochemical changes in organisms can be associated with hypoxia, most of these changes are non-specific. For example, the activities of LDH in many fishes not only increase during hypoxia, but also with a fall in temperature (Pierce and Crawford, 1997). Thus, measurement of LDH alone would not be a reliable biomarker for hypoxia, unless all other factors are constant. Although much is known about the responses of fish to hypoxia, it is not clear which response is specific to hypoxia. Recent studies showed certain biochemical changes (e.g., Epiotein and Hypoxic Inducible Factor 1) in mammalian tissue culture may be specific to hypoxia (Wang and Semenza, 1993; Jelkman, 1994), and the use of these biochemical changes as specific hypoxic biomarkers in practical monitoring should be explored.

Relating Biochemical and Physiological Responses to Ecological Effects

While much is known about the tolerance of animals to acute hypoxia and biochemical and physiological responses of animals to hypoxia, surprisingly, the effects of hypoxia (especially long-term hypoxia) on growth and reproduction of marine animals are poorly understood. A recent study by Keckeis et al. (1996) showed reduced hatching success and deformation in fish *(Chondrostoma nasus)* when exposed to hypoxia. Thus far, very few attempts have been made to relate hypoxia to Darwinian fitness traits (e.g., growth and reproduction), or to relate observed biochemical/physiological responses of marine animals to population effects and significant ecological consequences. The paucity of data, therefore, does not permit us to extrapolate many of the observed biochemical and physiological responses to population consequences in ecological risk assessment. Research contributing to such information gaps would be extremely useful in environmental management.

REFERENCES

Austen, M.C. and B. Wibdom. 1991. Changes in and slow recovery of a meiobenthic nematode assemblage following a hypoxic period in the Gullmar fjord basin, Sweden. Mar. Biol. 111: 139-145.

Baden, S.P., L.O. Loo, L. Phil and R. Rosenberg. 1990. Effects of eutrophication on benthic communities including fish: Swedish west coast. Ambio 19: 113-122.

Bell, P.R.F. and I. Elmetri. 1995. Ecological indicators of large-scale eutrophication in the Great Barrier Reef lagoon. Ambio 24: 208-215.

Breitburg, D.L. 1992. Episodic hypoxia in Chesapeake Bay: Interacting effects of recruitment, behaviour and physical disturbance. Ecol. Monogr. 62: 525-546.

Breitburg, D.L., N. Steinberg, S. DuBeau, C. Cooksey and E.D. Houde. 1994. Effects of low dissolved oxygen on predation on estuarine fish larvae. Mar. Ecol. Prog. Ser. 104: 235-246.

Burggren, W.W. and D.J. Randall. 1978. The pattern of carbon dioxide excretion in the rainbow trout *Salmo gairdneri*. J. Exp. Biol. 72: 17-24.

Chew, S.F. and Y.K. Ip. 1992. Biochemical adaptations of the mudskipper *Boleophthalmus boddaerti* to a lack of oxygen. Mar. Biol. 112: 567-571.

Dalla-Via, J., G. VnD. Thillart, O. Cattani and A.D. Zwaan. 1994. Influence of long-term hypoxia exposure on the energy metabolism of *Solea solea*. 2. Intermediary metabolism in blood, liver and muscle. Mar. Ecol. Prog. Ser. 111: 17-27.

Depledge, M.H. 1993. Ecotoxicology: A science or a management tool? Ambio 22: 51-52.

Diaz, R.J. and R. Rosenberg. 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioral responses of benthic macrofauna. Oceanogr. Mar. Biol. Annu. Rev. 33: 245-303.

Diaz, R.J., R.J. Neubauer, L.C. Schaffner, L. Pihl and S.P. Baden. 1992. Continuous monitoring of dissolved oxygen in an estuary experiencing periodic hypoxia and the effect of hypoxia on macrobenthos and fish. Science of the Total Environment (Supplement 1992): 1055-1068.

Dunn, J.F. and P.W. Hochachka. 1986. Turnover rates of glucose and lactate in rainbow trout during acute hypoxia. Can. J. Zool. 65: 1144-1148.

Foerlin, L., S. Phil-Baden, S. Eriksson, A. Granmo, E. Lindesjoeoe, K. Magnusson, R. Ekelund, A. Esselin and J. Sturve. 1996. Effects of contaminants in roundnose grenadier *(Coryphaenoides rupestris)* and Norway lobster *(Nephrops norvegicus)* and contaminant levels in mussels *(Mytilus edulis)* in the Skagerrak and Kattegat compared to the Faroe Island. J. Sea Res. 35: 209-222.

Gabric, A.J. and P.R.F. Bell. 1993. Review of the effects of non-point nutrient loading on coastal ecosystems. Aust. J. Mar. Freshwat. Res. 44: 261-283.

Gamenick, I., A. Jahn, K. Vopel and O. Giere. 1996. Hypoxia and sulphide as structuring factors in a macrozobenthic community in the Baltic Sea shore: Colonisation studies and tolerance experiments. Mar. Ecol. Prog. Ser. 144: 73-85.

GESAMP. 1990. Joint Group of Experts on the Scientific Aspects of Marine Pollution: The state of the marine environment. UNEP Regional Seas Reports and Studies No. 115.

Gomoiu, M. 1992. Marine eutrophication syndrome in the north-western part of the Black Sea, p. 683-696. *In* R.A. Vollenweider, R. Marchetti and R. Vicviani (eds.) Marine coastal eutrophication. Elsevier, Amsterdam.

Gowen, R.J. and N.B. Bradbury. 1987. The ecological impact of salmonid farming in coastal waters: A review. Oceanography. Mar. Biol. Annu. Rev. 25: 263-575.

Handy, R.D. and M.G. Poxton. 1993. Nitrogen pollution in mariculture: Toxicity and excretion of nitrogenous compounds by marine fish. Rev. Fish. Biol. 3: 205-241.

Harper, D.E., L.D. McKinney, J.M. Nance and R.B. Salzer. 1991. Recovery responses of two Gulf of Mexico, p. 49-64. *In* R.V. Tyson and T.H. Pearson (eds.) Modern and ancient continental shelf anoxia. Geological Society (Special Publication 58), London.

HELCOM. 1996. Baltic Sea environment proceedings no. 64B. Third periodic assessment on the state of the marine environment of the Baltic Sea, 1989-1993 Background Document. Helsinki Commission, Baltic Marine Environment Protection Commission. 252 p.

Hiley, P.D. 1995. The reality of sewage treatment using wetlands. Wat. Sci. Tech. 32: 329-338.

Hill, A.D., A.C. Taylor and R.H.C. Strang. 1991. Physiological and metabolic responses of the shore crab *Carcinus meenas* (L.) during environmental anoxia and subsequent recovery. J. Exp. Mar. Biol. Ecol. 150: 31-50.

Holeton, G.F. and D.J. Randall. 1967a. Changes in blood pressure in the rainbow trout during hypoxia. J. Exp. Biol. 46: 297-305.

Holeton and Randall. 1967b. The effect of hypoxia upon the partial pressure of gases in blood and water afferent and efferent to the gills of rainbow trout. J. Exp. Biol. 46: 317-327.

Jelkmann, W. 1994. Biology of erythropoietin. Clinical Investigator 72 (6 Supplement): S3-S10.

Josefson, A.B. and B. Widbom. 1988. Differential response of benthic macrofauna and meiofauna to hypoxia in the Gullmar Fjord basin. Mar. Biol. 100: 31-40.

Justic, D., T. Legovic and S. Rottini. 1987. Trends in oxygen content 1911-1984 and occurrence of benthic mortality in the northern Adriatic Sea. Estuarine and Coastal Shelf-Science 25: 435-445.

Keckeis, H., E. Bauer-Nemeschkal and E. Kamler. 1996. Effects of reduced oxygen level on the mortality and hatching rate of *Chondrostoma nasus* embryos. J. Fish Biol. 3: 430-440.

Kimor, B. 1992. Impact of eutrophication on phytoplankton composition, p. 871-878. *In* R.A. Vollenweider, R. Marchetti and R. Vicviani (eds.) Marine coastal eutrophication. Elsevier, Amsterdam.

Kuo, A.Y. and B.J. Neilson. 1987. Hypoxia and salinity in Virginia estuaries. Estuaries 10: 277-283.

Lu, L. and R.S.S. Wu. 1998. Benthic recolonization on organic polluted sediment Environ. Pollut. 101: 241-251.

Mirza, F.B. and J.S. Gray. 1981. The fauna of benthic sediments from the organically enriched Oslofjord, Norway. J. Exp. Mar. Biol. Ecol. 54: 181-207.

Moss, A.J., G.E. Rayment, N. Reilley and E.K. Best. 1992. A preliminary assessment of sediment and nutrient export from Queensland coastal catchment. Report of Queensland, Department of Environment and Heritage and Department of Primary Industry, Brisbane. 33p.

New, M.B. and I. Csavas. 1995. Aquafeed in Asia: A regional review. Farm made aquafeed. FAO Tech. Pap. 343. 24p.

Nilsson, H. and R. Rosenberg. 1994. Hypoxic response of two marine benthic communities. Mar. Ecol. Prog. Ser. 115: 209-217.

Paerl, H.W. 1993. Emerging role of atmospheric nitrogen deposition in coastal eutrophication: Biogeochemical and trophic perspectives. Can. J. Fish. Aquat. Sci. 50: 2254-2269.

Patruno, J. and J. Russel. 1994. Natural wetland polishing effluent discharging to Wooloweyah Lagoon. Water Sci. Tech. 29: 4.

Peakall, D. 1992. Animal biomarkers as pollution indicators. Chapman and Hall, London.

Pierce, V.A. and D.L. Crawford. 1997. Phylogenetic analysis of glycolytic enzyme expression. Science 276: 256-259.

Pihl, L. 1994. Changes in the diet of demersal fish due to eutrophication-induced hypoxia in the Kattegat, Sweden. Can. J. Fish. Aquat. Sci. 51: 321-336.

Pihl, L., S.P. Baden and R.J. Diaz. 1991. Effects of periodic hypoxia on distribution of demersal fish and crustaceans. Mar. Biol. 108: 349-360.

Pihl, L., S.P. Baden, R.J. Diaz and L.C. Schaffner. 1992. Hypoxia-induced structural changes in the diet of bottom-feeding fish and crustacea. Mar. Biol. 112: 349-361.

Randall, D.J., D.J. McKenzie, G. Abrami, G.P. Boniolotti, F. Natiello, P. Bronzi, L. Bolis and E. Agradi. 1992. Effects of diet on responses to hypoxia in sturgeon *(Acipenser naccarii)*. J. Exp. Biol. 170: 113-125.

Rosenberg, R., L.O. Loo and P. Moeller. 1992. Hypoxia, salinity and temperature as structuring factors for marine benthic communities in a eutrophic area. Neth. J. Sea Res. 30: 121-129.

Schaffner, L.C., P. Jonsson, R.J. Diaz, R. Rosenberg and P. Gapcynski. 1992. Benthic communities and bioturbation history of estuarine and coastal systems: Effects of hypoxia and anoxia, p. 1001-1016. *In* R.S. Vollenweider, R. Marchetti and R. Viviani (eds.). Marine coastal eutrophication. Elsevier, Amsterdam.

Thomas, P.R., P. Glover and T. Kalaroopan. 1995. An evaluation of pollutant removal from secondary treated sewage effluent using a constructed wetland system. Wat. Sci. Tech. 32: 87-93.

Tyson, R.V. and T.H. Pearson. 1991a. Modern and ancient continental shelf anoxia. Geological Society (Special Publication 58), London.

Tyson, R.V. and T.H. Pearson. 1991b. Modern and ancient continental shelf anoxia: an overview, p. 1-24. *In* R.V. Tyson and T.H. Pearson (eds.) Modern and ancient continental shelf anoxia. Geological Society (Special Publication 58), London.

UNEP. 1991. The state of the world environment. United Nations Environment Programme, Nairobi. 48 p.

Val, A.L. and J. Lessard and D.J. Randall. 1995. Effects of hypoxia on rainbow trout *(Oncorhynchus mykiss)*: Intraerythrocytic phosphates. J. Exp. Biol. 198: 305-310.

Vismann, B. 1990. Sulfide detoxification and tolerance in *Nereis (Hediste) diversicolor and Nereis (Neanthes) virens* (Annelida: Polychaeta). Mar. Ecol. Prog. Ser. 59: 229-238.

Vollenweider, R.A. 1992. Coastal marine eutrophication: Principles and control, p. 1-20. *In* R.A. Vollenweider, R. Marchetti and R. Vicviani (eds.) Marine coastal eutrophication. Elsevier, Amsterdam.

Wang, G.L. and G.L. Semenza. 1993. General involvement of *hypoxia-inducible* factor 1 in transcriptional response to hypoxia. Proceedings of the National Academy of Sciences of the United States of America 90(9): 4304-4308.

Weigelt, M. and H. Rumohr. 1986. Effects of wide range oxygen depletion on benthic fauna and demersal fish in Kiel Bay 1981-1983. Meeresforschung 31: 124-136.

Weigelt, M. 1990. Oxygen conditions in the deep water of Kiel Bay and the impact of inflowing salt-rich water from the Kattegatt. Meeresforschung 33: 1-22.

Whiteledge, T.E. 1985. Nationwide review of oxygen depletion and eutrophication in estuarine and coastal waters. Informal Report BNL 37144 NOAA. Rockville, Maryland.

Woo, N.Y.S. and R.S.S. Wu. 1984. Changes in body composition in the red grouper *(Epinephelus akaara)* and the black sea bream *(Mylio macrocephalus)* during hypoxic exposure. Comp. Biochem. Physiol. 77A: 475-482.

World Resources Institute. 1992. World Resources 1992-93. Oxford University Press, Oxford. 369 p.

Wu, R.S.S. 1982. Periodic defaunation and recovery in a subtropical epibenthic community, in relation to organic pollution. J. Exp. Mar. Biol. Ecol. 64: 253-269.

Wu, R.S.S. and N.Y.S. Woo. 1985. Respiratory responses and tolerance to hypoxia in two marine teleosts, *Epinephelus akaara* (Temminck and Schlegel) and *Mylio macrocephalus* (Basilewsky). Hydrobiologia 119: 209-217.

Wu, R.S.S. 1990. Environmental tolerance of some marine fish: Applications in mariculture management, p. 197-207. *In* R.C. Ryan (ed.) Proceedings of the International Symposium of Fish Physiology, Fish Toxicology and Fisheries Management. U.S. Environmental Protection Agency, Athens.

Wu, R.S.S. and P.K.S. Lam. 1997. Lactate dehydrogenase and glucose 6 phosphate dehydrogenase in the green mussel *Perna viridis*: Biomarkers for hypoxia in the marine environment. Wat. Res. 31: 2797-2801.

Wu, R.S.S. and P.K.S. Shin. 1998. Sediment characteristics and colonization of soft-bottom benthos: A field manipulation experiment. Mar. Biol. 128: 475-487.

Wu, R.S.S., K.L. Wan and P.K.S. Lam. Behavioral and cardiac responses of the shrimp *Metapenaeus ensis* to hypoxia. (In prep.).

Wu, R.S.S, P.K.S., Shin. D.W. Mackay, M. Mollowney and D. Johnson. Management of marine fish farming in the sub-tropical environment: A modelling approach. Aquaculture (In press).

How Remote Sensing can Assist in Coordinating Oil Spill Response Planning and Improve Oil Spill Management

Christer Colliander

SPOT Asia, 73 Amoy Street
Singapore 069892

Olov Fäst

Swedish Space Corporation, P.O. Box 4207
S-17104 Solna, Sweden

COLLIANDER, C. and OLOV FÄST. 1999. How remote sensing can assist in coordinating oil spill response planning and improve oil spill management, p. 461-470. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Remote sensing in combination with global positioning system (GPS) and geographic information system (GIS) can be used as a powerful tool for managing an operation spread out over a large area. This paper discusses possible applications of remote sensing in the different phases of an oil spill incident: contingency planning before, overview and response management during and damage assessment after the oil spill incident. The use of these tools will enhance the effectiveness not only of oil spill detection and monitoring but also of the planning and management of the oil spill response.

This paper gives some examples of the technology available today and the potential improvements that can be effected through the application of this technology.

Remote Sensing and GIS

Remote sensing is the technique to collect and analyze electromagnetic radiation at a distance. There are a number of different techniques and technologies used for remote sensing, each designed to be optimal for certain applications. Usually, a combination of sensors is the best way to obtain the necessary information for a specific task or mission. Sensors can be classified as active or passive. The radar is a typical example of an active sensor. It emits its own energy and records how that energy is reflected from the objects that are illuminated. An ordinary photographic camera can, in this respect, be regarded as a passive remote sensing device, where the film records the reflected sunlight from an object and, thus, stores an image of the object.

When speaking of remote sensing, one normally speaks of sensors installed on a satellite or an aircraft. The sensor principle is however often the same in sensors installed at fixed sites on the ground, or on land vehicles or ships. The different platforms all have their unique advantages and disadvantages. Again, a combination could be the best way to obtain the necessary information.

GIS stands for computer systems, hardware and software, that are optimized for handling data with regard to its geographical location (as opposed to organizing it by date, or initial letter or some other criterion). GIS is used for map production, maintenance planning, forestry, agriculture, telecommunications, etc. A variety of complementary information is usually also stored in the GIS, depending on its purpose. GIS designed for oil spill contingency planning would typically contain a fairly sophisticated coastal map, associated with attributes, such as sensitivity to pollution for different areas, etc. For oil spill contingency planning, it would also be interesting to store information on available resources in different areas, etc.

Today, the remote sensing data can be used directly in combination with GIS. This combination provides for a quantum leap in the usefulness both of the GIS and of the remote sensing data. The development in this area is still only in the beginning and holds great promise for the future.

Already today, GIS using remote sensing data as map overlay is a very effective tool for qualified contingency planning and implementation of a program for coastal zone management.

Planning the Response

Airborne and Satellite Remote Sensing to Gather Background Information for Oil Spill Contingency Planning (Colliander, 1997)

The first step of any planning process is to get a clear picture of the problem. In planning the protection of a coastal zone, the nature and location of the sensitive areas, as well as of the potential threats have to be analyzed.

In GIS, data can be organized in a manageable form. As a basis for the oil spill contingency plan, available information on ship movements, as well as statistics on accidental and intentional discharges at sea need to be collected and organized.

Optical sensors on satellites such as Landsat and SPOT are well suited to map the vegetation in the coastal zone. The data can be analyzed to produce environmental sensitivity maps, another important basis for the contingency plan.

Active sensors on satellites such as ERS and RADARSAT can be used for gathering data on ship movements and oil spills at sea. Their all-weather imaging capability makes them very useful as complements to the optical sensors.

Both for planning the response and for assessing damage if it occurs, a time series of what the coastline has looked like can be very valuable. The existence of vast archives of satellite data provides the possibility to study temporal changes in the past, at different times of the year, etc. The satellite data alone do not give complete information, but they give a snapshot of the situation in a wide geographic area, and combined with other information give a very clear overview picture. For planning purposes, and as a check on other information, such as recent changes that have not yet entered into available maps, the satellite imagery is an extremely cost-effective and powerful tool. Based on the satellite imagery, the detailed aerial and ground surveying can be focused, and thus conducted in a manner that saves both time and resources.

On a smaller scale, people record data about a coastline they are responsible for on a portable computer with GIS software, in order to have the data available and well structured if and when a spill threatens to hit the shore. This database can be used both to plan and to organize the cleanup measures—how to use the given conditions of the area in the best way. In a stressful situation, it is also invaluable to have a clear and well structured idea of what areas have to be protected first.

These private *ad hoc* GIS databases can be very effective on a small scale. They tend to have the most value when used by the same person that entered the data to support his memory of exactly what this or that shoreline actually looked like.

In order to use the same technique on a larger scale, some standardization is needed. Once this standardization has come about, which should normally occur with the maturing of technology, a much more widespread use is possible.

One could see an extensive use of this technology by large organizations in the future, integrating known data such as statistics on ship traffic with large-scale observation such as overviews in satellite images and detailed observation such as photography/video recording and beach inspection. This will generate very powerful databases on which to base the contingency plans.

A mode of operation, which is entirely feasible using technology available today, is to analyze some overviews based on data from optical satellites, then select areas in the satellite image that are particularly sensitive to oil spill damage, and fly a camera or video with GPS annotation over these areas. The detailed overflight pictures can be structured using the GIS to keep track of what images are taken when and where and what overall coverage and detail are available over a certain area.

In fact, in an ongoing incident, when one can predict with fair accuracy where the oil will hit the shore, it might be a good idea to have the spotter aircraft do a run to photograph the shoreline in order to gather an up-to-date dataset. This will give a firm basis for the discussion that will inevitably take place after the spill hit the shore, of how much damage was done. In this case, both a time series of the particular sensitive shoreline and a fresh up-to-date detailed photography are very useful for focusing the discussion on facts rather than opinion.

Spill Surveillance

One has to distinguish between operational spills of small size that are a nuisance but not large enough to be combatable and spills of a larger size that are either the result of a criminal action or an accident which need a response in the form of a cleanup operation.

Remote Sensing as Deterrent Against Intentional Oil Ppills

Trials using airborne remote sensing equipment for oil spill detection were carried out in the early 1970s both in Europe and in North America.

During the 1980s, routine flights for pollution patrol were gradually established in several countries in northern Europe. Today, almost all countries with coastlines on the North Sea or Baltic Sea perform such pollution patrol missions, using aircraft with fairly similar remote sensing equipment installed.

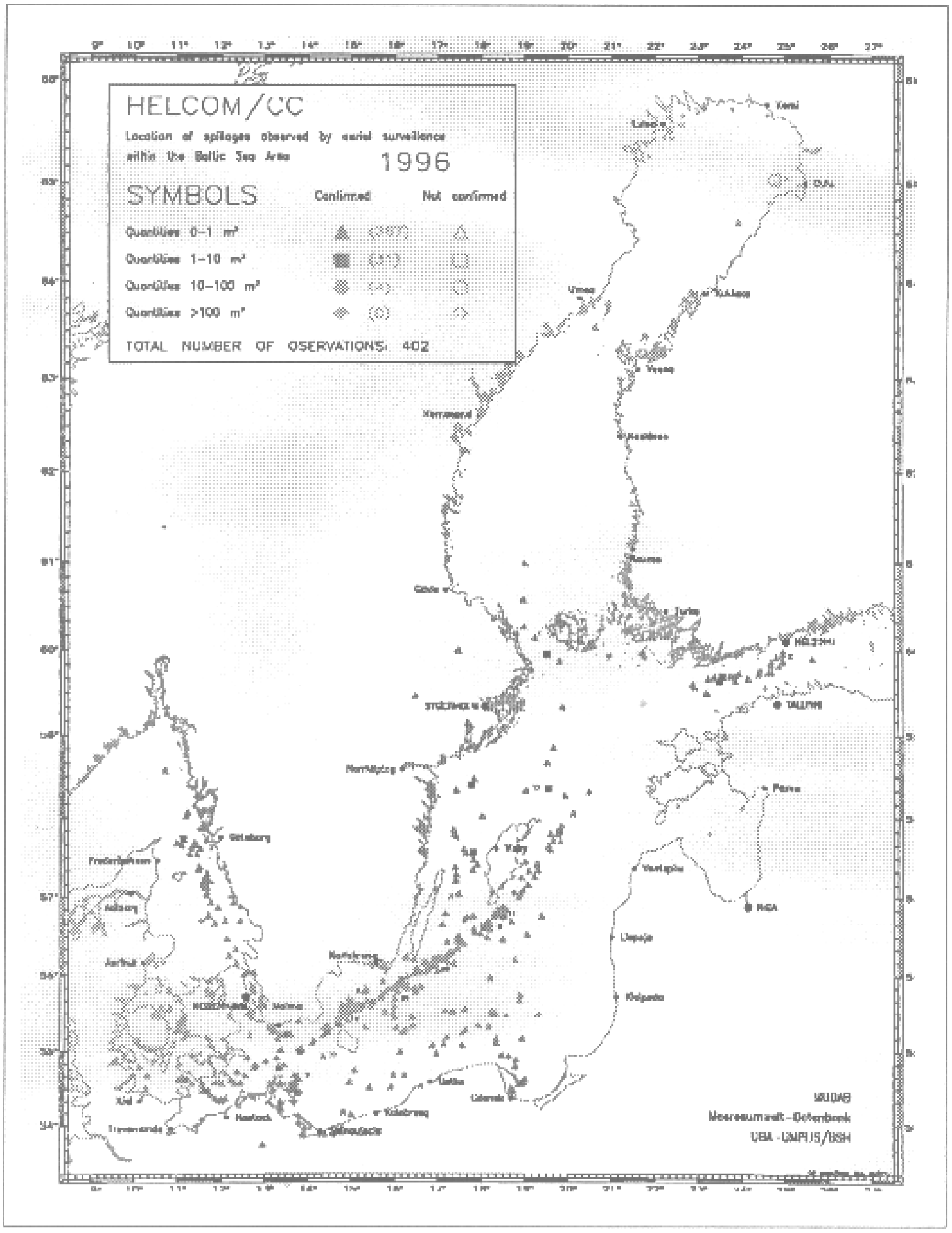
An effect of this routine surveillance seems to be that the number and size of operational spills has gone down. This is of course very hard to prove as there are no statistics available for the spills that go undetected, at the same time as a higher and higher percentage of the spills are detected with daily aerial surveillance fully operational.

Today, in fact, in the Baltic Sea, the number of detected spills is actually going up as a result of increased shipping traffic to the Baltic states with the opening up of this area politically and economically. The size of the typical oil spill today is, however, very small as compared to those that were reported 15 years ago. Figure 1 shows the location and size of the spills detected by aerial surveillance in the Baltic Sea area in 1996.

Also today, radar satellites are emerging as a very interesting complement to the airborne surveillance. Tests have been conducted in the Baltic and the North Sea, where airborne surveillance has been coordinated with the satellite passes. This increases the sea surface that can be monitored at a marginal cost increase. At the same time, statistics are gathered for planning future airborne activities. A system where coastguard organizations can subscribe to a monitoring service from a satellite receiving station has been discussed. This would give the individual coastguard access to early warning and statistics at a reasonable cost, as the system would be shared by several nations. The fixed orbits for the satellite passes limits the time and repetition frequency with which a specific area can be covered from space. Satellites can therefore complement but not replace airborne surveillance.

The airborne surveillance further has the advantage of showing a visible presence, which works as a further deterrent against illegal actions and serves also to establish a presence over, for instance, heavily trafficked straits and shiplanes.

Figure 1. Oil Spills Detected by Aerial Surveillance in the Baltic Sea Area in 1996 (Courtesy of Helcom/CC and the Swedish Coast Guard).



Remote Sensing to Give an Overview of a Spill Situation

A well-established monitoring program serves as a strong deterrent. Still, there will be accidents and intentional spills from time to time, so the organization needs to be equipped and prepared to act when these occur. Monitoring should be conducted with the aim to detect these spills as early as possible. The organization should also be able to deploy aircraft on short notice if a spill or other serious incident is reported. In addition to this, a quick check with the appropriate satellite operators if there is any recent satellite imagery, or if some suitable satellites could be programmed to capture imagery of the area can be made. These procedures must be planned, prepared and rehearsed. They should all be part of a national contingency plan.

In the case of a spill that is large enough to require handling and countermeasures, one will typically want to have a fresh overview of how the spill spreads and moves at least once every six hours. There are today dedicated sensor packages, complete with integrated data handling and communication, suitable for installation in small, inexpensive aircraft. The aircraft can also be redirected on short notice, and it can carry out a wide range of tasks.

Legal Aspects on Remote Sensing of Oil Spills

All available remote sensing data should be secured as evidence and as a reference in case there are environmental damages at a later stage of the incident. To secure an overall image of the entire scene is always very useful. A detailed review of how airborne remote sensing can be used to secure evidence can be found in the Bonn Agreement (1993).

Another aspect that gives the airborne surveillance extra importance is that the legal system in most countries still requires the testimony of a person, rather than sensor data on its own, for a conviction in court. A testimony by a Coastguard Officer, backed by remote sensing data, provides for a very strong case.

It is appropriate in this context to mention the importance of good communication between the legal authorities and the agency conducting the maritime surveillance. Routines for documentation should be adapted to the national legislation, and prosecutors and other government officials handling maritime cases should have a basic understanding of the methods and technologies used by for instance the coastguard.

This has been done to some extent for example in Sweden where the coastguard is today empowered to put a nominal fee on polluting the national waters. This fee is levied directly on the shipowner and related to the size of the ship and the size of the spill but in most cases independent of whether the spill was intentional or not. In this way, a simpler way to effect a level of enforcement of environmental law has been created, where the often very difficult task of finding an officer on the ship who can be shown to have committed a crime or demonstrated gross negligence can be avoided.

Work in this field is, however, an ongoing process. The Swedish government has appointed during the spring of 1998 an expert investigator to review the whole issue of legislation, evidence and prosecution in these cases.

In the Baltic Sea area, work is also underway to unify port fees in all countries on the Baltic Sea, and to have the port fee include the cost for receiving oily wastes in port. At the same time, there is to be a unified minimum fee on spills that are detected using aerial surveillance.

Managing the Spill Response

Integrating Near Real-time Remote Sensing in Combating Oil Spills

An aircraft equipped with dedicated remote sensing and communication equipment is an indispensable part of a maritime disaster response organization. Complementary data can be obtained from satellites (large area overview, low repetition rate) and ships in the area (accurate information but of a very limited area). The aircraft will be able to gather both large-scale overviews and accurately positioned information on the features of interest. Airborne scanners can be used to estimate the thickness, spread and volume of the slick, and also to check on booms and the effect of dispersants. In general, the aircraft serves as the eyes of the on-scene coordinator. Day and night information on the development of the incident can be available for exact and correct decision-making.

Dedicated communication equipment, mobile or permanently installed, should be a part of the infrastructure to support the on-scene coordinator during an incident.

The new MSS 5000 system from the Swedish Space Corporation is an integrated airborne remote sensing system designed to facilitate the use of remote sensing in an oil spill combat situation. It uses modern methods for data compression and data transmission together with built-in GIS functionality to provide the on-scene coordinator with up-to-date information. The information is GPS-positioned and can be directly included in a digital situation map of the operation area. Some additional details on the new system are given (Offshore Magazine, 1997).

Remote Sensing and Trajectory Modelling

Once the remote sensing data have been adapted for feeding into GIS, it is a fairly straightforward development to use the up-to-date overview for feeding also into the oil spill trajectory model used to predict the movement of the oil spill. This step should greatly enhance the accuracy of the prediction given by the trajectory model. A detailed description of this possibility has been given by Uzzell and Fast (1996).

Remote Sensing to Support and Monitor Oil Spill Cleanup and Restoration Efforts

When the initial rescue of life, property and environment is concluded, it is time to collect and evaluate all documentation and prepare for the recovery of cost and perhaps also for legal actions. Time series remote sensing data from aircraft and satellites are very useful in combination with other information such as written reports and logs, photographs and other information.

When the evaluation and the lessons learned from a major incident provide feedback for updating the plans and manuals for the future, a time series remote sensing imagery will give clear and objective descriptions of the situation at different times.

Conclusion

Coastal zone management and protection of the environment is a growing concern for the countries in East Asia. In the near future, one can foresee that the regional and national infrastructure is refined, as ratification and implementation of relevant instruments such as the International Convention for the Prevention of Pollution from Ships 1973 as Modified by the Protocol of 1978 (MARPOL 73/78), the London Convention, Oil Pollution Preparedness Response and Cooperation (OPRC) 1990, etc. leads to the preparation and implementation of plans of action which target marine pollution and management.

When the regional and national agencies that will be entrusted with these tasks begin their work they will need access to affordable, yet accurate and timely information.

The tools available or rapidly becoming available today will facilitate a dramatic improvement in the control and overview of oil spill incidents at sea: Where did the spill occur, where is the oil now, what resources are threatened, how effective are the countermeasures?

With better control also follows an improved deterrent effect as the awareness of the control spreads in the community.

It is, however, important to realize that one system, or one sensor, alone cannot meet all the relevant requirements. A combination of technologies, platforms and sensors is necessary, as well as a sound data distribution system to ensure that the data are available in an easily understandable format, when and where needed.

References

Bonn Agreement. 1993. Manual – Oil Pollution at Sea – Securing Evidence on Discharges from Ships.

Colliander, C. 1997. Remote sensing for exclusive economic zone protection, an operational scenario. Third Annual GIS Asia Pacific Conference and Exhibition, 14-16 October 1997, Jakarta.

Offshore Magazine. 1997. Airborne system enhances Norwegian oil spill combat. Offshore Magazine, October 1997, 110 p.

Uzzell, J.B. and O. Fäst. 1996. Integrating remote sensing into an emergency response system. Second International Airborne Remote Sensing Conference and Exhibition, 24-27 June 1996, San Francisco.

Mangrove Swamps as Pollutant Sink and Wastewater Treatment Facility

Nora F.Y. Tam and Y.S. Wong

*Department of Biology and Chemistry, City University of Hong Kong
83 Tat Chee Ave., Kowloon, Hong Kong SAR, China*

TAM, NORA F.Y. and Y.S. WONG. 1999. Mangrove swamps as pollutant sink and wastewater treatment facility, p. 471-484. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Mangrove ecosystems have been used as convenient disposal sites for wastewater in addition to its ecological values. During a recent ecological study in 18 mangrove swamps in Hong Kong, elevated concentrations of nutrients and heavy metals were found in some soils, suggesting that mangroves acted as potential sinks for trapping pollutants from anthropogenic sources. Since 1990, field trials and greenhouse experiments have been conducted to examine the effects of employing mangrove ecosystems to treat wastewater. Results from a field study in Futian National Nature Reserve, China indicate that discharging municipal sewage into the landward region of the mangrove forest did not cause any detectable damage to mangrove plants, benthic invertebrates and algal species. Settled domestic sewage was purified by mangrove soils and plants. The greenhouse experiments using fabricated computer-controlled tide-tank systems demonstrated that mangrove plants, with periodic flooding of seawater, were very tolerant to strong wastewater. The excess nutrients and heavy metals in sewage were trapped in mangrove soils, and nutrients taken up by mangrove plants were beneficial to their growth. These data indicate that mangrove swamps were effective in treating municipal wastewater.

Introduction

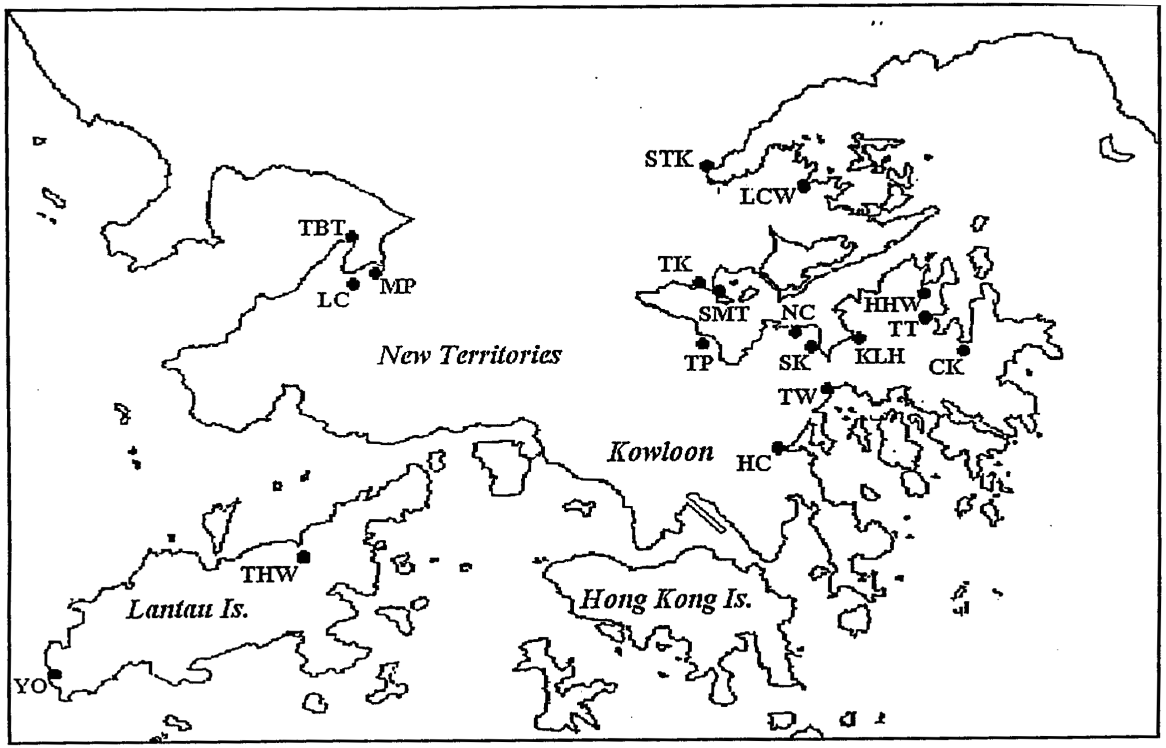
Mangrove ecosystems are important intertidal wetlands found along sheltered estuarine shores in the tropical and subtropical regions. They supply food for aquatic organisms and benefit the fisheries and aquaculture; provide feeding, nesting and roosting habitats for wildlife and birds; and are attractive sites for leisure and various recreational activities (Boto, 1992). Mangrove ecosystems are also known to have high resistance to stressed environment and are often used as convenient sites for dumping domestic refuse and construction wastes, discharging municipal, livestock and industrial sewage (Clough et al., 1983). The extensive root systems of mangrove plants decrease the water flow rate, trapping the suspended solids and pollutants in wastewater. The mangrove sediments, being reduced, anaerobic and rich in sulphide content, also favor the retention and accumulation of pollutants such as heavy metals (Lacerda et al., 1993; Tam and Wong, 1995). Elevated concentrations of heavy metals in mangrove sediments have been reported (Mackey et al., 1992; Lacerda et al., 1993; Tam and Wong, 1995; Tam and Yao, 1998) and mangrove sediments often act as heavy metal sinks (Harbison, 1986; Silva et al., 1990; Lacerda et al., 1993; Tam and Wong, 1993, 1995). This unique characteristic of a mangrove ecosystem suggests that mangrove wetlands can be developed to a simple, low cost wastewater treatment facility. However, the extent of pollutants that can be accumulated in mangrove ecosystems and their performance in purifying wastewater is often unknown. The present paper therefore aims: (1) to examine the degree of pollutants accumulated in 18 mangrove swamps in Hong Kong; (2) to investigate the effectiveness of mangrove ecosystems in treating municipal wastewater; and (3) to discuss the retention of heavy metals in simulated mangrove ecosystems.

Accumulation of Pollutants in Mangrove Ecosystems

Surface sediments of 18 mangrove swamps in Hong Kong (Figure 1) had different concentrations of nitrogen and phosphorus (Figure 2), and heavy metals (Figures 3 and 4). The mangrove swamps located in the western side (Deep Bay Region) of the territory, including Mai Po, Lut Chau and Tsim Bei Tsui, had significantly higher concentrations of total P, Cu, Zn, Cd and Pb than the other swamps. The Deep Bay Region is more influenced by the freshwater input from the Pearl River Estuary, which is the largest river in southern China having a drainage area of 450,000 km^2 and with an estimated annual flow of 308 billion m^3. The river is well known to have a heavy sediment load, and high concentrations of pollutants from domestic, industrial and agricultural sources.

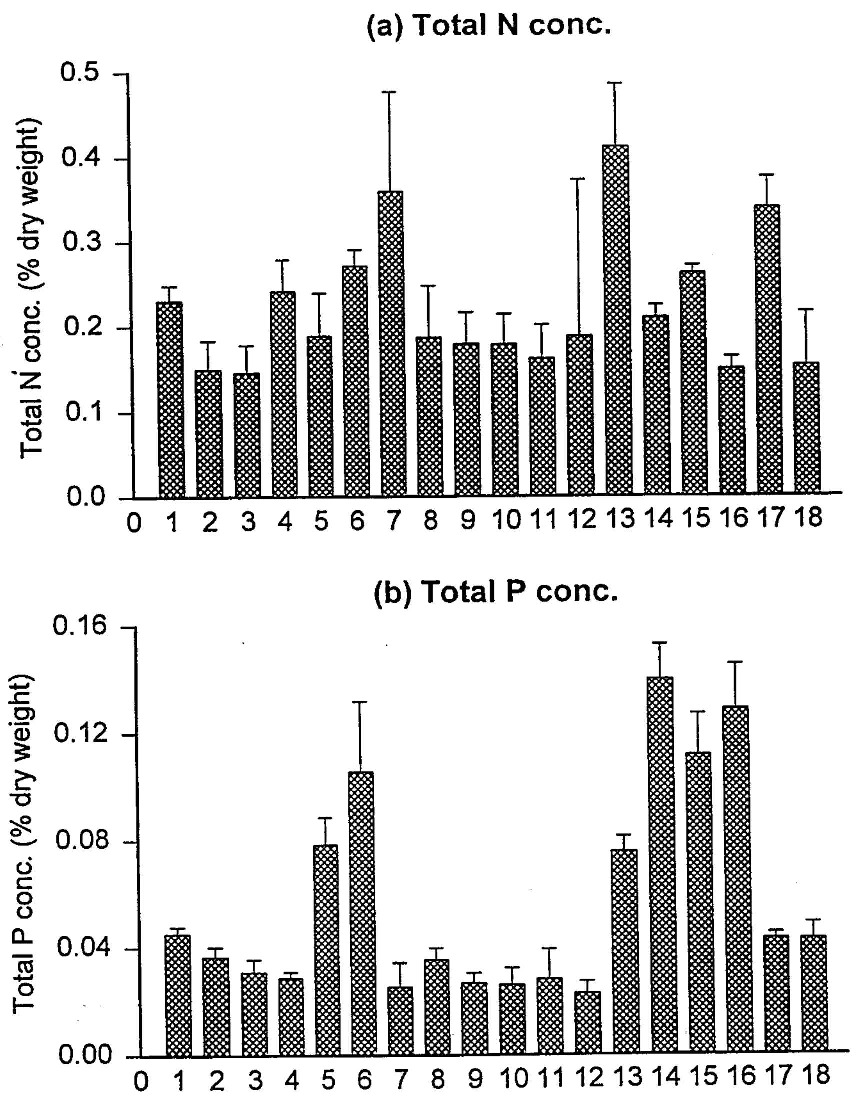
In addition to these three swamps in Deep Bay, mangrove swamps at Nai Chung, Tolo Pond and Ho Chung also had very high levels of phosphorus and heavy metals. These swamps have been seriously affected by human activities. In Ho Chung, the effluents of the dye factory, the livestock wastes from pig farms in the upper part of the river, and waste discharges from boat people along the river accounted for the high pollutant content. Similarly, Nai Chung also receives

Figure 1. Location of the 18 Mangrove Swamps in Hong Kong which were Sampled for Determining the Degree of Nutrient and Heavy Metal Contamination.



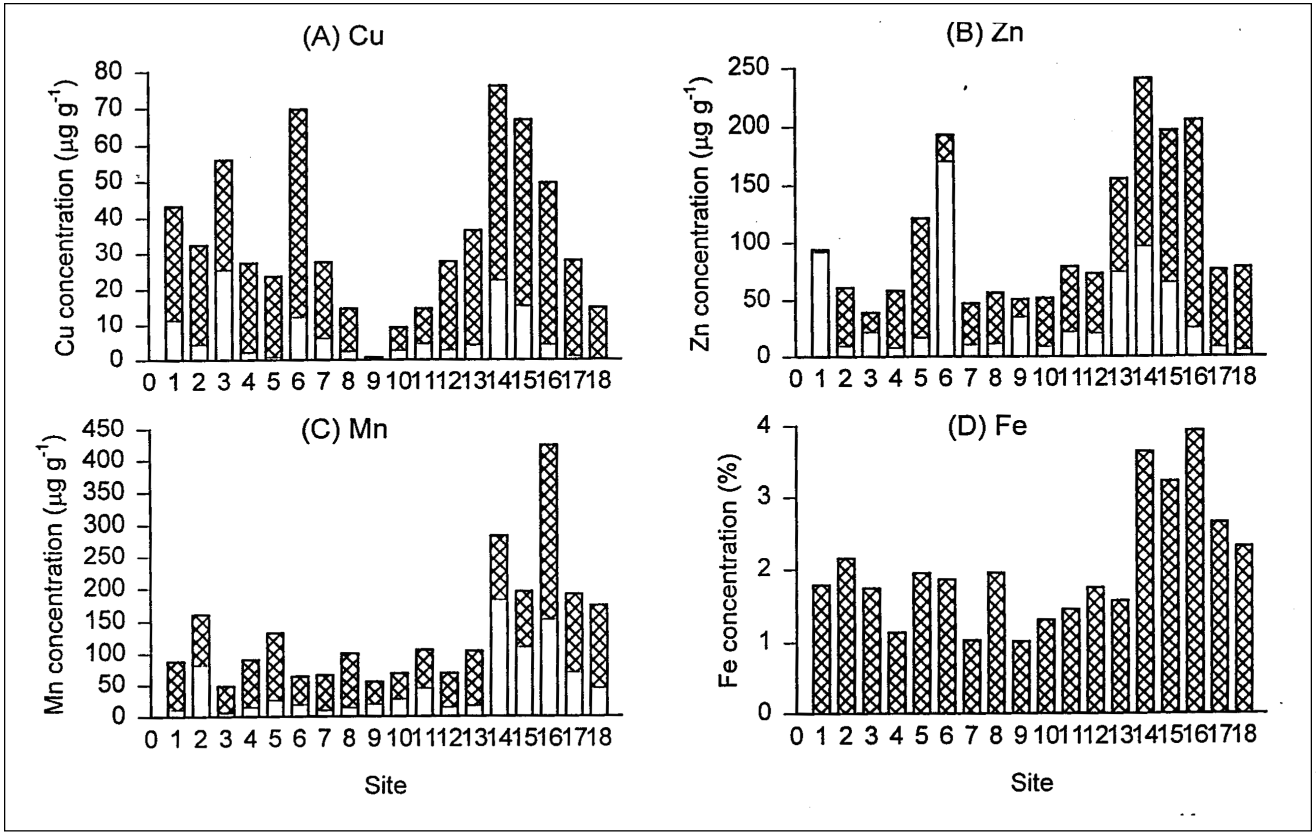
Site 1: Sha Tau Kok (STK), 2: Lai Chi Wo (LCW), 3: Sam Mun Tsai (SMT), 4: Ting Kok (TK), 5: Tolo Pond (TP), Nai Chung (NC), 7: Sai Keng (SK), 8: Kei Ling Ha (KLH), 9: Hoi Ha Wan (HHW), 10: Tai Tan (TT), 11: Chek Keng (CK), 12: Tai Wa (TW), 13: Ho Chung (HC), 14: Mai Po (MP), 15: Lut Chau (LC), 16: Tsim Bei Tsui (TBT), 17: Tai Ho Wan (THW), 18: Yi O (YO).

Figure 2. Concentrations of Total Nitrogen and Phosphorus in Surface Sediments of 18 Mangrove Swamps.



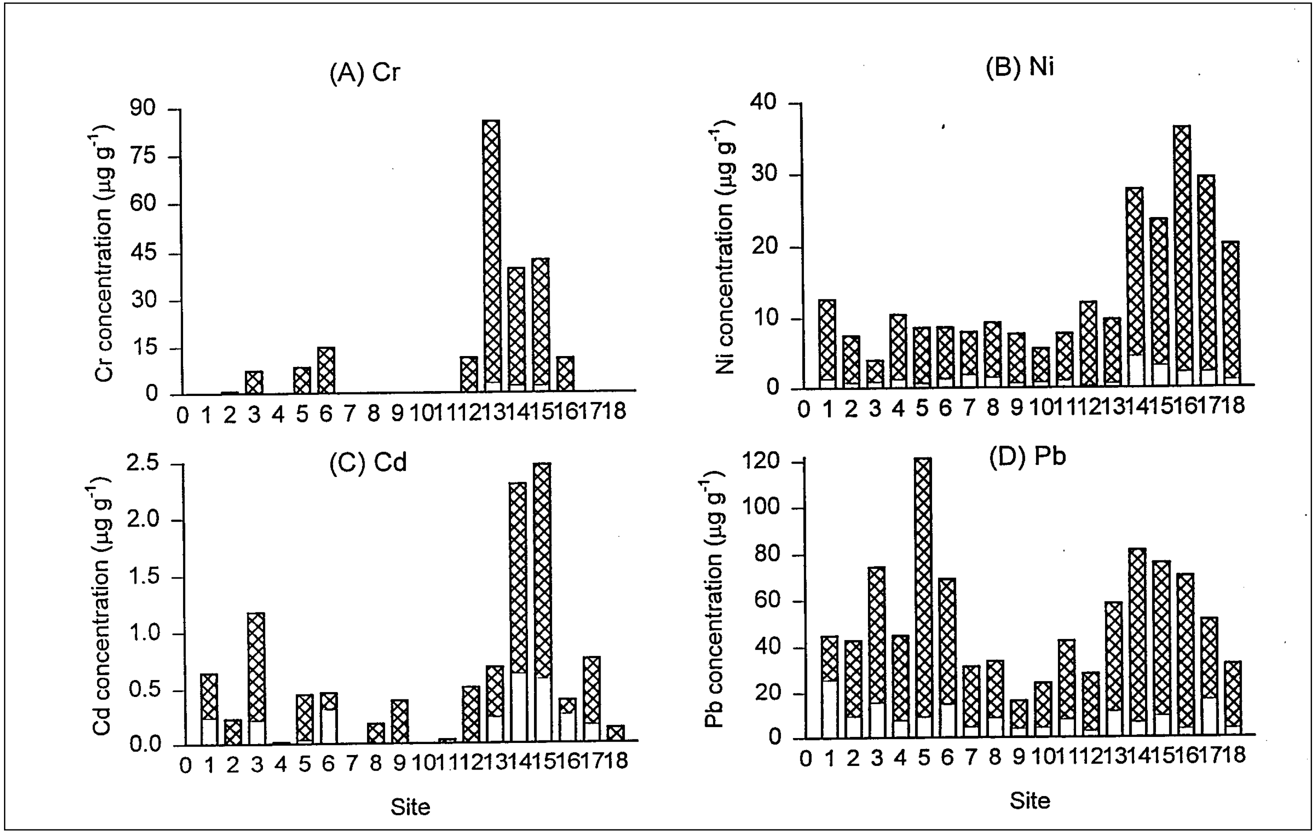
Site 1: Sha Tau Kok (STK), 2: Lai Chi Wo (LCW), 3: Sam Mun Tsai (SMT), 4: Ting Kok (TK), 5: Tolo Pond (TP), Nai Chung (NC), 7: Sai Keng (SK), 8: Kei Ling Ha (KLH), 9: Hoi Ha Wan (HHW), 10: Tai Tan (TT), 11: Chek Keng (CK), 12: Tai Wa (TW), 13: Ho Chung (HC), 14: Mai Po (MP), 15: Lut Chau (LC), 16: Tsim Bei Tsui (TBT), 17: Tai Ho Wan (THW), 18: Yi O (YO).

Figure 3. Concentrations of Cu, Zn, Mn and Fe in Surface Sediments of 18 Mangrove Swamps in Hong Kong.



Empty bar: bioavailable metal; Whole bar: total metal. Site numbered 1 to 18 is the same as that in Figure 2.

Figure 4. Concentrations for Cr, Ni, Cd and Pb in Surface Sediments of 18 Mangrove Swamps in Hong Kong.



Empty bar: bioavailable metal; Whole bar: total metal. Site 1: Sha Tau Kok (STK), 2: Lai Chi Wo (LCW), 3: Sam Mun Tsai (SMT), 4: Ting Kok (TK), 5: Tolo Pond (TP), Nai Chung (NC), 7: Sai Keng (SK), 8: Kei Ling Ha (KLH), 9: Hoi Ha Wan (HHW), 10: Tai Tan (TT), 11: Chek Keng (CK), 12: Tai Wa (TW), 13: Ho Chung (HC), 14: Mai Po (MP), 15: Lut Chau (LC), 16: Tsim Bei Tsui (TBT), 17: Tai Ho Wan (THW), 18: Yi O (YO).

discharge from surrounding houses, restaurants and waste dumping from weekend visitors. Tolo Pond is located within Tolo Harbor, one of the most polluted enclosed harbors in Hong Kong. The heavy metal concentrations in these six swamps are classified as moderately (Class C) to seriously (Class D) contaminated sediments according to the classification system adopted by the Hong Kong Government (EPD, 1992). On the contrary, the swamps situated in more remote locations especially those within the country park area (e.g., Hoi Ha Wan, Chek Keng, Tai Tan, etc.) had little human disturbance and had low values of nutrients and heavy metals. These data indicate that excessive nutrients and heavy metals in both incoming tidal water and freshwater inputs could be retained and accumulated in mangrove sediments. The mangrove sediments could be viewed as pollutant sinks.

Moreover, most of the heavy metals accumulated in mangrove sediments were not bioavailable, as reflected by the relatively low concentrations of ammonium acetate (pH 4) extractable heavy metals (Figures 3 and 4). This means the pollutants retained in sediments were unlikely to have any damaging effect on biotic communities of the mangrove ecosystem. A recent ecological survey on Hong Kong mangroves found that the mangrove plant and animal communities in these contaminated swamps did not show any symptom of damage. In fact, the mangrove swamps located in these polluted regions, in particular, Deep Bay Region, had larger mangrove coverage, the plants were taller and the animal diversity was higher than the other swamps (Tam et al., 1997; Tam and Wong, 1998). These suggest that mangrove ecosystems had a relatively high tolerance to the polluted environment. Flora and fauna are able to resist the heavy metals accumulated in mangrove sediments. These features imply that mangrove ecosystems could be developed into a proper wastewater treatment facility.

Mangrove Ecosystem as Wastewater Treatment Facility: Field Trial

Since 1991, an experimental site of around 1,800 m^2 in Futian National Nature Reserve in the Shenzhen Special Economic Zone of China was constructed to examine the feasibility of using mangrove wetlands as sewage treatment facility (Wong et al., 1995, 1997). Another site of similar size, 150 m away from the experimental site, was used as the control site. The properties and quantities of wastewater collected from local premises, after settling overnight, are summarized in Table 1.

Results from this systematic field study indicate that discharge of primarily settled municipal sewage to the landward region of the mangrove ecosystem during low tide period for more than 3 years did not affect the mangrove plants. The changes in diameter, height and production of two dominant mangrove species,

Table 1. Properties of Settled Municipal Sewage Discharged into the Experimental Site in Futian (mean and standard deviations of 18 values are shown).

Parameters	First Loading Period	Second Loading Period
Discharge duration	Sept. 91 - Oct. 92	Dec. 94 - June 96
Discharge frequency	3 times per week	3-4 times per week
Volume per discharge (m^3)*	12 **	20
Total discharge (m^3)	2,600	5,072
pH	7.52 ± 0.28	7.55 ± 0.07
Conductivity (mS cm^{-1})	0.10 ± 0.02	0.95 ± 0.08
BOD (mg O_2 L^{-1})	55.9 ± 21.4	194.2 ± 41.2
TKN (mg L^{-1})	24.7 ± 9.0	38.5 ± 5.3
NH_4^+-N (mg/l)	18.4 ± 0.2	28.1 ± 0.3
Total P (mg/l)*	1.23 ± 0.77	4.84 ± 0.78

* It was planned to discharge 20 m^3 municipal wastewater during low tide period, which was equal to around 2-4 cm wastewater added onto the surface of the mangrove floor (depends on how far wastewater was spread towards the foreshore region).

** Due to leakage problems of the water pipes and the sedimentation tank, volume of wastewater added to mangrove system during the first loading period was less than 20 m^3.

Kandelia candel and *Aegiceras corniculatum*, during the study period in the experimental site was comparable to that of the control site (Wong et al., 1997). No differences between experimental and control sites were found in terms of the species diversity and abundance of macroalgae and benthic invertebrates colonizing the mangrove floor (Yu et al., 1997). During the study, the tidal and foreshore water did not show any increase in organic matter (in terms of BOD), nutrients and heavy metal concentrations, indicating that the pollutants in municipal sewage were purified by the ecosystem before the next tidal flushing. The nutrient concentrations of mangrove surface sediments collected in locations near the discharge points (the landward region) of the experimental site were significantly higher than that of the control site (Tables 2 and 3). This field trial reveals that mangrove intertidal wetlands are of great potential for purifying municipal wastewater and are unlikely to produce any harmful effects on biotic communities of the ecosystem. Nevertheless, the sewage collected in this location, especially at the beginning of the study when Shenzhen City had just started to be developed,

Table 2. Effect of Sewage Discharge on Nitrogen Concentrations of the Surface Sediments (0-10 cm) at 2 and 5 m from the Landward Region in Futian Mangrove Swamp.

Time	TKN (%)		NH_4^+-N (μg g^{-1})	
	Exp. Site	Control Site	Exp. Site	Control Site
2 m from landward region				
Dec. 1994	ND	ND	19.50 ± 0.01	17.00 ± 0.02
July 1995	0.355 ± 0.011	0.295 ± 0.007	44.13 ± 4.67	38.22 ± 3.22
Oct. 1996	0.401 ± 0.029	0.340 ± 0.035	40.97 ± 7.03	20.52 ± 2.80
5 m from landward region				
Dec. 1994	0.284 ± 0.006	0.269 ± 0.036	17.03 ± 1.78	16.85 ± 1.24
July 1995	0.284 ± 0.015	0.253 ± 0.014	40.58 ± 5.57	32.96 ± 3.69
Oct. 1996	0.322 ± 0.022	0.245 ± 0.010	20.79 ± 0.88	16.81 ± 1.03

Exp. Site: Experimental site with sewage discharged into the landward region.
ND: Not determined as no samples were collected at that time.

Table 3. Effect of Sewage Discharge on Total Phosphorus and Carbon Concentrations of the Surface Sediments (0-10 cm) at 2 and 5 m from the Landward Region in Futian Mangrove Swamp.

Time	Total P (%)		Total C (%)	
	Exp. Site	Control Site	Exp. Site	Control Site
2 m from landward region				
Dec. 1994	ND	ND	ND	ND
July 1995	0.234 ± 0.037	0.188 ± 0.001	3.585 ± 0.198	5.168 ± 0.284
Oct. 1996	0.268 ± 0.007	0.195 ± 0.016	5.637 ± 1.186	4.848 ± 0.731
5 m from landward region				
Dec. 1994	0.195 ± 0.021	0.187 ± 0.050	4.064 ± 0.193	4.172 ± 0.224
July 1995	0.177 ± 0.001	0.188 ± 0.011	4.978 ± 0.265	4.747 ± 0.302
Oct. 1996	0.207 ± 0.008	0.186 ± 0.025	4.765 ± 0.209	3.956 ± 0.234

Exp. Site: Experimental site with sewage discharged into the landward region.
ND: Not determined as no samples were collected at that time.

was relatively weak (Table 1). The hydraulic loading was also not high due to some unpredicted difficulties in field study such as leakage in the water pipes and settling tank, pump being stolen and not sufficient sewage in the collection point, etc. Therefore, simulated mangrove studies are currently conducted in the greenhouse to assess the maximal capacity of the mangrove ecosystem in treating wastewater of different strengths. The long-term effects of discharging wastewater on biotic communities, in particular, plants and microbes in sediments are also investigated.

Wastewater Treatment Efficiency of a Simulated Mangrove Tide-Tank System: Greenhouse Experiment

A simulated mangrove tide-tank system consisted of 12 PVC tanks was constructed, each tank connecting to a storage reservoir of seawater (for tidal flushing) and planted with 16 one-year-old *Kandelia candel* seedlings. The tanks were computer-controlled to simulate the tidal regime by flooding with seawater from the storage tank once a day. Every day, the high tide period was from 7 p.m. to 7 a.m., followed by a 12-hour low tide period. The system was acclimatized for one year in a greenhouse before employing for wastewater treatment. Details of the experimental setup are described in Chu (1998) and Chu et al. (1998).

The greenhouse study shows that the mangrove ecosystem was effective in removing nutrients and heavy metals from wastewater but the treatment efficiency was affected by sewage strength and kinds of pollutants (Table 4). Around 98% removal of inorganic nutrients and 96% removal of heavy metals were achieved when the system was loaded with normal (NW) and medium wastewater (5NW). However, if the system was loaded with strong wastewater (25NW), the removal efficiency dropped to around 75% for N and P, 88% for Ni and Zn, 92% for Cu, Cd and Cr ions; and the pollutant levels in these effluents were higher than the discharge limits. These findings suggest that the mangrove ecosystem had a high capacity in retaining pollutants from normal to medium sewage and the system could be used for a very long time before the saturation level was reached, therefore, it is suitable for treating domestic sewage. On the other hand, the system had limitation on treating strong wastewater and the efficiency needed to be improved. More experiments are currently performed to enhance the treatment performance of the mangrove system.

In spite of high concentrations of pollutants in wastewater, mangrove plants in tide tanks appeared to be healthy and normal, without exhibiting any symptom of damage. The high concentrations of heavy metals in wastewater were

Table 4. Treatment Efficiency of the Simulated Mangrove Tide-Tank System at the End of the Wastewater Loading Experiment (Week 16).

Parameters	Normal wastewater (NW)			Medium wastewater (5NW)			Strong wastewater (25NW)		
	Influent conc. (mg/l)	Effluent conc. (mg/l)*	Percentage removal (%)	Influent conc. (mg/l)	Effluent conc. (mg/l)*	Percentage removal (%)	Influent conc. (mg/l)	Effluent conc. (mg/l)*	Percentage removal (%)
NH_4^+-N	40	0.85	97.9	200	2.50	98.8	1000	247.5	75.3
PO_4^{3-}-P	10	ND	100	50	ND	100	250	68.2	72.7
COD	500	150	70.0	2500	395	84.2	12500	1640	86.9
Cu^{2+}	1	ND	100	5	0.2	98.0	25	3.9	92.2
Cd^{2+}	0.1	ND	100	0.5	ND	100	2.5	0.2	92.0
Cr^{6+}	2	ND	100	10	0.15	97.0	25	1.75	93.0
Zn^{2+}	5	0.5	90.0	25	1.55	93.8	125	16.55	86.8
Ni^{2+}	1	0.2	80.0	5	0.2	96.0	25	3.1	87.6

NW: composition is similar to the municipal sewage in Hong Kong. 5NW consists of the pollutant concentrations 5 times the normal wastewater. 25NW: pollutant concentrations are 25 times the normal wastewater.

*: concentration in the effluent was calculated after eliminating the dilution effect of the tidal seawater.

Percentage removal = (Influent concentration-Effluent concentration)/Influent concentration x 100%.

ND: not detected as the concentration in effluent was below the detection limits of the flame atomic absorption spectrophotometry.

immobilized in sediments and only little was bioavailable (Tam and Wong, 1993, 1995; Chu, 1998). Moreover, the root systems of mangrove plants are extensive and act as good barriers for preventing metals migrating to the more sensitive aerial parts of the plants. This explains why the mangrove plants were not damaged by the strong wastewater. Previous studies also reported that mangrove plants were able to tolerate high concentrations of heavy metals (Chen et al., 1995). The growth of *Avicennia alba, Rhizophora muoronata* and *R. mangle* was not inhibited by Zn, Pb, Cd and Hg ions in the sediment (Chen and Lin, 1988).

Plants grown in tide tanks receiving strong wastewater (25NW) had higher growth rates than in other tanks. The plants were taller, and the leaves were darker with higher biomass production (Chu, 1998). The mean stem height in 25NW treated tanks was around 48 cm, while those in 5NW and NW tanks were 46 and 44 cm, respectively. The high concentrations of nutrients and organic matter in this strong wastewater (25NW) stimulated plant growth. It has been reported that mangrove sediments were often nutrient deficient. Addition of nutrients would result in an increase in plant growth and production (Clough et al., 1983; Boto, 1992; Chen et al., 1995; Wong et al., 1997). These data indicate that if wastewater discharged to a mangrove ecosystem could be properly managed and controlled, not only the wastewater could be treated effectively, but the production of the ecosystem could also be enhanced. More detailed studies should be done to have a better understanding of this low-cost and effective wetland treatment system.

References

Boto, K.G. 1992. Nutrients and mangroves, p. 129-145. *In* D.W. Connel and D.W. Hawker (eds.) Pollution in tropical aquatic systems. CRC Press Inc., Ann Arbor, Michigan.

Chen, G.Z., S.Y. Miao, N.F.Y. Tam, Y.S. Wong, S.H. Li and C.Y. Lan. 1995. Effect of synthetic wastewater on young *Kandelia candel* plants growing under greenhouse conditions. Hydrobiologia 295: 263-273.

Chen, R. and P. Lin. 1988. Role of mangrove in mercury cycling and removing mercury in estuary, p. 370-375. *In* P. Hills, R. Keen, K.C. Lam, C.T. Leung, M.A. Oswell, M. Stokes and E. Turner (eds.) Pollution in the urban environment. POLMET 88. Vincent Blue Copy Co. Ltd., Hong Kong.

Chu, H.Y. 1998. Characterization and treatment efficiency of heavy metals and nutrients in a model mangrove ecosystem in constructed tide-tanks. The Hong Kong University of Science and Technology, Hong Kong. 170 p. M.Phil. thesis.

Chu, H.Y., N.C. Chen, M.C. Yeung, N.F.Y. Tam and Y.S. Wong. 1998. Tide-tank system simulating mangrove wetland for removal of nutrients and heavy metals from wastewater. Wat. Sci. Tech. 38: 361-368.

Clough, B.F., K.G. Boto and P.M. Attiwill. 1983. Mangroves and sewage: A re-evaluation, p. 151-162. *In* H.J. Teas (ed.) Biology and ecology of mangroves. Tasks for Vegetation Science Series. Vol. 8. Dr. W. Junk Publishers, Lancaster.

EPD (Environmental Protection Department). 1992. Hong Kong environment. Hong Kong Government Printer, Hong Kong. 180 p.

Harbison, P. 1986. Mangrove muds—a sink and a source for trace metals. Mar. Pollut. Bull. 17(6): 246-250.

Lacerda, L.D., C.E.V. Carvalho, K.F. Tanizaki, A.R.C. Ovalle and C.E. Rezende. 1993. The biogeochemistry and trace metals distribution of mangrove rhizospheres. Biotropica 25(3): 252-257.

Mackey, A.P., M. Hodgkinson and R. Nardella. 1992. Nutrient levels and heavy metals in mangrove sediments from the Brisbane River, Australia. Mar. Pollut. Bull. 24: 418-420.

Silva, C.A., L.D. Lacerda and C.E. Rezende. 1990. Heavy metal reservoirs in a red mangrove forest. Biotropica 22: 339-345.

Tam, N.F.Y. and Y.S. Wong. 1993. Retention of nutrients and heavy metals in mangrove sediments receiving wastewater of different strengths. Environ. Technol. 14: 719-729.

Tam, N.F.Y. and Y.S. Wong. 1995. Mangrove soils as sinks for wastewater-borne pollutants. Hydrobiologia 295: 231-241.

Tam, N.F.Y. and Y.S. Wong. 1998. Variations of soil nutrient and organic matter content in a subtropical mangrove ecosystem. Wat. Air Soil Pollut. 103: 245-261.

Tam, N.F.Y. and M.W.Y. Yao. 1998. Normalisation and heavy metal contamination in mangrove sediments. Sci. Tot. Environ. 216: 33-39.

Tam, N.F.Y., Y.S. Wong, C.Y. Lu and R. Berry. 1997. Mapping and characterization of mangrove plant communities in Hong Kong. Hydrobiologia 352: 25-37.

Wong, Y.S., C.Y. Lan, G.Z. Chen, S.H. Li, X.R. Chen, Z.P. Liu and N.F.Y. Tam. 1995. Effect of wastewater discharge on nutrient contamination of mangrove soils and plants. Hydrobiologia 295: 149-158.

Wong, Y.S., N.F.Y. Tam and C.Y. Lan. 1997. Mangrove wetlands as wastewater treatment facility: A field trial. Hydrobiologia 352: 49-59.

Yu, R.Q., C.Z. Chen, Y.S. Wong, N.F.Y. Tam and C.Y. Lan. 1997. Benthic macrofauna of the mangrove swamp treated with municipal wastewater. Hydrobiologia 347: 127-137.

Session V

Stakeholders' Participation

Women Stakeholders' Position: Make Our Role Doable and Rewarding

Helena Z. Benitez

National Centennial Commission-Women Sector
Philippine Women's University System
Development Institute for Women in Asia-Pacific (DIWA)
c/o Office of the President, Philippine Women's University
Taft Avenue, Manila, Philippines

BENITEZ, HELENA Z. 1999. Women stakeholders' position: Make our role doable and rewarding, p. 487-492. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

Stakeholders constitute the largest and most numerous of the affected sectors. They, therefore, need to be involved, committed, empowered and capacitated to successfully respond to the challenges and opportunities in managing pollution in the East Asian Seas.

Women constitute the largest of these stakeholder sectors. Their vital role in managing pollution in the East Asian Seas has, therefore, been defined by virtue of their numbers as well as developments that have transpired since the passage of the UN General Assembly in 1969 of the resolution banning all forms of discrimination against women. What needs to be identified is the manner of their participation. They already have the numbers and the will.

Scientists, technologists and experts should provide the ways and the means of their participation. But, in providing these, what must be described should be within the capabilities and capacities of the women, given the fact that they also have to fulfill multifarious roles in the society.

Combining the energies, commitment and capabilities of women as stakeholders with the expertise of scientists and technologists would translate to an effective response to the challenges and opportunities for managing pollution in the East Asian Seas.

On behalf of the stakeholders I represent, the women, I express our appreciation for the inclusion of this session on Stakeholders' Participation in this conference on Challenges and Opportunities in Managing Pollution in the East Asian Seas. This is a very welcome development as it reflects correctly the realization that the challenges cannot be met and the opportunities cannot be seized unless the stakeholders themselves are actively involved, empowered and capacitated to manage pollution in the seas, whether East Asian or any other sea, ocean or body of water.

By definition, stakeholders constitute the largest and most numerous of the affected sectors and thereby have the most vital stake in whether the efforts succeed or fail. The scientists, academicians, technologists, policy-makers and administrators can provide the knowledge and the information, the strategies and the tactics. But if the stakeholders are left out and isolated from the process, the chances of success are dim. For this reason, therefore, this session is a very important one.

To my mind, and to many in the women's sector with whom I discussed the matter, we are way past the need to define the nature and parameters of the role of women in managing pollution. This is already a resolved issue. Let me tell you why we feel this way.

Thirty years ago, in 1966, during my term as Chair of the United Nations (UN) Commission on the Status of Women, we finally succeeded in approving and endorsing to the UN General Assembly the much-debated and long-awaited draft resolution banning all forms of discrimination against women. In 1969, the General Assembly adopted the resolution which became the UN Convention on the Elimination of All Forms of Discrimination Against Women after ratification by the member countries. With this landmark UN resolution, the women's sector had a firm base for pursuing and taking an active role in their own lives as well as in the societies in which they live. In the three decades since, women have used this UN mandate to carve out and fulfill larger, more activist roles in the way the world is managed and its resources used. Just last week, the UN made it possible starting in the year 2000 for women to submit directly to the UN complaints on sex discrimination, sexual harassment and other violations of their rights under the UN convention.

Being, as it were, the largest group of stakeholders by virtue of their gender and role as nurturers of home and children, women have established the primacy of their role in the success of whatever endeavor humankind seeks to undertake. And this is so in managing pollution in the East Asian Seas.

Since the UN Conference on the Human Environment in Stockholm in 1972 and the Earth Summit or the UN Conference on Environment and Development in Rio de Janeiro in 1992, the global action plans on environmental welfare and sustainable development, including the seas and the oceans, have largely been put in place. Our task—men and women together—is to make these action plans work. This international conference, the declaration by the UN of entire years as devoted to welfare of the oceans, of the atmosphere and of other components of our total and interconnected web of life and other fora and gatherings are parts of the task to translate the plans into operations.

In 1975, as President of the Third Session of the UNEP in Nairobi, I went to Geneva to follow up some items in the Law of the Seas. My interest in seas and oceans started when I became Chair of Natural Resources in the Senate of the Philippines from 1968 to 1973. I authored the Environment Policy and a number of bills on the protection of seas and lakes.

The concern of the women's sector as stakeholder, therefore, is the **how** of our participation. We would like to see in more concrete and workable terms **how** we will participate in managing pollution in the East Asian Seas. I will try to articulate how we women see ourselves helping manage pollution in the seas and then invite the scientists, scholars, technologists and other experts participating in the other sessions of this conference to take our inputs into account and help craft and put together the specific programs of action we women could pursue to help manage pollution in the East Asian Seas on whose shores we and our families and from whose bounties we derive a large part of our livelihood.

Two-thirds of the world's population dwell in Asia. A large proportion lives in countries washed by the East Asian Seas. Countries on the shores of these East Asian Seas account for 72% of inland and 43% of marine fishery resources of the world. Nine of the 19 countries that contribute more than one million metric tons of fish per year to global fish production are in Asia.

We, thus, have a situation where, on the one hand, successfully managing pollution of these seas means strengthening the region's capability to sustain global fishery production and the health and well-being of the two-thirds of the world's population that live in Asia, and where, on the other, **failing** to manage pollution will inflict incalculable hardships on these teeming millions due to loss of fish and other marine harvests due to pollution. The current trend, in the region as well as in the world, is the continuing decline in fishery production and mounting degradation of seawater quality due to pollution of the waters, the lands and the atmosphere. **The situation is serious and needs a serious response**.

Women primarily see their role in managing pollution of the seas as integral to and consistent with their role in managing households and caring for families and themselves. We realize well that everything is interconnected, that no person is an island but a part of the whole, to paraphrase the poet-visionary John Donne. It follows that what women do in managing their lives, their homes and their families ultimately also impact on the environment, including the East Asian Seas by virtue of the interconnectivity of everything. Thoughtless casting away of non-biodegradable wastes such as plastics, careless use of water resources in the home, failure to make children appreciate the wisdom of conservation all contribute to the degradation of the world's resources and environment. Women realize this well. We have the will and the resolve. Help us attain the technical and practical ability to do something about them so our will and our resolve can be effectively harnessed and applied. You are the experts. We look to you for expertise. We are the doers and implementors. We are ready to do our part.

When you, scientists, academicians, technologists, administrators, prescribe how we women as stakeholders should discharge our duties, we would like you to bear in mind certain day-to-day realities in the lives of women. These realities are summed up in the saying that "*a woman's work is never done*". This means that what we should do to help manage pollution in the seas and how we would go about doing it should not and cannot unreasonably add to or distract and detract our fulfilling the other multifarious tasks of our lives. Women are hardput enough with other equally crucial tasks, some of more urgent immediacy. We should be able to do our bit for the environment without unduly neglecting these other tasks. You would help us immeasurably if you could make this possible. Show us in practical and doable terms how to make the job of managing pollution seamlessly integrated with what we must do every day in taking care of our families, homes and communities.

On this score, you should perhaps know that women of Asia are "work addicts". This is a finding published earlier this month by Elle, the women's magazine, from a survey conducted in 1998 which drew 20,000 responses from 30 countries, including 4,500 responses from Asia. Work signified accomplishment and fulfillment for 78% of Asian women according to this research finding. There is, therefore, an abundant reservoir of women in Asia willing and able to work hard, in fact addicted to working.

Just to cite an example, the National Council of Women of the Philippines, an umbrella organization of more than 200 women's organizations nationwide, has a membership of more than 10 million Filipino women. They are yours to enlist and harness in managing pollution in the East Asian Seas.

My own experience as Chair of the women's sector of the National Centennial Commission (NCC) is instructive as well. By all accounts, the NCC program which aims to document the contribution of Filipino women in winning and waging the independence of our country has been a major success story of the Centennial. *Herstory*, as we called the enterprise, successfully unearthed and brought to light and life the deeds and achievements of these Filipinas, heretofore, overshadowed and ignored because of the male-dominated bias of our researchers and scholars, as denoted by the very word *history*. But with *herstory*, the researchers and historians of the NCC have been able to foster a more gender-fair rendering of our country's struggle for and winning of national independence.

On a more specific scale, a housewife and mother who metamorphosed into a civil society and community organizer in one of the fishing communities in Cavite Province, where I come from, is one of the success stories among many others in the annals of the Philippine Rural Reconstruction Movement, which I am honored to chair.

At one time or another in her life, this woman sold fresh and smoked fish, retailed clothes on credit, and set up her own small tailoring and dressmaking shop. Then in 1986, when she was 31, she became active in her church. Along with her new-found faith came a deeper understanding of the problems of her community and a resolve to try to do something about them. She became active as a volunteer Barangay Health Worker. Subsequently, in 1993, she organized together with 30 neighbors and churchmates, an advocacy and action group called Abot-Kamay (Reaching Hands) which later became Akay (Guiding Hand) Association. She organized livelihood projects, led community advocacy and action projects in coastal rehabilitation, cleanliness drives for the shorelines of her town, preservation of mangroves for fish breeding, delivery of social services like deep wells, latrines, barangay health center and voter education to make their advocacy bear directly on the town's political leadership structure and decision-making.

In 1995, she was elected president of the provincial federation of fisherfolks, which is an integral component of the Manila Bay-wide federation of fishermen. This federation consists of 45 people's organizations in the four provinces abutting Manila Bay—Cavite, Bulacan, Pampanga, Bataan, plus Navotas town of Metropolitan Manila.

In articulating these things, I realize that answers are not going to be easy to come by. That it would take imagination and creativity. That the information, education and mobilization process would itself be a formidable task. That workable management systems and procedures would need to be put in place. In other words, professionalism and expertise would have to blend with energy, enthusiasm and good intentions. But by focusing on the issue of how rather than what, I might have contributed to a more productive and purposive search for answers.

Let me conclude this presentation with a brief recapitulation. Women are well aware of the pivotal role we could and are prepared to discharge in managing pollution in the East Asian Seas. We have the numbers and the will. We, however, look to scientists, academicians, technologists and other experts and specialists to provide us the means and the ways. Your expertise combined with our will and commitment as stakeholders will provide the direction, power and synergy for a meaningful and workable response to the challenges and the opportunities in managing pollution in the East Asian Seas. We are all in this together, experts and stakeholders regardless of gender.

Interactive Approach with Stakeholders in Coastal Zone Management: The Dutch Experience

Joost H.M. De Ruig and Mathi Den Exter

Ministry of Transport, Public Works and Water Management
National Institute for Coastal and Marine Management
P.O. Box 20907, 2500 EX The Hague, The Netherlands

DE RUIG, JOOST H.M. and MATHI DEN EXTER. 1999. Interactive approach with stakeholders in coastal zone management: The Dutch experience, p. 493-506. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The Dutch coastal zone and its hinterland are densely populated. More than half of the country lies below sea level. Safety against flooding completely depends on the strength of the dunes and dikes. Next to it lies the coastal zone, which is the most important recreation and nature area in the western part of the country. It is not surprising that activities within the coastal zone deeply affect the life of the citizens and especially those of the local communities. In a democratic society, public opinion usually influences policy decisions. In The Netherlands, several models have been used in policy preparation, like the so-called Chain approach and the INFRAPLAN method. The resulting policy does not necessarily have to be fully agreed to by everyone concerned, but one that is widely accepted.

The interactive and participatory policy approach (PPA) in the Dutch coastal zone was initiated in the 1970s during the Delta project. Public opinion resulted in important changes in the original design of the project. In the late 1980s, lessons learned were used in the establishment of a long-term policy regarding the erosion of the Dutch coast in which stages in public opinion and phases of the policy cycle have been linked.

Nowadays, the "dynamic preservation" policy offers opportunities for a more integrated management approach in the coastal zone. Essential elements are multisectoral and multidisciplinary approaches and inputs from a number of

nongovernment stakeholders. For large-scale land reclamation plans which require complicated policy preparation as, for instance, the Amsterdam Airport in the sea, all relevant partners in the coastal zone should be involved in an early stage—a real communication challenge for a custom-made interactive strategy with stakeholders.

Introduction

Socioeconomic development in coastal regions, in many respects, is more rapid than elsewhere in the hinterland. An increasing portion of the world's gross income is generated in these areas. Coastal zones provide ideal conditions for transportation, housing, recreation, agricultural and industrial development. A large heterogeneity of policy issues exists in the coastal zone. The conflicts between the dynamics of natural system and socioeconomic development are becoming more evident. Where the oceans, atmosphere and land intersect, the narrow strip of low-lying land and the adjacent coastal waters (known as the coastal zone) has been subjected to human influence (van der Plas, 1993), causing complex interaction of the natural systems in both coastal land and the sea.

Integrated coastal zone management (ICZM) is an effective mechanism to prevent, mitigate and manage adverse environmental concerns while addressing present day development challenges. ICZM is performed in a dynamic context of natural processes and changing demographic and socioeconomic conditions.

This paper deals with ICZM in general and participatory policy approach (PPA) in particular. Models of interactive approach will be discussed briefly. The paper will focus on the Dutch experience in interaction and communication between politicians, civil servants and other stakeholders.

The Need for ICZM and Interactive Policy

"Fighting" the sea is part of the Dutch history, winning most of the time but sometimes losing. Over the past decades, the dikes around the Dutch coast have been strengthened to meet the required safety standards. Lessons gained from half a century of hydraulic engineering and water management in the Dutch Delta could be of interest for delta area management in other countries. In those early days, engineering work and management were undertaken separately for the sole purpose of assuring survival in the low-lying delta region. Taking advantage of the lessons learned throughout their long history, the Dutch now adopt the integrated management approach to resolve new problems of the coastal zone. For instance, the goal of a large-scale project was modified/changed during execution as a result of continuous interaction among all stakeholders involved in the decision-making process. Natural systems in a delta provide unexpected surprises, both threats and opportunities. Flexible planning and a stepwise approach are necessary in finding an optimum approach to sustainable development (van der Plas, 1993).

ICZM promotes cooperation between stakeholders. The incentives for cooperation are the fulfillment of common needs and attainment of project objectives, resulting in a win-win situation. Specifically, the ICZM program includes integration of:

- Various levels of government from ministry, province, to local units—commonly known as vertical integration;

- Various functions of different government agencies in terms of policies, governance, legislation, enforcement and management which cut across all sectors of the economy—generally known as horizontal integration;

- Responsibilities of government and nongovernment organizations, local groups/stakeholders; and

- Various disciplinary approaches to coastal problems including engineering, socioeconomics and legislation.

The way in which ICZM is executed will depend to a large extent on cultural, political, economic and historical conditions. Its success will, therefore, depend on the degree of public endorsement. Many case studies on coastal management practices today show that initial leadership can come from grassroots movements as well as the central government. Both approaches have their advantages and disadvantages. Local, small-scale projects can provide, in relatively short time, useful experiences that can close the loop between analysis, planning and implementation. Bottom-up and top-down approaches should, therefore, meet during a stage at the cyclic process of ICZM program implementation.

Civil engineering projects in the coastal zone usually serve public interest in terms of water management, coastal defense and reclamation of land from the sea, etc. However, many civil engineers sometimes have difficulties to get their projects started. In several cases, public resistance against the projects took several years or decades to be implemented. Sometimes they resulted in essential modifications of the project's original design or even termination. Very often the public interest on a proposed project may wane. In a number of cases, ecological effects triggered public resistance. An evaluation study of the Asian Development Bank shows that involvement of communities, participation of stakeholders in choosing, designing and managing activities that affect them, have a larger impact on project success than all other factors combined (Sullivan, 1998).

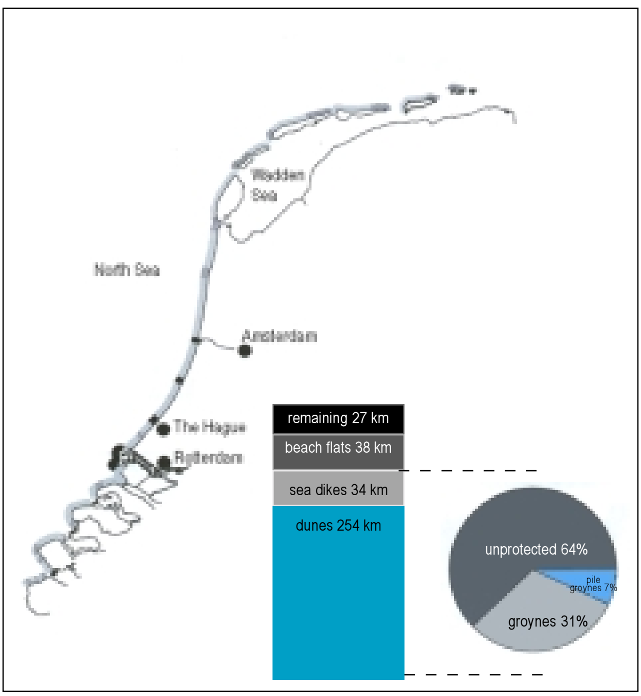
DUTCH PARTICIPATORY POLICY EXPERIENCE IN THE COASTAL ZONE

Experience from The Netherlands shows that PPA can be of help to the complex activities of ICZM projects especially through the interaction between politics, civil servants and public opinion.

Dynamic Preservation of the Dutch Coastline

During the 1970s and 1980s, the erosion problem of the Dutch North Sea coast (Figure 1) was not fully recognized. The erosion undermined dikes and dunes and caused safety problems. Each year, about 20 ha of dunes disappeared. But the government did not provide a budget for constructing preventive structures to arrest erosion. Until 1997, the Dutch parliament requested the government to establish a long-term coastal structure policy in response to growing public concern. However, the government only submitted such a policy until 1990.

Figure 1. The Dutch Coastline.



The crucial step that led to the establishment of the long-term policy was a discussion published in a public report in 1989. It gave only facts and alternative policies without suggesting appropriate actions. Accompanied by a video film, thousands of the reports were sent to all authorities and persons who might be interested. Since the publication of the report, there was a public outcry to stop the erosion. The public opinion was reflected in the results of public consultation conducted by the Advisory Board of Public Works and Water Management. Apart from taking note of the public opinion, the Minister and officials of the Ministry of Public Works and Water Management did not suggest any alternative solution.

The second important step taken by the PPA was to consult stakeholders and interested groups. The Royal Institutions of Engineers organized a congress for technicians, business people, policy-makers and politicians. On the other hand, the environmental groups interested in preserving the natural dunes organized a congress on natural coastal protection. Officials from the Ministry of Public Works and Water Management presented only informative speeches at both congresses. Both congresses led to the same consensus: "Stop the erosion". Consensus was also reached in consultation with the provinces, the Union of waterboards and other ministries. These bodies were involved in the discussions on the draft report to advocate for stopping the erosion. One major question remained—the Ministry of Finance had to provide the budget.

The third step came by luck. A five-day storm did heavy damage to large dune areas. Emergency measures were necessary. The public was very indignant. The incident created an atmosphere for some decisive actions. The budget for long-term solution of the erosion problem was finally agreed upon under a new policy on "dynamic preservation" of the coast. Finally, in 1990, the Dutch government and the parliament decided to implement this new coastal defense policy. This policy is primarily aimed at ensuring safety against flooding and preserving the values of dunes and the beaches (Figure 2).

To keep the momentum of public support, periodic evaluation of the coastal defense policy is necessary. Five years after the decision for "dynamic preservation", the first overview of the benefits and bottlenecks of the new coastal defense policy was presented through the second government coastal report, "Kustbalans 1995". The overall conclusion of the evaluation study is that the choice for "dynamic preservation" made in 1990 was right. Sand nourishment is an effective method of coastline preservation, which also serves functional uses in the beach and dune area (De Ruig and Hillen, 1997; Figure 3). However, a more integrated management of the coastal zone is necessary to balance the interests of economic development and the maintenance of a natural, dynamic coastal ecosystem. An integrated coastal zone management report will be published in 2002 for public consent. The Provincial Consultative Bodies play a key role in the PPA process. Since 1990, they became responsible for all matters relevant to coastal protection and the preservation of the coast. Members of these bodies include representatives of the central government, provincial authorities, waterboards and representatives of coastal municipalities and nongovernment stakeholders.

Figure 2. "Dynamic Preservation" is Primarily Aimed at Identifying Locations with Long-term Coastline Development.

From 1990 onwards, structural retreat of the coastline has been counteracted by sand nourishments.

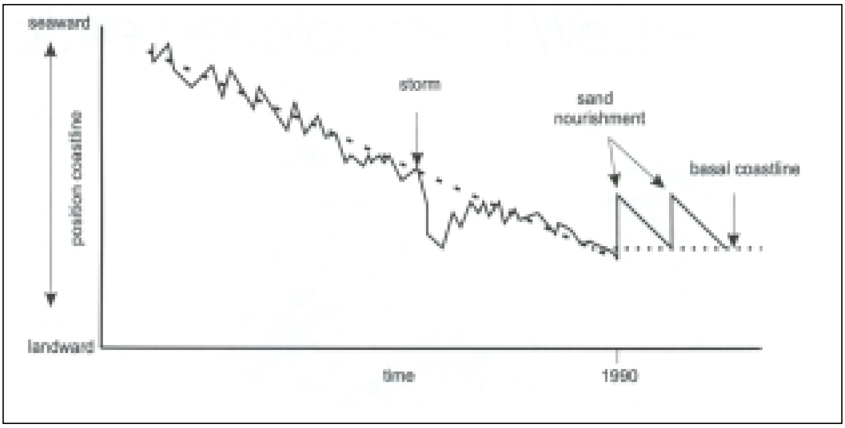
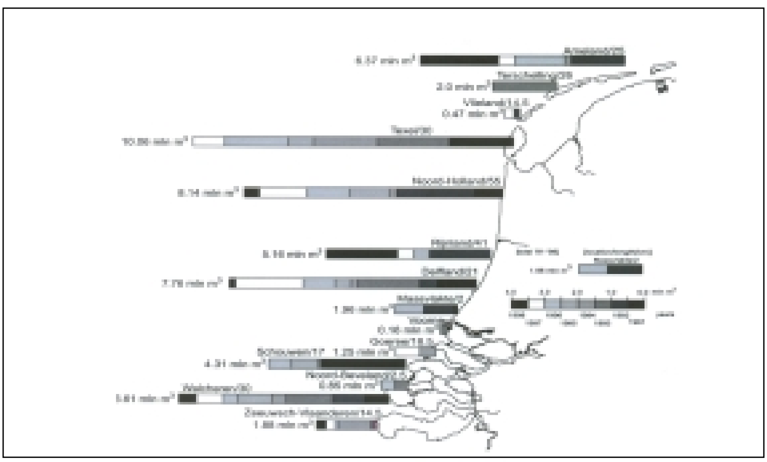


Figure 3. The Dutch Coast, Subdivided from South to North, into the Southwestern Delta, the Uninterrupted Holland Coast and the Wadden Tidal Flat Coast.

For each region, the sand nourishment volumes between 1991 and 1998 are indicated.



"Depoldering" Along the Westerschelde (Western Scheldt) Estuary

The Dutch do not really stick to one coastline preservation philosophy. Besides the "dynamic preservation" strategy, there is room for land and sea reclamation. In this last option, polders, which are now safely protected by dikes, will be surrendered to the Westerschelde estuary and the Wadden Sea for the restoration of ecologically rich salt marshes and mudflats. However, the idea of relinquishing the polders incites strong opposition from some members of the public.

As to the Westerschelde case (De Ruig, 1996), The Netherlands has agreed to the deepening of the shipping channel of the Westerschelde estuary, which is the seaway to the Belgium port of Antwerp. Fully aware of the negative environmental effects of the dredging works on the salt marshes and mudflats, the plan was approved on the condition that compensation be made for the ecological change. Such compensation could entail abandoning several, selected polders and returning

Figure 4. Nature Development Plan in Order to Restore Ecological Damage by Dredging of the Shipping Channel of the Westerschelde (Western Scheldt) Estuary.

The dark 'B' locations contain selected 'depoldering' areas.

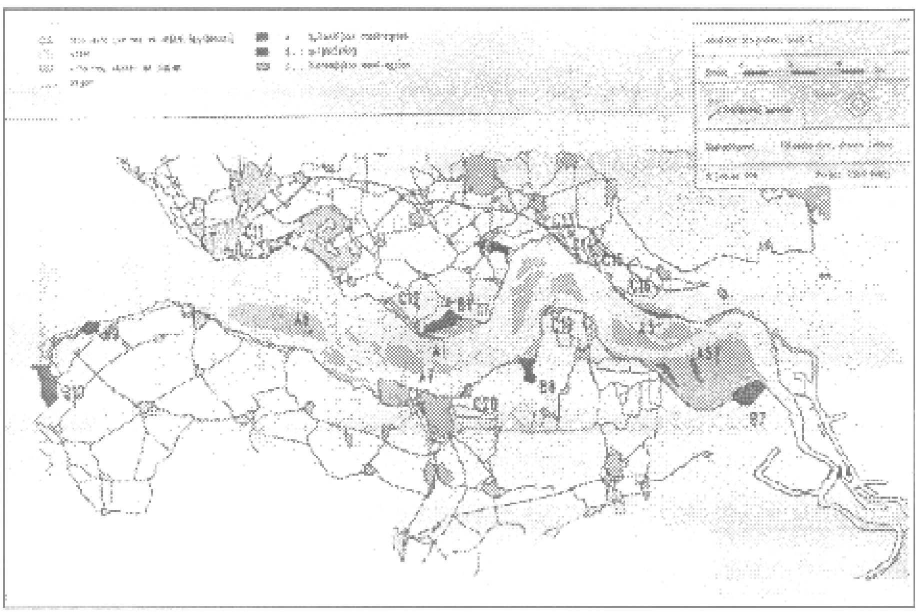
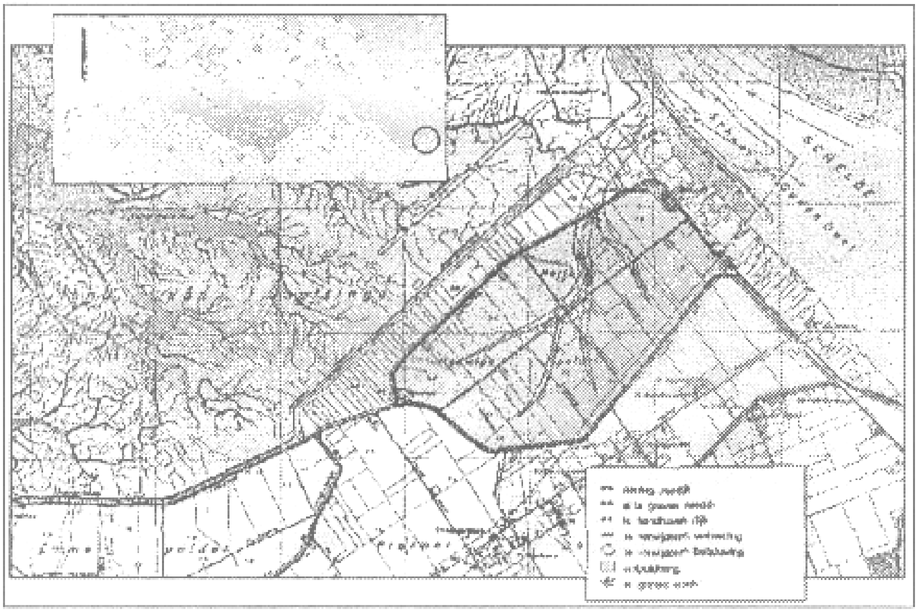


Figure 5. Example of a Selected 'Depoldering' Area: Hedwigepolder (320 ha) Near the Belgium Border.



that land to the sea. To do so would increase the surface area of water, allowing a gradient-rich tidal zone to develop in the emerging salt marshes and mudflats. Besides, the risk of flooding of the polders behind the dike is supposed to diminish. From an environmental perspective, this decision would both be logical and desirable (Figures 4 and 5).

The struggle against the sea is deeply embedded in Dutch history and culture. Land reclamation and accretion are essential to that heritage. In contrast, surrendering land to the sea is not part of that legacy. Indeed, the mere thought of returning land to the sea naturally provokes widespread resistance. During storms, sea dikes have been known to break and inundate the land. The struggle between the Dutch and the sea, especially in the province of Zeeland, where the Westerschelde flows, is an age-old issue. In February 1953, large parts of Zeeland were flooded where nearly 1,900 lives were lost in the disaster. In 1996, the population of Zeeland made a stand against the idea of removing the dikes. Although public opinion on this case was "not right" (on the contrary, "depoldering" diminishes the risk of flooding of the remaining land area), the government misjudged the opinion of the stakeholders. "Be right" and "to put in the right" are different matters. In view of the sensitive nature of the proposals, the government has decided to withhold the plans.

While the technical solution may have environmental benefits and safety from flooding, it is not necessarily socially acceptable. A more open decision-making process is a necessity for creating public support. Thus, it is essential that the Zeeland society and other stakeholders were consulted and involved in order to enlist their support. A shared vision on safe "depoldering" among stakeholders is necessary. This vision should contain a more holistic management approach, not just compensating the loss of natural environment. This approach shall create a win-win situation.

MODELS OF INTERACTIVE APPROACH

The essence of an interactive approach is a well-organized process of listening, informing, talking and again listening to social actors which is sometimes referred to as the "Poldermodel" (Figure 6). It is a process of communication and analysis. Participatory policy should:

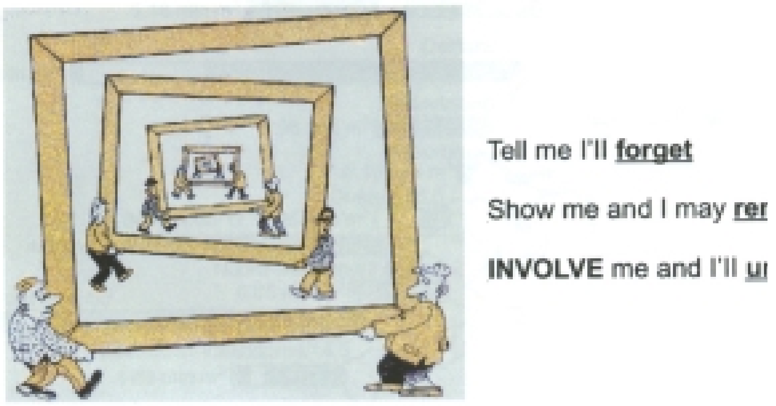
- Always be based on a thorough analysis (of the region, the goals and tasks of the participants and/or the [special] programs of the participants);
- Facilitate the communication between participants concerned, with the analytical base as a joint reference; and
- Structure the communication process in order to reach a realistic, feasible and fully agreed result or outcome.

The PPA methodology can be divided into three groups of policies:

- A networking process (IPEA, INPRO), focusing on "interest";
- A chainlike process (Chain approach), focusing on "coherence"; and
- A cognitive process (INFRAPLAN), focusing on "experience" and "appreciation".

These methods involve a few simple steps or procedures like consultation, interviews, meetings and computer-aided brainstorms.

Figure 6. The Philosophy of an Interactive Approach with Stakeholders.



The "Poldermodel"

The so-called "Poldermodel" of consultation and negotiation is deeply embedded in the genes of the Dutch. In the Middle Ages, they started the battle against the water to keep their feet dry. They gained large areas of land from the sea and lakes by reclamation. The people who inhabited the new territories in a way lived on the bottom of the sea or lake. The surrounding areas were higher. Keeping the polders dry was technically relatively simple. Windmills were used to pump out the excess water. The quantity of water that needed to be pumped out, however, differs from area to area. Some people preferred a lower level than others. This called for consultation and negotiation, hence the term "Poldermodel" was born! The present policy-making process is closely related to the original "Poldermodel".

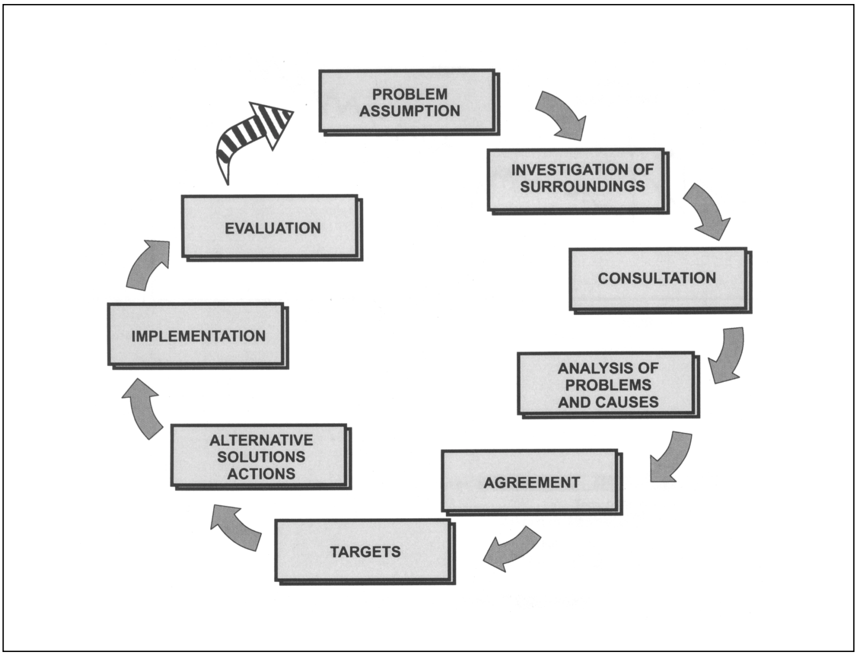
Under the first PPA phase, attention will be given to the fine, good and positive aspects of the issue or problem in order to preserve the useful elements. The next PPA phase is a structural and exhaustive process in which participants will be asked for bottlenecks and problems they have experienced. Then (and this is the main point of an interactive approach) there is the phase in which participants in a creative process are stimulated to find solutions for the established problems (Figure 7).

Participatory policy approaches guarantee a higher quality of policy building by:

- Integrating into existing (formal) procedures;

Figure 7. The Chain Approach.

A PPA example of a step-by-step way of working (Spaink, 1998).



- Accelerating the speed in the process of seeking solutions;
- Enhancing the understanding, commitment and acceptance, thus the support for the policy;
- Enlarging the chance of finding new solutions, thus increasing the resolving powers and the coherence of the policy process as a whole;
- Enhancing the manageability of the policy process, thus improving its structure;
- Improving the concern and consistency of the policy process;
- Improving the efficiency with the aid of advisors, experts and professionals; and
- Offering a conducive atmosphere for participation, thus improving the accessibility of the policy process.

It is not easy to measure the quality of an interactive (participatory) policy analysis (PPA). In summary, apart from general criteria such as effectiveness, efficiency and consistency, the general criteria for PPA process are (Mayer, 1997; Borup, 1998):

- Integrality: A good design takes all the parameters of choice into account; the quality of the policy decision is better.

- Attainability: Is a PPA (sometimes costly) able to achieve its goals? Does it have enough commitment from the parties involved? Is the necessary expertise available and are there sufficient resources?

- Flexibility: Can the PPA process be adapted when the strategic need or context changes?

The above outlines some basic principles of participatory policy-making. In reality, each process will be different and the precise attainment depends upon the initial situation, the problem and the surroundings. It will always be and should be "custom made" like, for instance, in an area plan approach (Spaink, 1998).

Integrated Implementation at the Local Level: Area Planning

A successful approach in The Netherlands in implementing national policies at the local level is integrated area management, with emphasis on spatial planning. As a linkage between the local communities, local waterboards, interest groups and the national implementing agencies, the provincial government takes the lead in developing an integrated local area plan. The area approach is suitable for water systems, including coastal and marine systems. It has to be agreed upon by all parties involved in what the delineation of the area will be. About 10 different integrated coastal area plans have so far been developed in The Netherlands, specifically for estuaries, tidal basins, marine parks and parts of the coastal strip including the dune areas. The first coastal area plan, namely the Oosterschelde (Eastern Scheldt) was prepared in 1993. A more recent one is the integrated policy plan for the Vooedelta, both in southwestern Netherlands.

A provincial board for area planning and management is normally chaired by the provincial governor. All national departments responsible for implementing relevant national policies with implications for the specific area are partners. The mayors of the local communities and the chairman of the waterboards are also members of the area board. Their participation enables them to benefit from national programs. The final result of integrated area planning is an integrated action plan that is agreed upon and signed by all parties involved in the area board. The agreed integrated area plan, thereafter becomes a guide for land-use planning. The local communities have a mandate for its implementation while the province provides the necessary supervision.

After the adoption of the area plan, the area board will continue to integrate the implementation and enforcement of the plan, thus creating a working environment between the government and citizenry. The local NGOs are invited to participate in the area board meeting and, in most cases, they are also involved in the planning processes (Bijlsma, 1998).

Conclusions

To achieve the goals of sustainable economic development, one should be aware of the strong relationship between the land and the sea, between the functional uses and the ecosystems. Such relationship poses challenges to coastal and marine policy and ICZM program implementation. Furthermore, the increasing complexity of the decision-making process and the required networking with a variety of stakeholders call for a paradigm shift from sectoral to a more holistic management approach in broader hydrological, social, economic and psychological dimensions. The government decision-making process becomes more open to stakeholders and the public in general. These developments make public policy elements of increasing importance within ICZM.

In this new setting of the public policy decision-making process, the role of the government agencies is changing dramatically. Management through dialogue and cooperation at federal, regional and local levels with a variety of stakeholders is quite different from conventional bureaucratic management procedures.

A more open decision-making process is a necessity for creating public support and for implementation of the policy decision. An early participation of the public and other stakeholders in analyzing problems and formulating ideas on possible solutions is an important condition for success. The consultation does not have to be a single policy that is fully agreed to by everyone concerned, but it can lead to a policy that is widely accepted. Such policy does not end in paper, but produces results "on the streets" (Spaink, 1998).

Thus, information and communication need special attention in policy-making (Dunn, 1994). Allocation of time and budget for public relations is important.

The objectives of policy intervention should be based on sound scientific reasoning and therefore a linkage between research and monitoring on the one hand and the policy-making process on the other should be established in an early stage.

Participatory policy approach process needs to be reliable, credible and transparent. The concerned government agencies should encourage active participation by stakeholders and local communities. Governments at all levels should be accountable for their actions (Sullivan, 1998). Only then will the public at the far end of the implementation understand the objectives and the need for change and have confidence in their government's actions.

References

Bijlsma, L. 1998. Developing water policy in The Netherlands. 1998 IOC-KMI International Workshop on ICM, Seoul, Korea.

Borup, I. 1998. Survey of the surroundings of interactive policy preparation in the Dutch "Rijkwaterstaat" (in Dutch). Report RIKZ/AB-98. 127 p. National Institute for Coastal and Marine Management, The Hague.

De Ruig, J.H.M. 1996. Communication on coastline management: Land meets sea. ICZM Workshop, Miedzyzdroje, Poland.

De Ruig, J.H.M. and R. Hillen. 1997. Developments in Dutch coastline management: Conclusions from the second governmental coastal report. J. Coastal Conserv. 3: 203-210.

Dunn, W.N. 1994. Public policy analysis: An introduction. 2nd ed. Prentice Hall, Englewood Cliffs.

Mayer, I.S. 1997. Debating technologies: A methodological contribution to the design and evaluation of participatory policy analysis. Tilburg University Press.

Spaink, E. 1998. Chain approach: Results oriented policy. Ministry of Transport, Public Works and Water Management/AUROP.

Sullivan, P.H. 1998. Political objectives and financial means between dream and reality. Proceedings of Sustainable Development Delta 1998.

van der Plas, A.B.M. 1993. Coastal zone management: Challenge for sustainable development. Ministry of Transport, Public Works and Water Management.

How Media can Help in Marine Environmental Protection and Management

Manuel S. Satorre, Jr.

International Federation of Environmental Journalists (IFEJ)
Asia-Pacific Forum of Environmental Journalists (AFEJ) and
Philippine Environmental Journalists Inc. (PEJI)
c/o PEJI, Holy Family Village II, Banilad, Cebu City 6000, Philippines

SATORRE, JR., MANUEL S. 1999. How media can help in marine environmental protection and management, p. 507-511. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

This paper discusses the role of the Global Environment Facility and media in sustainable development. It also focuses on the role of media in covering environmental issues that affect people's lives. The importance of environmental journalists' associations is emphasized as well as the need to train journalists to enhance marine environmental protection and management.

GEF, Media and Development

When the Independent Evaluation team led by Dr. M.S. Swaminathan of the M.S. Swaminathan Foundation based in Chennai, India submitted its report to the Governing Council of the Washington, D.C.-based Global Environment Facility (GEF), the stark revelation was that GEF, also known as "The Green Fund" was not visible in many countries of the world. It was not even visible in countries which were represented in the Governing Council and had GEF political and nongovernment organization (NGO) focal points.

In the countries where GEF was not visible, it was very clear that projects undertaken by the GEF's three implementing agencies—United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) and

World Bank (WB)—had isolated the projects and limited their scope to governments and NGOs. Media has never been made part of the development process. Yet, it is common knowledge that if development programs were to be made "transparent," they must generate public awareness so that their benefits can either be appreciated or even replicated when they become successful.

The focal areas of GEF—Climate Change, Biological Diversity, Land Degradation, International Waters in addition to Ozone Layer Depletion—are so comprehensive in scope and complicated (as these encompass vast areas of environmental issues) that clear understanding is needed for programs to gain full support of communities being assisted and the people of the world as a whole. For without community support, no matter how successfully projects may have been implemented, they will never become sustainable. Sustainability requires project nourishment and protection of whatever conservation measures had been installed.

Mass Media and Environmental Issues

How can community and people support be generated in sustainable development projects? That support can be achieved by harnessing the mass media through the reportage not only of the projects but of vital environmental issues which directly affect communities and people's lives including the future of planet earth.

Although reportage is inherent in its function, mass media is already preoccupied with many urgent issues such as politics, economics, culture, arts, entertainment and others. These other issues get immediate media attention because they have a direct impact on the lives of the media audience and are continuously being explained by media. In these issues, media has made it a point to educate itself because these issues are considered urgent and usually get audience attention.

In the case of the environment, the issues are so complicated and remote that unless there is an immediate impact on a community, they are not covered. Such impacts usually come in the form of violent or tragic situations such as people poisoned by eating polluted shellfish or finfish, people dying due to floods or storms or from chemical poisoning from factories.

In other environmental situations, media simply ignores the issues probably because media itself does not have a clear understanding of what is happening. In human society, oftentimes, what one does not understand, one usually ignores.

Under this circumstance, to get media involved to help in marine environmental protection and management, it must be taught how to understand the issues and their impact on communities and people. Understanding the issues will enable the people to also comprehend what is happening in their own communities and to support sustainable development initiatives.

ENVIRONMENTAL JOURNALISTS' ASSOCIATIONS AND TRAINING PROGRAMS

At the start of the environmental movement in the 1960s which peaked in the 1980s leading to the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, media had practically ignored the importance of environmental issues. Hardly does one find any environmental story in a newspaper, much less on the front page. Neither does one hear radio or see television reports on the environment.

This had prompted the Bangkok-based United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) to call for a Media Conference on the Environment in 1988 which resulted in the establishment of the Asia-Pacific Forum of Environmental Journalists (AFEJ). Dr. Kazi Jalal, who was then head of the Environment and Natural Resources Division of ESCAP and is now the chief of the Environment and Social Development Division of the Manila-based Asian Development Bank (ADB), still recalls that the idea was to form a group of environmental journalists' associations in the Asia-Pacific Region so that they will lead and inspire other journalists to focus reportage on the environment. From an initial 11 countries in which fora of environmental journalists were organized, AFEJ today has grown to cover 18 countries in the region.

To sustain the growth of environmental journalism in the region, through the help of ESCAP and two American journalism professors, AFEJ came up with an environmental training manual called "Reporting on the Environment: A Handbook for Journalists". First published in 1988, it was updated and released in 1996 as a guide to every journalist not only in the Asia-Pacific Region but also the whole world on how to understand and report on environmental issues. The book has been translated into several Asian languages and has been used in every training program undertaken by AFEJ and its affiliate organizations in East Asia composed of the China Forum of Environmental Journalists (CFEJ), Japan Forum of Environmental Journalists (JFEJ) and Korea Reporters' Club on the Environment (KORECE); in Southeast Asia, with the Philippine Environmental Journalists Inc. (PEJI), Indonesian Forum of Environmental Communicators (IFEC), Malaysian Forum of Environmental Journalists, Thailand Forum of Science and Environmental Communicators (TFSEC) and Singapore Forum of Environmental Communicators

(SFEC); in the Pacific, PINA Forum of Environmental Journalists and Solomon Islands Forum of Environmental Journalists; in South Asia, Forum of Environmental Journalists of India, Pakistan Forum of Environmental Journalists (PFEJ), Green Press of Pakistan, Maldives Forum of Environmental Journalists, Forum of Environmental Journalists of Bangladesh, Mauritius Union of Environmental Journalists, Nepal Forum of Environmental Journalists and others. AFEJ has also accepted training groups as associate members.

AFEJ, through the years, has embarked on programs to train journalists in environmental reporting. This has resulted in the growing coverage of environmental issues in countries where an affiliate is operating. It has also initiated joint environmental communication projects with NGOs and other institutions. In addition, it has regularly published newsletters and has come up with State of the Environment reports in their respective countries. It has also established Group Study Exchanges on environmental issues.

Apparently, inspired in what AFEJ has been doing in the Asia-Pacific Region, journalists in the United States later formed the American Society of Environmental Journalists in the early 1990s. Soon, journalists from other countries formed their own environmental journalists' associations. This led to the formation of the International Federation of Environmental Journalists (IFEJ) through the initiative of the United Nations Education, Scientific and Cultural Organization (UNESCO). IFEJ is now based in Paris and covers 40 countries all over the world.

Both AFEJ and IFEJ hold yearly congresses to discuss vital environmental journalism issues and other environmental concerns. The 6th Congress of IFEJ was held in Colombo, Sri Lanka in November 1998. Another IFEJ Congress is set in Bogota, Colombia in October 1999. AFEJ, on the other hand, will hold its congress in Dhaka, Bangladesh in August 1999.

If media is to be tapped to enhance marine environmental protection and management, it must be exposed to such issues through a continuing training program. For it is only by understanding these issues that media would be able to do proper coverage and create public awareness, specially in countries where coastal management programs are being undertaken.

To facilitate media training in marine environmental protection and management issues, coastal management program initiators must have to link up with both AFEJ and IFEJ which already have an existing network of environmental journalists reporting on other environmental issues. Through a partnership with program managers, AFEJ and IFEJ-linked journalists can be trained in a series of workshops that will also take them to actual project sites. Under the program, training materials on marine environmental protection and management can be produced for use in the training of more journalists.

The catch here is that if a journalist is trained to report on a particular issue, he or she will develop a kind of expertise. This will help prompt the journalist to write more about the issues for use in the mass media such as newspapers, magazines, radio, television, newsletters and other communication channels.

Without tapping the journalist by developing his or her expertise on marine environmental protection and management issues, such topics will not be given as much focus in the mass media considering the vastness of environmental issues that have yet to be covered by media. Since media does not have enough resources to switch its focus to such specialized issues as marine environmental protection and management, the coastal management project managers must have to provide the funds and the training facility to get media's attention to these issues.

This has been proven in other training programs in which media has been tapped to develop its expertise in specialized environmental issues. The results were very encouraging as more newspaper space and radio and TV time were eventually given in the reportage of the issues.

Multisectoral Collaboration in the Philippines: A Coastal Management Initiative Builds on Experience

Alan T. White and Catherine A. Courtney

Coastal Resource Management Project
Tetra Tech EM Inc., 5th Floor, CIFC Towers, North Reclamation Area
Cebu City 6000, Philippines

WHITE, ALAN T. and CATHERINE A. COURTNEY. 1999. Multisectoral collaboration in the Philippines: A coastal management initiative builds on experience, p. 512-528. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

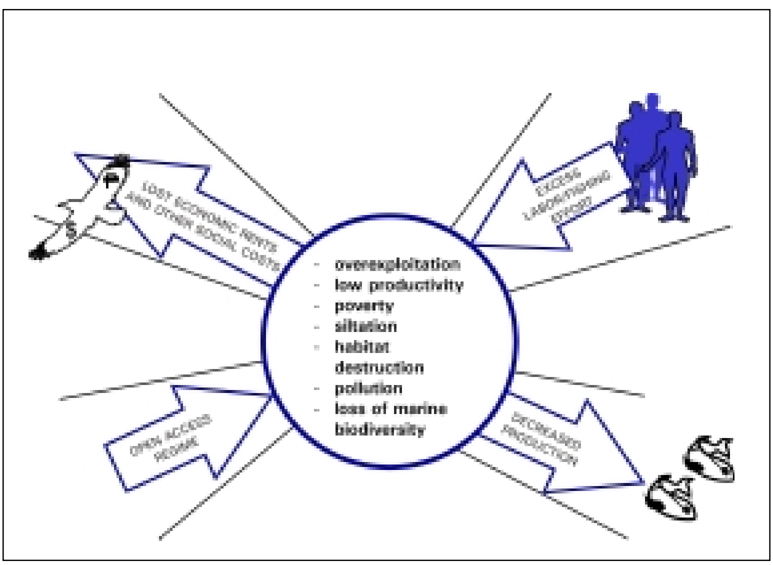
With fisheries declining, coral reefs battered, mangrove forests under threat, pollution levels rising and coastal communities experiencing increased poverty, the Philippines faces severe challenges in managing its coastal resources. Coastal management efforts began in the Philippines more than 20 years ago through various community-based projects. Now, integrated coastal management is expanding in the country and holds potential to reverse the trends. This paper analyzes the situation in relation to new approaches for coastal management being undertaken through the Coastal Resource Management Project (CRMP) supported by the United States Agency for International Development (USAID) and implemented by the Department of Environment and Natural Resources (DENR). This project, drawing on the lessons generated by past and ongoing coastal management initiatives, is emphasizing integrated approaches to management over narrowly focused fisheries management and habitat protection efforts. It highlights the increasingly important role of local governments and the changing roles of national government to effectively support integrated coastal management. Multisectoral collaboration is explained as standard procedure to achieve outcomes that are broad-based and sustainable. Local and national level activities are contrasted and shown as essential complements in building institutionalization of resources management within all levels of government. A practical results framework is explained for measuring relative success at the local government level of implementing best practices for coastal management. Finally, lessons

being learned related to collaboration, level of focus, education and communication, who is responsible and expansion of the project are highlighted.

Philippine Setting for Coastal Management

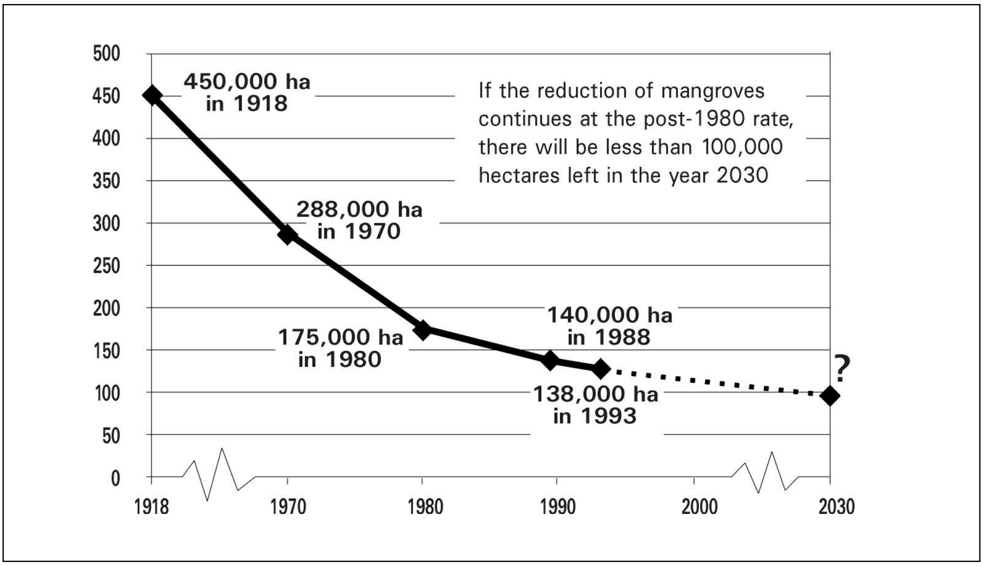
The Coastal Resource Management Project (CRMP) supported by the United States Agency for International Development (USAID) is a project of the Department of Environment and Natural Resources (DENR) and managed by Tetra Tech EM Inc. The CRMP began in 1996 and will operate for seven years with funding of approximately US$17 million. The overall mission of the CRMP is to "catalyze coastal resource management in the Philippines to a threshold that will expand nationwide and be sustainable beyond the life of the project" (Courtney and White, 1996). This large goal is premised on the assumption that the Filipinos are ready to address their coastal management problems in earnest. It also assumes that strategic interventions will catch on and spread to many areas of the country if designed and implemented with full collaboration of government, nongovernment organizations, the private sector, the academe and other stakeholders. The CRMP was formulated with a realization that certain primary coastal management issues must be addressed. It is also realized that the forces driving these issues such as open access regimes, excess labor, declining production and others as shown in Figure 1 are not trivial and need to be understood and corrected as possible.

Figure 1. Situational Analysis for a Typical Philippine Coastal Area.



The extent of the problems in the Philippines should not be underestimated. Although it is easy to talk about destructive fishing and overfishing, population growth, pollution and poverty in the abstract, figures are revealing and help us appreciate the extent of the problem. Mangroves are in trouble as shown in Figure 2 with only about 140,000 hectares remaining in the country. Catch per unit effort is less than one-tenth of what it was in 1950 both at the national as well as the local scale as shown in Figures 3 and 4. Coral reefs are deteriorating which also contributes to declining fish catch. Pollution is increasing rapidly along coasts where urban development is prevalent.

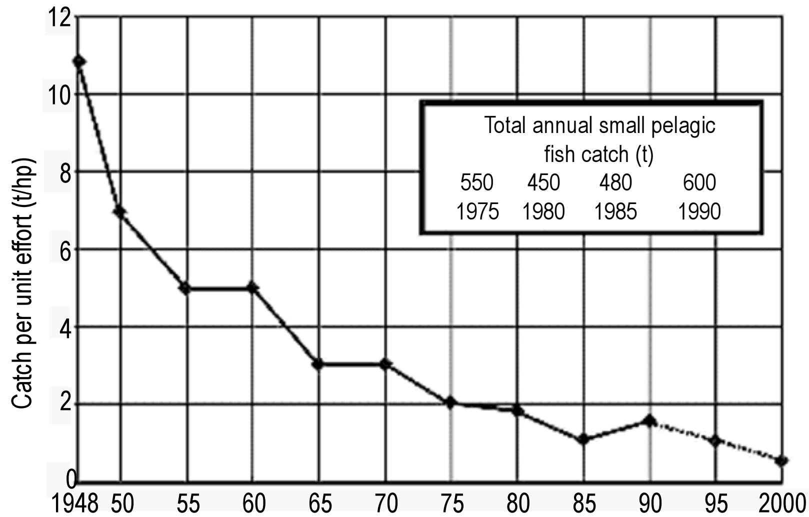
Figure 2. Mangrove Area Decline in the Philippines.



Source: DENR (1988); World Bank (1989); White and de Leon (1996).

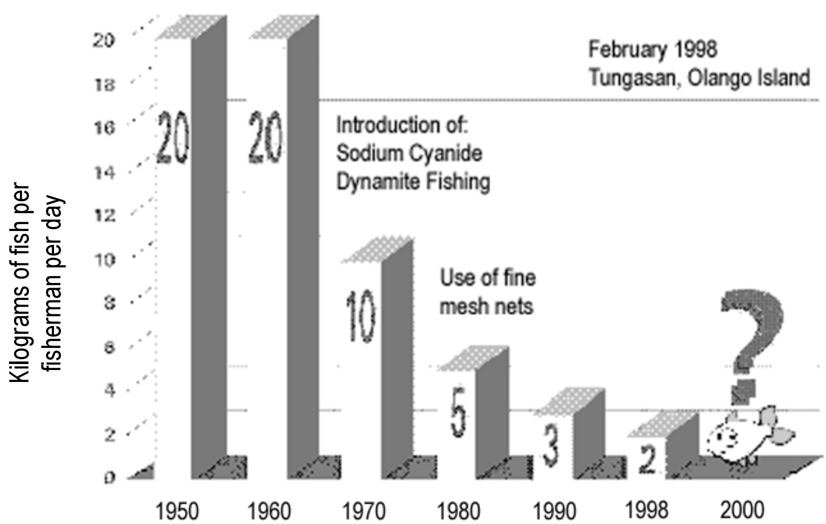
Given the rather dire situation in Philippine coastal areas, the CRMP, together with the DENR and the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture (DA) has formulated a set of operational goals and objectives. These reflect the urgent need to protect critical coastal habitats and to reduce fishing effort (Figure 5). The mechanisms used to achieve these objectives have evolved from a significant history of coastal management in the country starting in the mid-1970s. The various coastal projects have ranged from small island conservation activities to set up marine reserves and sanctuaries, to large, baywide and national programs to improve the state of coastal resource management. Although there have been successes and failures, there is a wealth of lessons learned which are now being used to design more effective programs. These lessons are summarized by Courtney and White (in press) and are also reflected in the design and operation of the CRMP described below.

Figure 3. Trend of Catch Per Unit Effort Since 1948 for Small Pelagic Fish Catch.



Source: Dalzell et al. (1987).

Figure 4. Declining Catch Per Fisherman in One Fishing Village Since 1960.



Trend of catch per unit effort for one barangay, Olango Island, Cebu (Result of community assessment of coastal resources conducted by the Coastal Resource Management Project)

Figure 5. Operation Goals and Objectives for Coastal Resource Management.

Project Implementation Mechanisms

The CRMP espouses multidisciplinary, multisectoral (crossing political and institutional as well as environmental boundaries), multistage and participatory processes of planning, implementation and monitoring for coastal management as learned from past efforts in coastal management (Chua and Scura, 1992; Scura et al., 1992; Christie and White, 1997). The CRMP promotes these crosscutting and integrated approaches with a focus on sustainable resource use which minimizes impacts on coastal ecosystems from fishing, aquaculture and tourism. This integrated approach is accomplished by collaborating with ongoing projects of the municipal and national governments and other donor-assisted projects focused on the coastal environment and its governance. Key activities are:

- Participatory coastal resource assessment as defined by Walters et al. (1998);
- Participatory and integrated coastal management (ICM) planning;
- Economic development for coastal resource users through environment-friendly enterprise development;

- Implementation of limited access regimes such as marine sanctuaries, use zones, gear restrictions and licensing of resource users;

- Training in skills relevant for ICM planning and implementation;

- Legal instruments required for effective support of ICM;

- Policy analysis and formulation; and

- Monitoring and evaluation.

The CRMP activities are being implemented at the national and local levels to expand project activities to 2,000 km of coastline by the year 2001. The core of CRMP field work is located in 29 municipalities along 670 km of coastline. The various mechanisms used to implement and expand the project activities involve collaboration with national and local government units and various private organizations as indicated in Figure 6. Collaboration; information, education and communication; and other means are applied at the national level to support field level work (Figure 6). The six learning areas of CRMP are located primarily in the southern half of the country while the main office is in Cebu (Figure 7).

Figure 6. National and Local Expansion Mechanisms of CRMP.

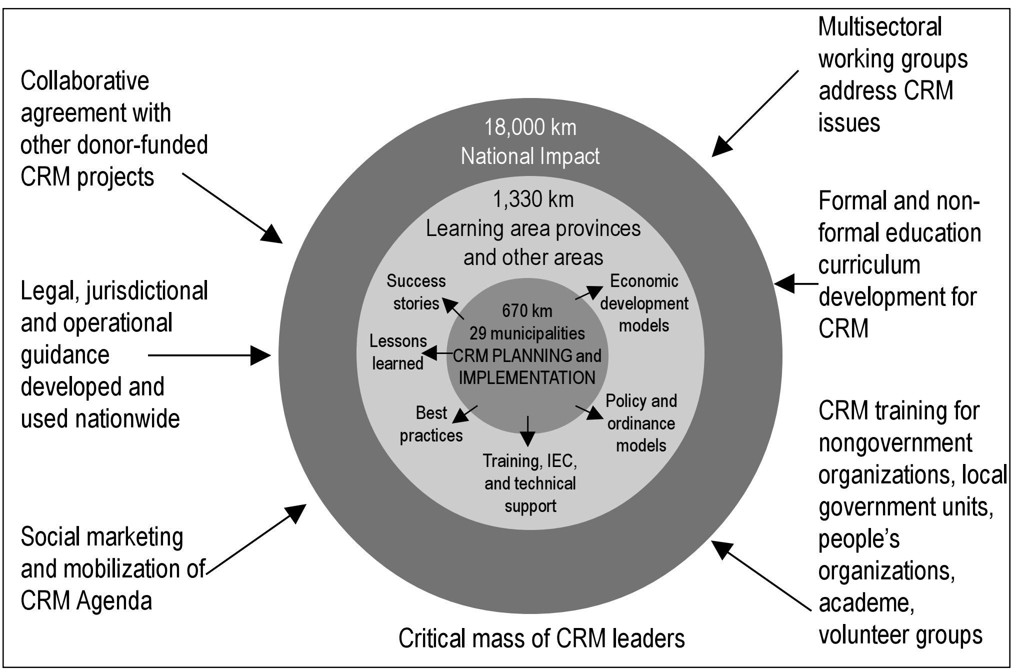
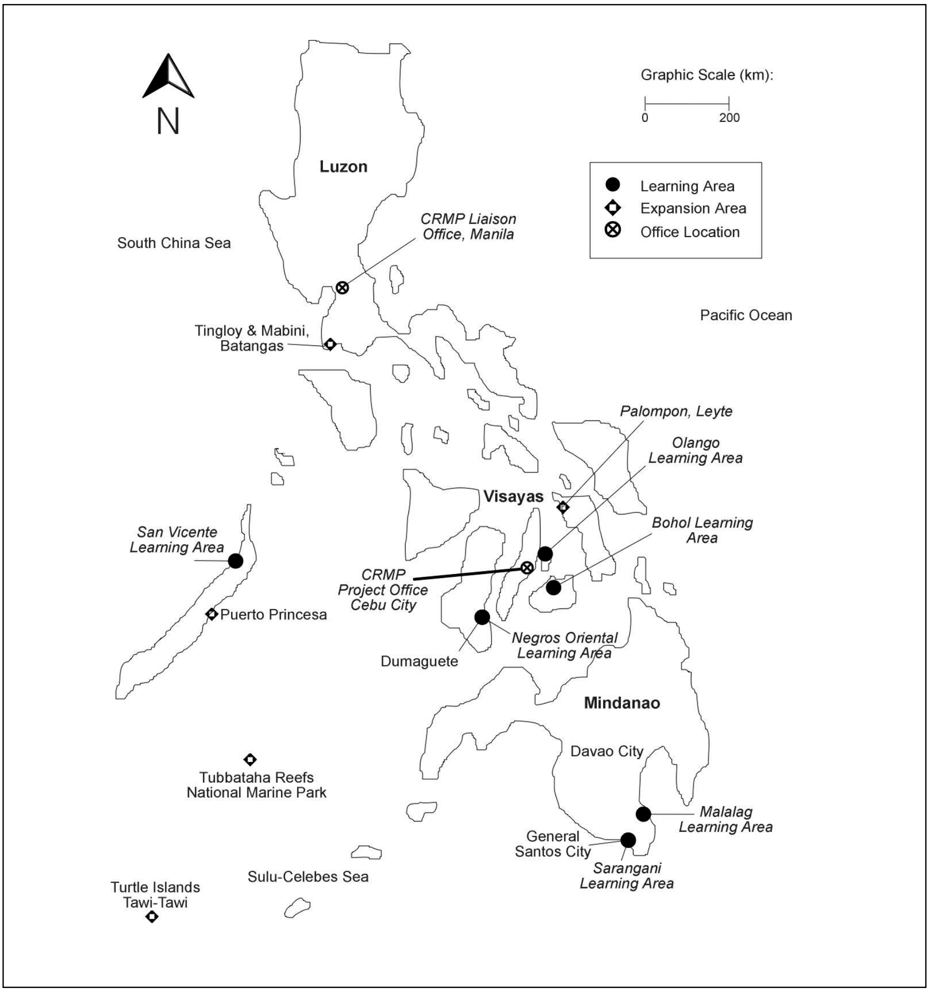


Figure 7. Learning and Expansion Areas of CRMP.



The results framework for CRMP as designed for USAID and for tracking the progress of the project is shown in Figure 8. The two primary indicators give a geographical sense of project presence and an indication of biophysical improvement or change for coral reefs. The kilometers of coastline with improved management of coastal resources being implemented is qualified through the successful implementation of certain interventions as listed in the box entitled, "Improved Local Implementation of CRM".

The six learning areas and 29 municipalities where CRMP is focusing its field efforts are all engaged in a participatory CRM planning process. This process

Figure 8. Results Framework for the CRMP.

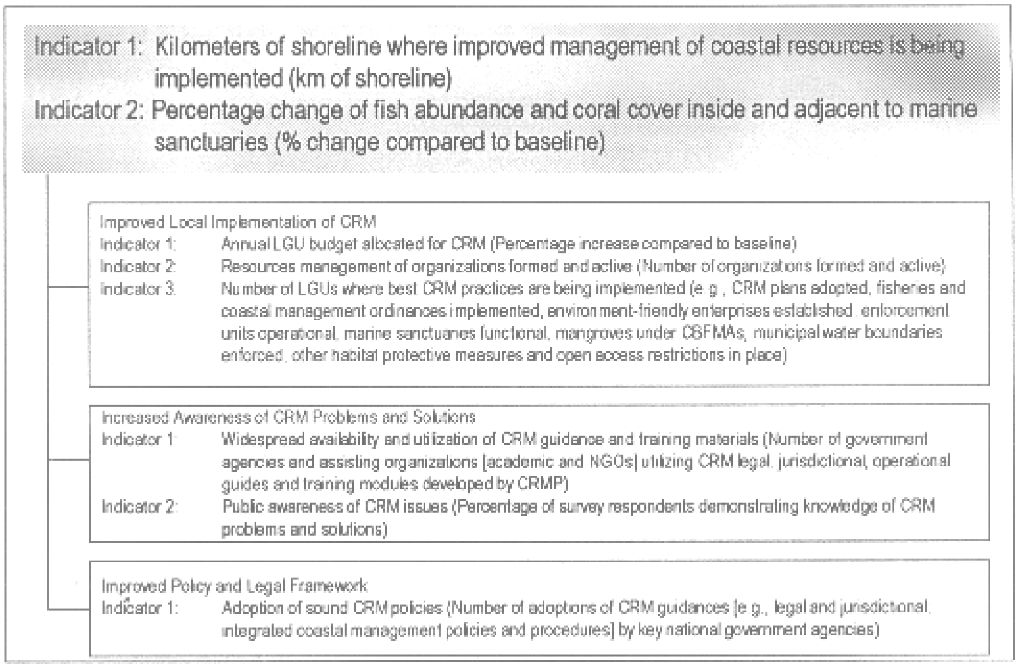
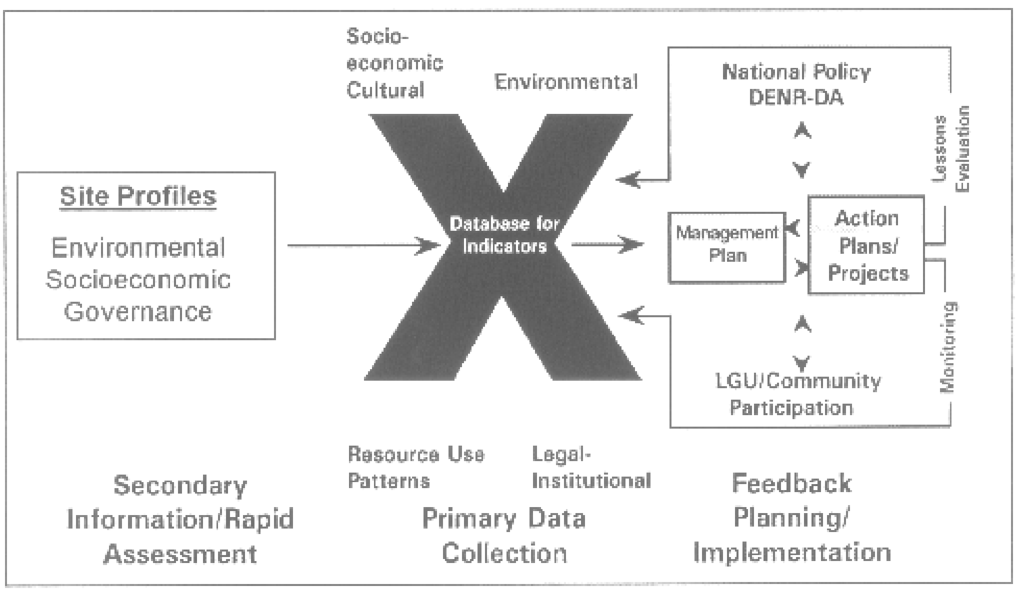


Figure 9. Cyclical Data Collection, Monitoring, Planning and Implementation Process.



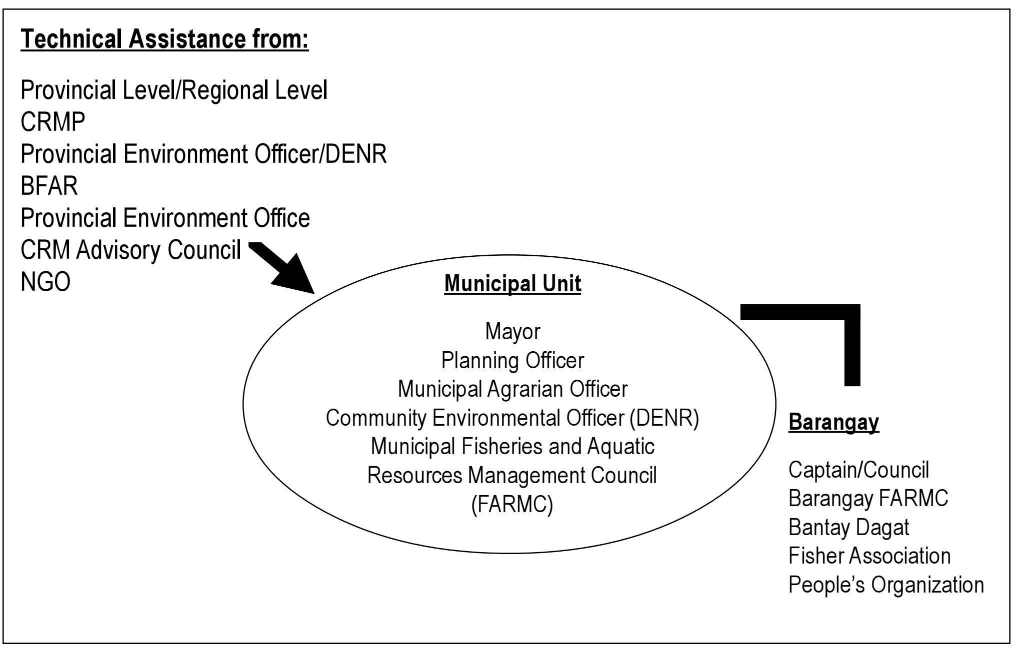
Source: White and Lopez (1991).

attempts to build on good information and a database for plan formulation (Figure 9). This cyclical process continually engages more stakeholders so that barangay and municipal level plans and actions are the result. A key factor in the success is that local governments allocate budget and resources to support coastal management. The budget allocation is one of the results monitored by CRMP. Other key activities and results are:

- Participatory integrated coastal management plans at municipal and learning area levels developed and implemented;
- Appropriate ordinances by local governments passed and enforced;
- Barangay and municipal (city) resource management organizations functional;
- Personnel trained and function in CRM; and
- Increased enterprise opportunities in place.

The primary players in this planning process are at the local government (provincial, municipal and barangay) level (Figure 10). It is apparent that the

Figure 10. Municipal Integrated Coastal Management Unit Key Participants.

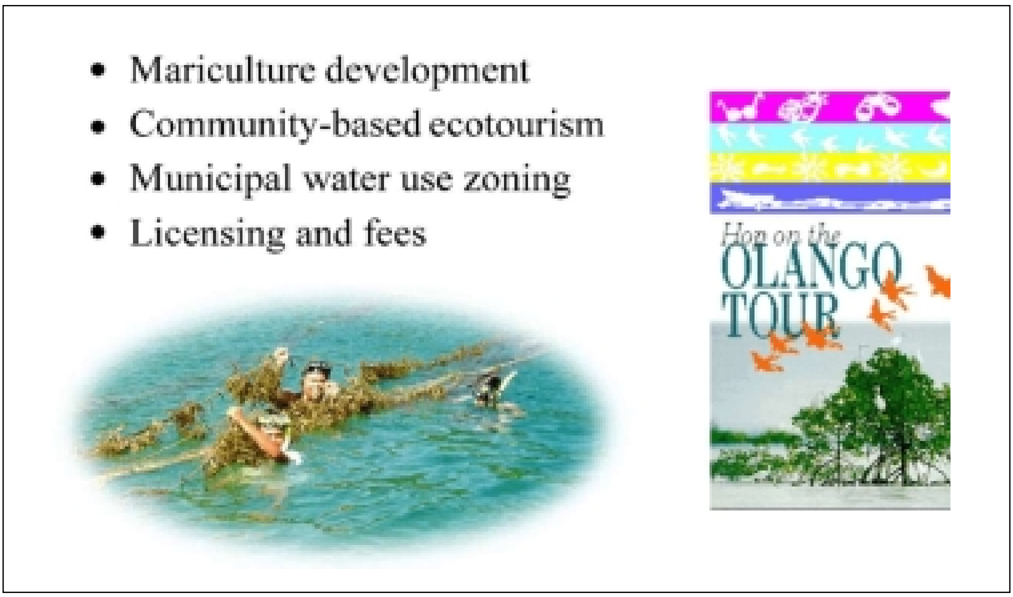


provincial and national government offices play mostly a technical assistance role to the municipal and city governments in this process. This has been reinforced in the Philippines with the passing of the Local Government Code in 1991 and the Fisheries Code of 1998 that strongly support local jurisdiction and responsibility for management of coastal resources. This jurisdiction now extends to 15 km offshore as well.

Economic Incentives for Coastal Management

The development of economic alternatives to fishing and natural resource exploitation is a high priority issue for coastal management in the Philippines. The types of enterprises being supported by CRMP are both environment-friendly

Figure 11. Developing Economically Driven Coastal Management Alternatives.



and generally require a clean and healthy environment to thrive (Figure 11). Thus, an added benefit of enterprise development is that local stakeholders will have a built-in incentive to protect their fragile coastal areas.

Probably the largest economic incentive for improved coastal management in the Philippines will be better knowledge and understanding about the real benefits from protecting and managing the resource base as natural resources.

Some research and analysis of new and published data have revealed the potential economic gain from a hypothetical bay or stretch of coastline (about 20 km long) if it is protected and used in a sustainable manner. In addition, the cost of

Table 1. Annual Revenues (values) of Coastal Resources in a Hypothetical Bay and the Associated Costs of Management.

Resources	Area (km^2)	Potential Annual Revenue ** (in US$)
ANNUAL REVENUES		
Coral reefs	5	250,000
Fisheries		90,000
Tourism		75,000
Shoreline protection		60,000
Biodiversity		25,000
Mangrove forest	1	120,000
Fisheries		50,000
Wood		10,000
Shoreline protection And other contributions***		60,000
Open-water fisheries not dependent on either reefs or mangroves	10	10,000
Total		**380,000 (P15.2 million)**
ANNUAL COST OF MANAGEMENT		
Staff community level work (2 persons)		9,000
Training		5,000
Sanctuary maintenance		6,000
Patrol boat and operation		10,000
Information dissemination		2,000
Other		2,000
Total		**34,000 (P1.36 million)**

US$1 = P40 in 1998

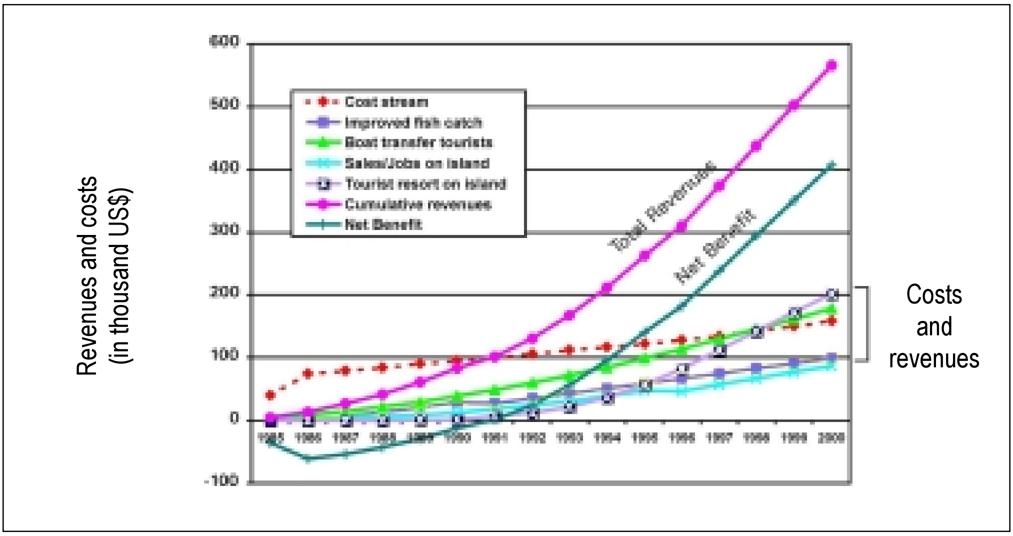
** This analysis assumes that without management, revenues would be significantly less or zero.

*** This figure is a small portion of the estimates by Costanza et al. (1989) for shoreline protection, recreation and habitat which has not been estimated for Philippine mangroves.

Source: White and Cruz-Trinidad (1998).

managing this bay has been estimated to compare the required investment of management with the potential returns. As seen in Table 1, the returns from sustainable use and protection are much higher than the cost of management. These numbers make a clear and strong case for stopping the destruction of coastal resources in the Philippines.

Figure 12. Accrued Revenues and Costs from the Sustainable Use of Apo Island Coral Reef and Fishery Resources.



A similar analysis for a small marine reserve protecting about one square kilometer of coral reef on Apo Island, Negros Oriental also shows the high return versus cost of management of a 15-year period (Figure 12). The community on this small island has gained tremendously from the management regime started in 1984 through community participation and local institution mentoring of Silliman University. This small-scale model cannot always be replicated at a larger scale but at least it indicates that success is possible at a scale where local communities can manage their own resources.

Collaboration, Partners and Training are Critical

Since the inception of CRMP in 1996, it has been building partnerships and collaboration among the government and private sectors in the country. Several examples of partnerships and collaboration are shown in Figure 13. In addition to these activities, the CRMP has enlisted the full support of the League of Municipalities through a search for the best CRM program award. It has also established working agreements with donors implementing similar projects such as the Asian Development Bank-supported Fisheries Resources Management Project. Other partners throughout the country are shown in Figure 14.

Figure 13. Promoting Partnerships and Multisectoral Collaboration.

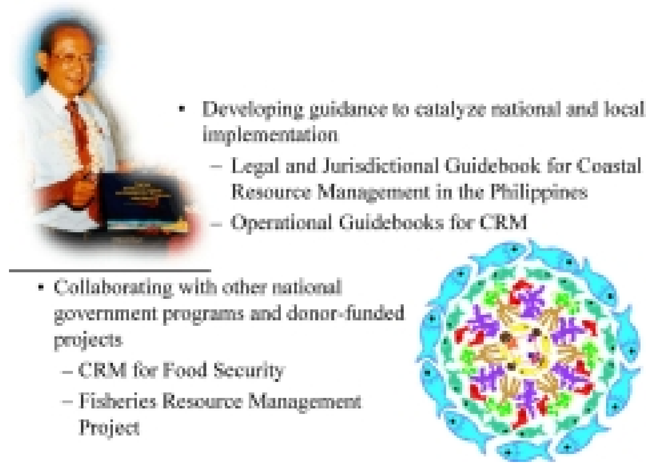
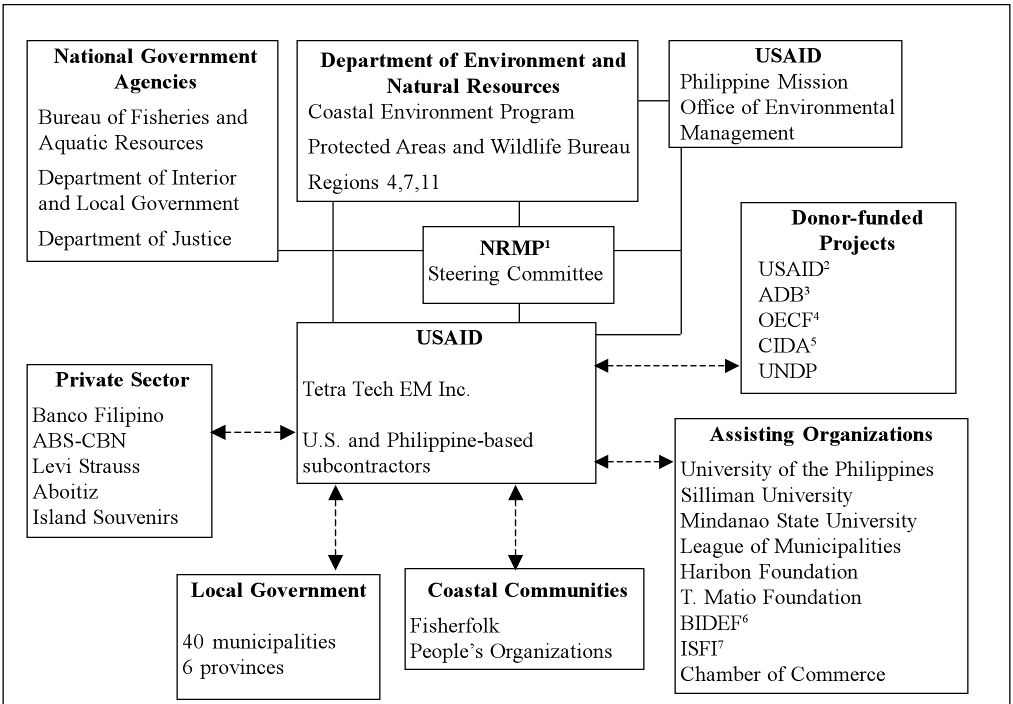


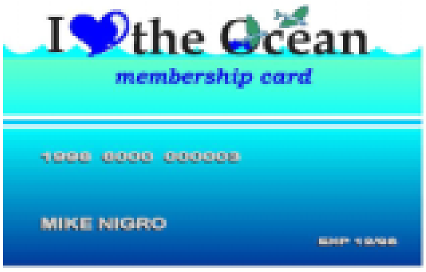
Figure 14. CRMP Partners and their Relationships.



[1] NRMP = Natural Resource Management Project
[2] USAID = United States Agency for International Development
[3] ADB = Asian Development Bank
[4] OECF = Overseas Economic Cooperation Fund
[5] CIDA = Canadian International Development Agency
[6] BIDEF = Bohol Integrated Development Foundation
[7] ISFI = Institute of Small Farms and Industries

Figure 15. Establishing a Broad Support Base for CRM.

- Providing opportunities and mechanisms for individual and collective action
- Involving all sectors of society and all ages



- Over 10,000 members of the "I Love the Ocean" movement
- 50,000 participate in the International Year of the Ocean parades, ocean quiz bowls, "Save the Ocean" painting contests, Blue Tapestry community arts project
- 70,000 participate in International Coastal Clean-up

Information, education and communication play a key role in informing people all over the Philippines about the need to conserve and manage coastal resources. The CRMP has embarked on a large variety of activities to permeate the different parts of society with information about coastal management and its importance (Figure 15). Publications and videos have been augmented with social mobilization activities in both local field areas as well as urban centers. A major event in 1998 was a traveling exhibit: "Our seas, our life", that visited five cities and attracted more than one million viewers.

Vance Packard of the Pyramid Climbers has said that: "Leadership appears to be the art of getting others to want to do something that you are convinced should be done". Since changing human behavior is a large aspect of any coastal management initiative, this reality can be applied to the situation in the Philippines where good leaders are needed to stimulate people into action to conserve their coastal environment. CRMP has taken this to heart and designed several training courses that aim to increase the technical capability of various individuals and institutions to take on the task of improved coastal management. One of the themes of all training in CRMP is to build leaders. As an example of the number of people directly affected and trained by the project with an opportunity for leadership building, Table 2 lists the different kinds of training conducted in Negros Oriental.

Table 2. Number of People Trained in CRM Activities in Negros Oriental Learning Area with Nine Municipalities and 100 km of Coastline.

Activity	No. of Participants
ICM training	
10-day training	35
3-day training	486
Project orientation	1,380
Resource assessment	548
Law enforcement	2,021
Education seminar	679
Enterprise training	176
Cross-visits	40
Total	**5,365**

LESSONS BEING LEARNED

The lessons of CRMP point to the real difficulty of implementing integrated coastal management in the context of environmental degradation and poverty. The need to develop multipronged approaches is essential to any level of success so that economic and environmental issues can be addressed simultaneously. A few key lessons are:

- Focus on national and local level work simultaneously;
- Use multiple education and communication strategies to build a wide base of support for integrated coastal management;
- Encourage collaboration and synergy among agencies and donor projects;
- Promote expansion by supporting demand from committed local governments and other institutions; and
- Support leadership in ICM through training, education and learning by doing.

References

Chua, T.E. and L.F. Scura, Editors. 1992. Integrative framework and methods for coastal area management. ICLARM Conference Proceedings 37, 169 p.

Christie, P. and A.T. White. 1997. Trends in development of coastal area management in tropical countries: From central to community orientation. Coastal Management 25: 155-181.

Costanza, R., S.C. Farber and J. Maxwell. 1989. Valuation and management of wetland ecosystems. Ecol. Econ. 1: 335-361.

Courtney, C.A. and A.T. White. 1996. Onwards to more aggressive leadership in Philippine coastal resource management. Tambuli No. 1: (1-5 November).

Courtney, C.A. and A.T. White. Integrated coastal management in the Philippines: Testing new paradigms. Coastal Management (1999), Taylor and Francis, New York. (In press)

Dalzell, P., P. Corpuz, R. Ganaden and D. Pauly. 1987. Estimation of maximum sustainable yield and maximum economic rent from the Philippine small pelagic fisheries. Bureau of Fisheries and Aquatic Resources Tech. Pap. Ser. 10 (3), 23 p.

DENR (Department of Environment and Natural Resources). 1988. Mapping of the natural conditions of the Philippines. Final Report Swedish Space Corporation, Solna, Sweden.

Scura, L.F., T.E. Chua, M. Pido and J.N. Paw. 1992. Lessons for integrated coastal zone management: The ASEAN experience, p. 1-70. *In* T.E. Chua and L.F. Scura (eds.) Integrative framework and methods for coastal area management. ICLARM Conference Proceedings 37, 169 p.

Walters, J.S., J. Maragos, S. Siar and A.T. White. 1998. Participatory coastal resource assessment: A handbook for community workers and coastal resource managers. Coastal Resource Management Project and Silliman University, Cebu City, Philippines. 113 p.

White, A.T. and A. Cruz-Trinidad. 1998. The values of Philippine coastal resources: Why protection and management are critical. Coastal Resource Management Project, Cebu City, Philippines. 96 p.

White, A.T. and R.O. De Leon. 1996. Mangrove resource decline in the Philippines: Government and community look for new solutions. Tambuli 1996.

White, A.T. and N. Lopez. 1991. Coastal resources management planning and implementation for the Fisheries Sector Program of the Philippines, p. 762-775. *In* Proceedings of the 7th Symposium on Coastal and Ocean Management.

World Bank. 1989. Philippines: Environment and natural resources management study. World Bank, Washington, D.C.

THE ROLE OF COMMUNITY IN ENVIRONMENTAL MANAGEMENT

Angel C. Alcala

Commission on Higher Education
5/F DAP Bldg., San Miguel Avenue, Ortigas Center
Pasig City, Philippines

ALCALA, ANGEL C. 1999. The role of community in environmental management, p. 529-537. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

ABSTRACT

In the Philippines, communities have participated in agricultural community development since the 1950s. However, their active involvement in coastal and marine environments dates back much later to the 1970s. This was brought about by these factors: perceived widespread destruction of the environment and depletion of marine resources; failure of top-down management approaches of government to arrest environmental deterioration, forcing communities to seek other solutions to the worsening destruction of coastal resources; and the relative success of early community-based management and protective schemes for coastal and marine resources. Community-based approaches make sense as communities are the de facto managers of their resources. Communities are most effective when organized. This process is usually done by outside agencies/organizations that are skilled in social preparation, environmental education and community organizing. A working, empowered community organization, especially if institutionalized, is crucial to the sustainability of environmental management projects. Through such an organization, and with the assistance of local government units and partner organizations, a community performs activities, such as development planning, protective management, income generation, capacity training, environmental monitoring and networking. Communities appear to be most effective in "simple" projects (e.g., fisheries protection and management) without other complicating issues (e.g., industrial pollution). Complex projects involving several stakeholders and many environmental issues would require integrated coastal management approaches.

INTRODUCTION

In the Philippines, the important role of the community in rural development was realized by community developers as early as the 1950s (pers. obs.). During these times, the focus was mainly on agriculture and the thrusts were on improvement of the quality of human life as indicated by increased agricultural production, improved health and better nutrition. There was little, if any, concern for the environment, as large areas of many islands were covered with forests, seas, rivers and lakes that were productive. To bring about rural development, it was deemed necessary to organize residents or communities of rural areas to initiate activities and projects to improve both agricultural production and social services.

The participation of Philippine coastal and fishing communities in environmental management dates back to the 1970s (Alcala, 1998) and was brought about by a number of factors. By this time marine scientists and professional diving groups using Self-Contained Underwater Breathing Apparatus (SCUBA) had begun to document the widespread destruction of coral reefs. Moreover, observations on massive cutting of mangroves and upland deforestation increased people's awareness of the critical service functions of the environment in maintaining fisheries. Another factor was the perception of local communities that government, with its top-down resource-oriented management approach characterized by control, monitoring and surveillance by central authorities without the involvement of local communities, was not able to stop the destruction of marine ecosystems. This forced people to seek other solutions to the worsening natural resource degradation (Williams, 1994). The 1980s saw the rapid acceptance of community-based coastal resource management projects mostly initiated by nongovernment organizations and academic institutions. In the 1990s, local government became more open to adopting management systems involving community participation as allowed under the 1991 Local Government Code (Ferrer et al., 1996). Still another factor was the relative success of marine and coastal environmental projects in which communities had extensively participated (Ferrer, 1992; Alcala and Vande Vusse, 1994; Carlos and Pomeroy, 1996; Alcala, 1998).

The important role of communities in the management of upland forests has been recognized by the Philippine government. Since 1992, the Department of Environment and Natural Resources has established community-based forestry projects (pers. obs.).

The active participation of organized communities in the management of coastal environment and resources has gained worldwide acceptance as one of the viable strategies in the management of marine ecosystems and the dwindling fishery resources (Scura et al., 1992; Pomeroy, 1994; Ruddle, 1994; Gubbay, 1995). A recent paper with a worldwide perspective argues that fishery management practices of tribal and peasant societies are generally successful because they are consistent with fishery biology and the chaotic nature of marine resources (Acheson and Wilson, 1996).

This paper focuses on coastal communities that took the major leadership in managing the environment and the resources therein, with the assistance of partners initiating interventions to address problems of poverty, deteriorating environment and depletion of resources. These partners include academic institutions, local government units and nongovernment organizations. The communities are generally poor and consist mostly of fishermen who depend for their livelihood on coastal ecosystems, including coral reefs, mangroves, estuaries, seagrass beds and adjacent shallow marine waters. These communities live in coastal areas far from industrial zones which do not have serious pollution problems, except for sedimentation from uplands. Such areas are "simpler" than urbanized areas where multiple resource uses and the presence of several stakeholders with diverse goals in life often render environmental management difficult.

Activities Participated in by Communities

There are a number of activities in which local communities participate in the management of the environment. But before they can do so, they must be socially prepared, organized and empowered to perform their key role as day-to-day managers of the environment (Abregana, 1994; Wells and White, 1995; Newkirk and Rivera, 1996; Alcala, 1997, 1998). This is the community organizing phase, which includes environmental education, as carried out in most cases by nongovernment organizations and academic institutions in close cooperation with the local government units. (These outside organizations ideally should leave after viable community organizations have been firmly established.) Community organizing as a process is conducted by skilled social development workers and takes varying periods of time to result in the establishment of viable community organizations. This process is so important that, based on experience, other activities necessary for environmental management may not be possible without cohesive, working community or people's organizations. It is these organizations that make comprehensive development plans, identify projects and implement them.

Protective management activities are major concerns of organized coastal communities (Ferrer et al., 1996; Alcala, 1997). In areas where fishery resources are the focus of protection, the fish sanctuary or marine reserve usually takes a great deal of attention from communities. The reason is obvious. Marine sanctuaries have been shown to enhance fishery yields after a period of time (Alcala, 1988; Alcala and Russ, 1990; Russ and Alcala, 1996). Such protected areas are best managed by communities or co-managed by communities and local governments for the obvious reason that these stakeholders stay in those areas, in contrast to national agencies which have offices in provincial and national capitals. The establishment of fish sanctuaries requires approval of local (and sometimes national) governments, and sanctuary management depends on the implementation of regulations enacted by communities and duly approved by local governments. It is the responsibility of the community leaders to manage protected areas in a democratic manner. This is usually done through a management committee.

Communities need sources of livelihood which should be ideally sea-based. They have to work with people having skills in mariculture, sea ranching and other similarly productive activities. Fish ranching on seagrass beds, algal farming and saltmaking are some examples of productive activities of communities (pers. obs.; Luchavez, 1996). In few instances, increased incomes have been reported from enhanced fish yield and tourism as a result of the establishment of marine reserves (Alcala, 1997; Vogt, 1997). On small islands, handicrafts as souvenir items for tourists are additional sources of income. Income-generating activities help ensure sustainability of environmental management programs, but communities often require outside assistance from partner agencies.

A considerable part of community activity is networking with local and national agencies and organizations, academic institutions, and sometimes international agencies (Ferrer et al., 1996; Alcala, 1998). This is because in general communities need the skills and expertise of outsiders. Such areas as monitoring of environmental and resource quality, income generation, and resolution of legal issues require the help of experts and specialists. It is the responsibility of these specialists to involve and train members of the community to perform tasks they are capable of doing to reduce reliance on outsiders. This is especially true in routine monitoring of protected areas and income generation through introduced technologies. It must be understood, however, that communities may generate technologies by themselves. Examples of simple technologies developed by fishing communities in the Central and Western Visayas are mangrove reforestation to enhance fisheries and the building of rock mounds on seagrass beds which are alternately covered and uncovered by tides in order to ranch fish (pers. obs.). Another value of networking is to prevent or reduce the probability of certain influential individuals from manipulating community decisions for selfish ends.

Organized fishing communities are concerned with the training of their members in environmental management. They welcome seminars on a range of subjects to educate themselves on technical topics, including marine ecology, fisheries, nutrition, health, community dynamics and technologies to increase fishery production (pers. obs.). Partner organizations play an important role in facilitating the holding of these seminars. It is of course the organized community that makes these plans and executes them.

The above discussed activities serve to empower communities to develop a sense of being proprietors and managers of resources in coastal and marine areas. It is only when they feel and behave that they are "owners" of these resources that they can be expected to manage them in a sustainable manner (Walters, 1994).

Evaluation of Community-based Environmental and Resource Management Projects

Some questions about the usefulness of community-based approaches have been expressed. These include questions of responsibility, accountability and sustainability. Are communities responsible enough to be trusted with the management of their environment and resources? To whom are they accountable for the use of resources that may be entrusted to them? Pomeroy (1994) expressed his fear that subsistence-level fishing communities would not accept long-range management plans. Sorensen and McCreary (1990) argue that local governments and local communities cannot adequately manage their coastal resources because of their limited area jurisdiction, limited research capacity, limited budgetary resources and dominance of parochial interests in local politics. These questions are relevant and most of them have bearing on the larger issue of sustainability of community-managed projects. Most of these problems have been overcome by organized fishing communities in non-industrial areas through training, capacity building, linkage, and close cooperation with, and assistance from, local governments (Alcala, 1998). The issue of responsibility of communities is probably adequately addressed by the requirement of community organizing and their empowerment to manage their own resources in a sustainable way. It may be that communities are most effective in managing "simple" projects (e.g., fisheries protection) without complicated problems (e.g., industrial pollution). Based on a rough assessment of some 20 community-based environmental and fishery projects, it was concluded that in about half of them, the communities were successful in setting up: (1) viable and working community (people's) organizations; (2) working protected areas or marine reserves; (3) sources of livelihood; (4) networking arrangements; and (5) capacity building programs (Alcala, 1998). The first three criteria were fully accomplished but the other two were partially done.

Community-based management implies a major role for local communities in the process of managing the environment and resources. In practice, organized local communities need assistance from local government units in order to successfully manage their environments and resources to the extent that some writers have suggested the term co-management to describe the mode of management. In addition, as expressed earlier, players external to the community assist in various ways in the conduct of activities in the community, but since the primary manager of the environment and resources is the organized community, which is the largest stakeholder, the mode of management is essentially community-based.

Ferrer et al. (1996) reviewed nine community-based coastal resource projects throughout the country, ranging from simple ones aimed at protecting mangroves and coral reefs for fishery enhancement to complex ones in which a number of local organizations, academe and government units participated, each having its own objective. The complex ones may be said to practice the concepts of integrated coastal management. In this review, several lessons learned were drawn from the nine case studies (Newkirk and Rivera, 1996), including the need for community organizing, environmental education, partnership with government, demonstration of impact of marine reserves, alleviation of poverty and outside agents (partner organizations) for capacity building.

Carlos and Pomeroy (1996) reviewed and evaluated 104 community-based coastal resource management projects and programs which were established in the Philippines in 1984-1994. These ranged widely in scope and in complexity. Some of them had probably little, if any, community organizing, the single most important feature common to community-based management approaches, according to practitioners in this field. The authors classified these projects and programs according to various criteria and analyzed the types of interventions and activities employed. Their recommendations are worth looking at more closely. They are as follows: (1) look into costs and benefits of alternative project design, implementation and monitoring systems; (2) conduct quantitative impacts of project interventions on fish stocks, marine habitats, coastal resources and socioeconomic conditions of coastal communities; (3) consider factors that favor successful implementation of community-based coastal resources management (CBCRM) in different settings; (4) document processes and methods CBCRM practitioners use; (5) enhance technical and social skills of practitioners; (6) CBCRM institutions to promote CBCRM by replicating successful experiences; (7) continue providing technical support to strengthen and sustain local institutions engaged in CBCRM; (8) forge more partnerships and collaborative arrangements with other institutions in the conduct of CBCRM; and (9) work together towards the attainment of a unified legislative and policy framework attuned to the needs of the fisheries sector and CBCRM. From these recommendations, it appears that the authors favor the use of community-based approaches in the management of coastal environments and resources. Indeed, many outlying areas in the Philippines present themselves as potential sites for successful management by local communities.

References

Abregana, B.C. 1994. Attempts at community-based resource management: The development action project in the Bais Bay Basin (August 1991-December 1993). Silliman J. 37: 9-25.

Acheson, J.M. and J.A. Wilson. 1996. Order out of chaos, the case for parametric fisheries management. American Anthropologist 98: 579-594.

Alcala, A.C. 1988. Effects of protective management of marine reserves on fish abundances and fish yields in the Philippines. Ambio 17: 194-199.

Alcala, A.C. 1997. Roles of community-based fisheries management and marine reserves in coastal fisheries. Silliman J. 38: 159-169.

Alcala, A.C. 1998. Community-based coastal resource management in the Philippines: A case study. Ocean Coastal Manage. 38: 179-186.

Alcala, A.C. and G.R. Russ. 1990. A direct test of the effects of protective management on abundance and yield of tropical marine resources. J. Cons. CIEM 46: 40-47.

Alcala, A.C. and F.J. Vande Vusse. 1994. The role of government in coastal resource management, p. 12-19. *In* R.S. Pomeroy (ed.) Community management and common property of coastal fisheries in Asia and the Pacific: Concepts, methods and experiences. ICLARM Conference Proceedings 45, 189 p.

Carlos, M.B. and R.S. Pomeroy. 1996. A review and evaluation of community-based coastal resources management projects in the Philippines, 1984-1994. ICLARM, Makati City, Philippines. 78 p.

Ferrer, E.M. 1992. Learning and working together towards a community-based resources management. Research and Extension for Development Office, College of Social Work and Community Development, University of the Philippines, Diliman, Quezon City.

Ferrer, E.M., L.P. dela Cruz and M.A. Domingo, Editors. 1996. Seeds of hope. College of Social Work and Community Development. University of the Philippines, Quezon City, Philippines. 223 p.

Gubbay, S. 1995. Marine protected areas—past, present and future, p. 1-14. *In* S. Gubbay (ed.) Marine protected areas: Principles and techniques for management. Chapman and Hall, London. 232 p.

Luchavez, T.F. 1996. Ecosystems rehabilitation and resource management in Caliling, Negros Occidental, p. 22-28. *In* Proc. of the Visayas-Wide Conference on Community-based Coastal Resources Management and Fisheries Co-Management, ICLARM, Makati City, Philippines.

Newkirk, G.F. and R.A. Rivera. 1996. Synthesis, p. 195-202. *In* E.M. Ferrer, L.P. dela Cruz and M.A. Domingo (eds.) Seeds of hope. College of Social Work and Community Development, University of the Philippines, Quezon City, Philippines. 223 p.

Pomeroy, R.S. 1994. Introduction, p. 1-11. *In* R.S. Pomeroy (ed.) Community management and common property of coastal fisheries in Asia and the Pacific: Concepts, methods and experiences. ICLARM Conference Proceedings 45, 189 p.

Ruddle, K. 1994. Changing the focus of coastal fisheries management, p. 63-86. *In* R.S. Pomeroy (ed.) Community management and common property of coastal fisheries in Asia and the Pacific: Concepts, methods and experiences. ICLARM Conference Proceedings 45, 189 p.

Russ, G.R. and A.C. Alcala. 1996. Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines. Mar. Ecol. Prog. Ser. 132: 1-9.

Scura, L.F., T.E. Chua, M.D. Pido and J.N. Paw. 1992. Lessons for integrated coastal zone management: The ASEAN experience, p. 63-86. *In* T.E. Chua and L.F. Scura (eds.) Integrative framework and methods for coastal area management in ASEAN: Lessons learned. Bandar Seri Begawan, Brunei Darussalam.

Sorensen, J. and S. McCreary. 1990. Institutional arrangements for managing coastal resources and environments. Rev. 2nd ed. COAST. Renewable Resources Information Series. Coastal Management Publication No. 1, National Park Service, US Department of Interior and USAID.

Vogt, H.P. 1997. The economic benefits of tourism in the marine reserve of Apo Island, Philippines. Sea Wind 10: 13-19.

Walters, J.S. 1994. Property rights and participatory coastal management in the Philippines and Indonesia. Coastal Management in Tropical Asia 1994: 20-24.

Wells, S. and A.T. White. 1995. Involving the community, p. 61-84. *In* S. Gubbay (ed.) Marine protected areas: Principles and techniques for management. Chapman and Hall, London. 232 p.

Williams, M.J. 1994. Foreword, p. v. *In* R.S. Pomeroy (ed.) Community management and common property of coastal fisheries in Asia and the Pacific: Concepts, methods and experiences. ICLARM Conference Proceedings 45, 189 p.

Urban Waste Expertise Programme (UWEP)—Pilot Project Setting in the Batangas Bay Region, Philippines

Melchor S. Palmares

Urban Waste Expertise Programme (UWEP)
Center for Advanced Philippine Studies
Rm. 202 Loyola Heights Condominium
Esteban Abada cor. F. dela Rosa St.
Loyola Heights, Quezon City 1108, Philippines

PALMARES, MELCHOR S. 1999. Urban Waste Expertise Programme (UWEP)–Pilot project setting in the Batangas Bay Region, Philippines, p. 538-545. *In* Chua Thia-Eng and Nancy Bermas (eds.) Challenges and opportunities in managing pollution in the East Asian Seas. MPP-EAS Conference Proceedings 12/PEMSEA Conference Proceedings 1, 567 p.

Abstract

The Urban Waste Expertise Programme (UWEP) has developed four pilot projects on community-based management in the Batangas Bay Region, Philippines. Participation of stakeholders includes involvement in meetings, workshops and seminars; contribution of financial and manpower resources; involvement and endorsement of project activities by the local executives; data gathering; formulating constitutions and by-laws; promoting willingness to practice waste reduction and recycling; and formulating and implementing ordinances related to integrated sustainable waste management system.

Introduction

The Province of Batangas, Philippines is approximately 112 km south of Metro Manila. It has a total land area of 3,166 km^2 and a total population of about 1.5 million, with a 2.58% average annual population growth rate. It is composed of two cities and 32 municipalities, subdivided into four districts: District I—sugar, aquaculture and tourism area; District II—industrial area; District III—lakeshore area and District IV—agribusiness area.

The Batangas Bay Region was chosen as a pilot site by the Urban Waste Expertise Program (UWEP) for waste management.

The UWEP is funded by The Netherlands Government and managed by WASTE, a Dutch nongovernment organization. It is a six-year program (1995-2001) with the purpose of generating employment in waste handling through small- and micro-enterprises and improving the environmental conditions of low-income communities. Through its course, the program aims to develop local expertise by means of researches and implementation of pilot projects; disseminate documented knowledge and technology on waste management and promote waste policies, integrating small- and micro-entrepreneurs in the existing waste management systems.

The UWEP links up with the activities of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas and the Environment and Natural Resources Office of the Province of Batangas (PG-ENRO), the environment arm of the province. It uses the concept of integrated coastal management (ICM) (MTE, 1996), which means that the setting of objectives, planning and management of resources and systems in the coastal area should take an integrated rather than a sectoral approach. Furthermore, it concentrates on building partnerships and capabilities among different stakeholders. It is in this context that UWEP sees its Integrated and Sustainable Waste Management (ISWM) Project as supportive of the integrated coastal management program of Batangas Bay. It can become a partner in the protection and management of environment in the bay region. UWEP believes that waste management projects should comprehensively consider environmental, financial, economic, political, institutional, sociocultural and technological aspects. The collaboration among various stakeholders in the community ensures the sustainability of the project.

Pilot Project Setting

The UWEP has formulated four pilot projects in the Batangas Bay Region. These are: 1) establishment of local waste coordinating body in the municipality of Bauan, Batangas (June-December 1998); 2) development of community-based waste management system under a community-private partnership in Bauan (June 1998-June 1999); 3) enhancement of resource recovery and recycling sector in the municipalities of Bauan, Mabini, San Pascual, Tingloy and in the city of Batangas (June 1998-June 2000); and 4) the establishment of an integrated sustainable waste management in the island of Tingloy (June 1998-December 2000). These pilot projects are primarily implemented by the Batangas Social

Development Foundation, Inc., a local nongovernment organization acting as lead organization on community mobilization efforts.

The four pilot projects are interrelated in the sense that each project is supportive of each other. While the community is encouraged to practice waste minimization, reuse and recycling, it has the support of the junk shop operators as waste buyers. At the same time, the junk shop operators are organized into an environment cooperative. All these efforts have institutional and political support from the waste management coordinating body composed of representatives from different sectors on the project area.

STAKEHOLDERS' PARTICIPATION

Participation of stakeholders includes involvement in meetings, workshops and seminars; contribution of financial and manpower resources; involvement of local executives; data gathering; formulating constitutions and by-laws; promoting willingness to practice waste reduction and recycling; formulating and implementing ordinances related to integrated sustainable waste management system.

Data Gathering

This is the collection of information to determine the existing situation especially the local initiatives on solid waste management. This has resulted in the establishment of a database on micro-enterprises engaged in waste management (junk shop operators and waste buyers); community-based activities undertaken periodically by individuals, households, community organizations and nongovernment organizations and conditions that are particularly supportive or particularly inhibitory to micro-enterprises or community-based activities. The strategies used for the data gathering were actual interviews with key informants, site visits and field observations. Actual visits include local government offices. Interviews covered respective officers and personnel, itinerant waste buyers, waste pickers, leaders of community organizations and nongovernment organizations. Secondary materials such as reports, studies and municipal and provincial files were reviewed as sources of information for the study.

Project Proposal Development

Proposals for the four pilot projects mentioned above were developed based on the problems identified in the data gathering phase. The proposals were discussed with and accepted by the various stakeholders in Bauan and Tingloy. Roles and responsibilities were confirmed and project objectives were validated with the various stakeholders. The pilot projects are viewed as programs further specified by the target group in the course of the project. The proposals provide the direction and outline the boundaries for further development of the activities.

Courtesy Call

Courtesy calls were made on local executives of the municipalities of Tingloy and Bauan which provided the opportunity to inform them about the project objectives, rationale, methodologies, time frame and responsibilities of the stakeholders. Their role in the attainment of solid waste management system in selected project areas was also emphasized. Commitment in principle was also achieved.

Information and Education Campaign

The information and education campaign aims to provide information on waste segregation, recycling activities, effects of waste on the environment, and education on the possible implementation of waste segregation and setting up of a center for waste management activities. Stakeholders who wanted to be involved in the project participate in the workshops, open forums and undergo exposure trips to a Manila-based organization called *Linis Ganda*, a federation of cooperatives of junk shop operators.

Realizing the opportunities in proper waste management, the stakeholders have agreed to organize themselves and sustain a waste management system in their locality. Identification of other stakeholders for expansion of the project operations has been expressed.

Integration

Integration is done through house to house visits, field observations and consultation with local leaders. The integration process resulted in better understanding of the sociocultural condition, identification of potential leaders, establishment of good rapport with the local leaders, acceptance and better understanding of the project, eagerness by the different stakeholders to learn more about the project benefits, realization of the positive and negative aspects of previous efforts on waste management and expression of opinion about the project.

Project Orientation

Selected leaders and representatives of the different stakeholders in the community were oriented on the project rationale, objectives, roles and responsibilities of the stakeholders, mechanics of implementation, time frame, general activities and the pilot project relationship with other national projects. This has resulted in the formation of a local body or structure that would facilitate the implementation of an integrated sustainable waste management system and the development of a plan of action for the formation of the local body.

Implementation of Supporting Activities

Social marketing and technological options study

This is an investigation of the volume and type of demand for improved waste management facilities and the potential financial contribution from stakeholders. This study was a collaborative effort of the consultant from WASTE, local sanitation expert, Batangas Social Development Foundation, Inc., community of Tingloy, PG-ENRO and the GEF/UNDP/IMO Regional Programme. The team identified an alternative for the delivery of waste management services in the pilot barangay and measured the affordability to pay and the willingness to pay of the community for such service.

Study of marketing opportunities for recyclable materials

This study determines the market potential and processing of recyclable materials gathered by junk operators in the region. The team composed of a consultant from WASTE and the Batangas Social Development Foundation, Inc. was able to identify a marketing plan for recyclable materials that could provide additional income and employment opportunities as well as a credit fund to provide financial assistance to small junk shop operators.

Organization Building

A series of meetings and consultations were held as preparatory activities for the formalization of a municipal waste management coordinating body. Preparatory activities include the drafting of constitution and by-laws, formulation of a one-year action plan, establishment of an organizational structure and solicitation of funds for the body. A municipal waste management coordinating body was established in each of the project sites in Bauan and Tingloy. The coordinating bodies are composed of representatives from the local government units (e.g., Mayor's Office, Municipal Planning and Development Office, Municipal Engineering Office, Police Department, Health Office, Social Works, Sangguniang Bayan and Barangay Council) and private groups like schools, churches, cooperatives, NGOs, CBOs and junk shop operators. The coordinating bodies serve as venue to facilitate the institutionalization of an integrated and sustainable waste management system in the project area. An area in the municipality of Bauan was identified to serve as pilot site to carry out resource recovery and recycling in collaboration with junk shop operators in the area. A cooperative of junk shop operators from the Batangas Bay Region was also formed. Of the 25 junk shop operators in the region, 17 are members of the cooperative.

Capacity Building

Strengthening the membership of the waste management bodies and junk shop operators cooperative was attained through seminars where the principles, objectives and practical considerations in developing activities related to the concepts and requirements set forth by concerned government agencies were discussed. Two seminars have been conducted, the Membership Seminar on Cooperative and the Ecological Waste Management Seminar which were held in coordination with the Provincial Cooperative Development Office. After the seminar, the 17 members of the junk shop operators cooperative agreed to have a membership fee of ₱500* each and a total paid up capital of ₱40,000 payable upon registration and a total subscription capital of ₱136,000 payable within a year.

Establishment of an Integrated and Sustainable Waste Management System

This is the stage where the concepts and plans for an integrated and sustainable waste management system at the community level are put into practice. The residents are encouraged to practice waste minimization, reuse and recycling by bringing the marketable and biodegradable waste to the redemption center for further processing. The community and the junk shop operators under the supervision of the municipal waste management coordinating body will manage the center. The center will serve as storage site for recyclable materials and compost.

As for Tingloy, a waste management system has been recommended by WASTE. The municipal government allocated ₱75,000 for the system where the barangay council provides waste bins along the main streets. An ordinance regarding proper waste management is in process including the willingness to pay a monthly fee of

* *US$1 = ₱38 in 1998*

₱30 by the residents. For Barangay San Miguel, an existing waste management system is strengthened. Local engineers were tapped for the design of the redemption center and the barangay council has started, reclaiming an area of 1.7 hectares along the seashore.

Networking

This is the establishment of linkages with other organizations or institutions where resources could be shared. Measures could also be provided in the adoption of an integrated sustainable waste management system within their premises. Linkages were established with the private sector and with the provincial and municipal government offices, schools and churches within the region.

CONTRIBUTING FACTORS IN THE PROJECT PROCESS

Project Stakeholders' Role and Responsibilities

Local government units provide institutional support in terms of budget, formulation and implementation of local ordinance related to an integrated and sustainable waste management system, giving mandate to the local waste management bodies, information and education on environmental laws.

The involvement of nongovernment organizations and community-based organizations in community-based activities enhanced leadership in various activities and developed an organizational structure for waste management activities.

The role of junk shop operators and micro- and small-entrepreneurs in the promotion of resource recovery is translated into recyclable waste buying which at the same time provides additional income for the waste pickers.

The technical and funding support of the funding agency provides direction for effective and efficient project implementation.

Education and Capacity Building

Continuous education to raise public awareness is carried out to encourage wider participation from various sectors of the community.

Advocacy

Advocacy is considered at different levels—sharing of information with other organizations or municipalities to share the project experiences; formulation of ordinances and its implementation and development of linkages for resources sharing and mobilization.

REFERENCE

MTE (Multidisciplinary Team of Experts). 1996. The coastal environmental profile of the Batangas Bay Region. MPP-EAS Technical Report No. 5, 148 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Annex I

List of Participants

List of Participants

BELGIUM

Marc RICHIR
European Commission
Environment, Nuclear Safety and Civil Protection/Water Protection
TRMF 3/106
Rue de la Loi 200
B-1049 Bruxelles
Belgium
Phone: 32 2 295 8758
Fax: 32 2 296 8825
Email: marc.richir@dg11.cec.be

BRUNEI DARUSSALAM

SABRI Haji Mohd. Taha
Fisheries Department
3rd Floor, Ministry of Industry and Primary Resources Bldg.
Jalan Menteri Besar BB3910
Brunei Darussalam
Fax: 02 382069
Email: IKANBL1@BRUNET.BN

CAMBODIA

LONG Rithirak
MAK Sideth
CHEA Sina
Ministry of Environment
48 Samdech Preah Sihanouk
Tonle Bassac, Chamkarmon
Phonm Penh, Cambodia
Telefax: 855 23 27844
Email: minenvlb@forum.org.kh

CANADA

Donald HODGINS
Seaconsult Marine Research Ltd.
8805 Osler Street, Vancouver, B.C.
Canada V6P 4G1
Phone: 604 266 9135
Fax: 604 266 8855
Email: smrl@ultranet.ca

DPR KOREA

LI Hak Gwon
General Bureau for Cooperation with International Organizations (GBCIO)
Jungsong-dong, Central District
Pyongyang, DPR Korea
Phone: 850 2 18222/8306
Fax: 850 2 381 4461

JO Nam Ho
External Relations Department
State Hydrometeorological Administration
Oesongdong, Central Dist.
Pyongyang, DPR Korea
Phone: 850 2 33628
Fax: 850 2 381 4416

YUN Yong Sop
Ministry of Foreign Affairs
Kwangbok-dong Mangyondae District
Pyongyang, DPR Korea

INDONESIA

Rokhmin DAHURI
Center for Coastal and Marine
Resource Studies
Bogor Agricultural University
Gedung Marine Center Lantai 4
Fakultas Perikanan IPB P.O. Box 286
Bogor, Indonesia
Phone: 62 251 621 1068
Fax: 62 251 621 1086
Email: r-dahuri@indo.net.id

Hasjim DJALAL
Department of Foreign Affairs
Jl. Taman Pejambon No. 6
Jakarta 10110, Indonesia
Phone: 62 21 344 1508 ext. 4110
Fax: 62 21 385 8029

Martin O'NEILL
PB Power
Jl. H. Saidi V No. 4
Cipete Selatan
Jakarta Selatan 12410
Indonesia
Phone: 62 21 766 7985/86
Fax: 62 21 759 05634
Email: pbpowerjkt@pbworld.com;
oneillm@pacific.net.id

Tommy PURWAKA
BAPEDAL
Pollution Control, BAPEDAL
Jl. DI Panyaitan
Kav 4, Kebon Nanas
Jakarta, Indonesia
Phone: 62 21 720 2878/720 0009;
858 0066
Fax: 62 21 8590 4929

Aprilani SOEGIARTO
Indonesian Institute of Sciences-LIPI
Sasana Widya Sarwono
Jl. Jenderal Gatot Subroto No. 10
Jakarta 12710, Indonesia
Phone: 62 21 525 1542; 522 5711
Fax: 62 21 520 7226
Email: aprilani@centrin.net.id;
prosea@indo.net.id

Ni Wayan SUDJI
Environmental Management
Department
Bali Province Government
Jalan Basuki Rachmat
Niti Mandala, Renon
Denpasar, Bali
Indonesia
Phone: 62 361 231-167
Fax: 62 361 236-037

ZULHASNI
Subdirectorate for Marine
Pollution Control
BAPEDAL
Arthaloka Building, 6th Floor
Jl., Jend. Sudirman No. 2
Jakarta 10220, Indonesia
Phone: 6221 251 2562; 251 1540
Fax: 6221 251 1547; 251 1483
E-mail: zulhasni@hotmail.com

JAPAN

Makoto OMORI
Department of Aquatic Sciences
Tokyo University of Fisheries
4-5-7 Konan, Minato-ku
108-8477 Tokyo, Japan
Phone: 81 3 5463 0533
Fax: 81 3 5463 0542
E-mail: makomori@tokyo-u-fish.ac.jp

MALAYSIA

Hajah Rosnani IBARAHIM
Department of Environment
13th Floor, Wisma Sime Darby
Jalan Raja Laut, 50662 Kuala Lumpur
Malaysia
Phone: 60 3 2936235; 603 2947844
Fax: 60 3 2931044
E-mail: hri@jas.sains.my

TONG Soo Loong
Alam Sekitar Malaysia Sdn. Bhd. (ASMA)
No. 19 Jalan U8/84
Jelutong Business and Technology Center
40150 Shal Alam
Selangor, Malaysia
Tel. No: 60 3 745 4566
Fax No: 60 3 745 3566
E-mail:
sltong@enviromalaysia.com.my

Kum Sang LOW
Lasers and Optoelectronics Laboratory
Institute of Post Graduate Studies and Research
University of Malaya
50603 Kuala Lumpur, Malaysia
Phone: 60 3 759 4427/4428/4602 to 03
Fax: 60 3 756 8940/7568940/7594606
E-mail: h1lowks@umcsd.um.edu.my

Norzilla MOHAMED
UNDP Kuala Lumpur
Wisma U.N. Block C
Damansar Office Complex
Jalan Dungun, Damansar Heights
5490 Kuala Lumpur, Malaysia
Phone: 603 255 9122; 255 9133
Fax: 603 255 2870

A. SASEKUMAR
Institute of Post Graduate Studies and Research
University of Malaya
Kuala Lumpur 50603
Malaysia
Phone: 60 3 757 7000
Fax: 60 3 759 4606; 756 8940
Email: sasekumar@hotmail.com

ZULKIFLI Abdul Rahman
Department of Environment
12th Floor, Wisma Sime Darby
Jalan Raja Laut
50662 Kuala Lumpur
Malaysia
Phone: 60 3 294 7844
Fax: 60 3 293 1480
Email: zar@jas.sains.my

THE NETHERLANDS

Joost H.M. DE RUIG
Ministry of Transport, Public Works and Water Management
National Institute for Coastal and Marine Management
P.O. Box 20907
2500 EX The Hague
The Netherlands
Phone: 31 70 311 4373
Email:
J.H.M.druig@rikz.rws.minvenw.nl

Mattheus F. STURM
DHV Consultants
P.O. Box 1399
3800 BJ Amersfoort
The Netherlands
Fax No: 31 33 468 2601
Tel No: 31 33 468 2607
Email: we@cons.dhv.nl
theosturm@compuserve.com

Jian LIU
Erasmus University Rotterdam
Faculty of Law
P.O. Box 1738
3000 DR Rotterdam
The Netherlands
Phone: 31 10 408 1615
Fax: 31 10 212 5441
Email: liu@law.eur.nl

NORWAY

John S. GRAY
Section of Marine Zoology and
Marine Chemistry
Biological Institute
University of Oslo
P.O. Box 1064 Blindern
0316 Oslo, Norway
Phone: 47 2 254510
Fax: 47 2 2854438
Email: j.s.gray@bio.uio.no

PEOPLE'S REPUBLIC OF CHINA

DONG Lifang
China International Center for
Economic & Technical Exchanges
Ministry of Foreign Trade & Economic
Cooperation
18 Bei San Huan Zhong Lu
Beijing 100011
People's Republic of China
Telefax: 86 10 6201 1328

GAO Zhiguo
Institute of Marine Development
Strategy
State Oceanic Administration
1 Fuxingmenwai Ave.
Beijing 100860
People's Republic of China
Phone: 8610 6802 2137
Fax: 8610 6803 0757
Email: zgao@public.bta.net.cn

LI Haiqing
Department of International
Cooperation
State Oceanic Administration
1 Fuxingmenwai Avenue
Beijing 100860
People's Republic of China
Phone: 8610 6804 2695
Fax: 8610 6803 0799
Email: depicsoa@public.east.cn.net

LIU Jinxing
Ocean & Fishery Department
Liaoning Province
c/o Fuxingmenwai Ave.
Beijing 100860
People's Republic of China
Fax: 8610 6803 0799

LIU Lifen
Department of Sea Use
State Oceanic Administration
1 Fuxingmenwai Ave.
Beijing 100860
People's Republic of China
Fax: 8610 6803 0799

XU Kuncan
The Third Institute of Oceanography
State Oceanic Administration
No. 178 Daxue Road, Xiamen
People's Republic of China
Phone: 86 592 208 5880
Fax: 86 592 208 6646

XUE Xiongzhi
Environmental Science Research
Center
Xiamen University
Xiamen

People's Republic of China
Phone: 86 592 218 2216 or 218 6416
Fax: 86 592 218 4029 or 218 0655
Email: xzxue@jingxian.xmu.edu.cn

SPECIAL ADMINISTRATIVE REGION (SAR), CHINA

Paul K.S. LAM
Centre for Coastal Pollution and Conservation
Department of Biology and Chemistry
City University of Hong Kong
83 Tat Chee Ave.
Kowloon, Hong Kong SAR
China
Phone: 852 2788 7681
Fax: 852 2788 7406
Email: bhpksl@cityu.edu.hk

Nora F.Y. TAM
Department of Biology and Chemistry
City University of Hong Kong
83 Tat Chee Ave.
Kowloon, Hong Kong SAR
China
Phone: 852 2788 7793
Fax: 852 2788 7406
Email: bhntam@cityu.edu.hk

Rudolf S.S. WU
Centre for Coastal Pollution and Conservation
Department of Biology and Chemistry
City University of Hong Kong
83 Tat Chee Ave.
Kowloon, Hong Kong SAR
China
Phone: 852 2788 7402/7403
Fax: 852 2788 7406
Email: BHRSWU@cityu.edu.hk

PHILIPPINES

Corazon L. ABANSI
Batangas Bay Demonstration Project
PG-ENRO, Capitol Site
Batangas City, Philippines
Phone: 63 43 980 8242
Fax: 63 43 723 2468
Email: bpdenro@cybat.sequel.net

Eunice AGSAOAY
Institute of International Legal Studies
University of the Philippines Law Center
Diliman, Quezon City 1101
Philippines
Phone: 63 2 434 9532; 927 7180
Fax: 63 2 927 1788
Email: euniceja@pworld.net.ph

Angel C. ALCALA
Commission on Higher Education
5/F DAP Bldg.
San Miguel Avenue
Ortigas Center, Pasig City
Philippines
Phone: 63 2 635 5829
Fax: 63 2 633 1926
E-mail: sumanila@gaia.psdn.iphil.net

Joselito Francis ALCARIA
Department of Environment and Natural Resources
Region VII
Greenplains Subd., Banilad
Mandaue City, Cebu
Philippines
Phone: 63 32 345 3903
Fax: 63 32 346 2271
Email: ecosci@mozcom.com

Anthony AMBAHAN
UNEP Youth Advisory Council
c/o Public Affairs Office
Department of Environment and Natural Resources
CARAGA Region
Ambago, Butuan City
Philippines
Phone: 63 85 341 5579
Fax: 63 85 226 4500
Email: anthonya2@yahoo.com

Brenda Jay C. ANGELES
Institute of Human Rights
University of the Philippines Law Center
Diliman, Quezon City 1101
Philippines
Phone: 632 434 9525
Email: bjay@philonline.com

Agnes APAO
Biology Department
Silliman University
Dumaguete City 6500
Philippines
Telefax: 63 35 225 4608
Email: mlsu@mozcom.com

Constancio ARCIAGA
Department of Environment and Natural Resources
Region III
San Fernando, Pampanga
Philippines
Phone: 63 45 963 4652

Carlos ARIDA
Coastal Environment Program
Department of Environment and Natural Resources
Amalgamated Bldg.
Balite, San Fernando
Pampanga, Philippines
Phone: 63 45 963 4652

Remilio ATABAY
Department of Environment and Natural Resources
Region I
Boy's Scout Bldg.
Aguila Rd., San Fernando City
La Union, Philippines
Phone: 63 72 242 5342

Ma. Myrna BALLERA
Coastal Environment Program
Department of Environment and Natural Resources
Region 8, Sto. Nino Extension
Tacloban City, Philippines
Phone: 63 53 321 3319
Fax: 63 53 327 2591

Florendo BARANGAN
Department of Environment and Natural Resources
Region VII
Greenplains Subd.
Banilad, Mandaue City
Cebu, Philippines
Phone: 63 32 346 2209; 345 3903; 345 3904
Fax: 63 32 346 2271
Email: ecosci@mozcom.com

Romeo BASADA
Department of Environment and Natural Resources
Region XI
Door # 1, Felbets Bldg.
Lanang, Davao City
Philippines
Phone: 63 82 234 1867

Jay BATONGBACAL
Philippine Center for Marine Affairs, Inc.
c/o Institute of International Legal Studies
University of the Philippines Law Center
Diliman, Quezon City
Philippines
Phone: 632 434 9532; 927 7180
Fax: 632 927 1780
Email: philmar@pworld.net.ph

Helena BENITEZ
National Centennial Commission – Women Sector
c/o Office of the President
Philippine Women's University
Taft Avenue, Manila
Philippines
Phone: 63 2 536 8647; 521 3383; 524 2733
Fax: 63 2 722 7093

Domingo BRAVO
Department of Environment and Natural Resources
Region IV
1515 L & S Bldg.
Roxas Blvd., Ermita
Manila, Philippines

Jo-Rex CAMBA
Western Mindanao State University
San Jose Rd., Zamboanga City
Philippines
Phone: 63 62 200 7056
Fax: 63 62 991 3065
Email: leivendy@mailcity.com

Antonio H. CERILLES
Department of Environment and Natural Resources
DENR Compound
Visayas Ave., Diliman
Quezon City, Philippines
Phone: 632 928 0691 to 93
Fax: 632 920 4352

Frederick R. CONTRERAS
Tabangao Refinery, Pilipinas Shell Corporation
Tabangao, Batangas City
Philippines
Fax: 63 43 723 0722
Email: erick.r.contreras@shell.com.ph

Beatriz DAR
Coastal Environment Program
Department of Environment and Natural Resources
DENR Compound, Visayas Avenue
Diliman, Quezon City
Philippines
Phone: 63 2 920 2212; 426 3851
Fax: 926 1004
Email: betty@denr.gov.ph

Rebecca DEAUNA
Maritime Industry Authority
Room 515 PPL Bldg.
UN Ave., Manila
Philippines
Phone: 63 2 521 9526; 523 8651
Fax: 63 2 521 9526

Virgilio DE LA CRUZ
Department of Environment and Natural Resources
Region IV
1515 L & S Bldg., Roxas Blvd.
Ermita, Manila
Philippines
Phone: 63 2 536 9781

Celso DIAZ
Ecosystems Research and Development Bureau-Department of Environment and Natural Resources (ERDB-DENR)
Forestry Campus
College, Laguna
Philippines
Phone: 63 49 536 3628
Fax: 63 49 536 2850

Sheila Marie ENCABO
National Economic and Development Authority
NEDA sa Pasig
Amber Ave., Pasig City
Philippines
Phone: 63 2 633 6015
Fax: 63 2 633 6015
Email: smmencabo@hotmail.com

Evelyn ESTIGOY
PG-ENRO/BBDP
ENRO Bldg.
Provincial Capitol Complex
Batangas City 4200
Philippines
Phone: 63 43 930 8242
Fax: 63 43 723 2468
Email: batsenro@cybat.sequel.net

Elvero EUSEBIO
Department of Environment and Natural Resources
Region IV
1515 L & S Bldg.
Roxas Blvd., Ermita
Manila, Philippines
Phone: 63 2 536 9871

Edgardo GOMEZ
The Marine Science Institute
University of the Philippines
Diliman 1101, Quezon City
Philippines
Phone: 63 2 922 3944; 922 3921; 920 5301 loc 7416
Fax: 63 2 924 7678
Email:
edgomez@msi01.cs.upd.edu.ph

Leonora GONZALES
Philippine Women's University
Taft Ave., Manila
Philippines
Phone: 63 2 524 2612; 526 4936
Fax: 63 2 721 4942

Rafael GUERRERO III
Philippine Council for Aquatic and Marine Research and Development
Los Baños, Laguna 4030
Philippines
Phone: 63 49 536 5579
Fax: 63 49 536 1582
Email: rdg@sun1.dost.gov.ph

Gil JACINTO
The Marine Science Institute
University of the Philippines
Diliman 1101, Quezon City
Philippines
Phone: 63 2 922-3944
Fax: 63 2 924 7678
E-mail: gilj@msi01.cs.upd.edu.ph

James L. KHO
1044 BLP Condominium
Road 3, Pag-asa, Quezon City 1100
Philippines
Phone: 63 2 456 9986
Email: jl_Kho@philonline.com

Laureano LINGAN, Jr.
Department of Environment and Natural Resources-ERDS

Region IX
Pasonanca, Zamboanga City
Philippines
Phone: 63 62 991 1076

Raphael P.M. LOTILLA
National Economic and Development Authority
NEDA sa Pasig Bldg., Amber Ave.
Pasig City, Philippines
Phone: 63 2 633 6011
Fax: 63 2 633 6011
E-mail: rml@mail.neda.gov.ph

Esmeraldo LUNA
Department of Environment and Natural Resources-ERDS
Region V
Legazpi City, Philippines
Phone: 63 52 481 1860
Fax: 63 52 214 3886

Rachel MALLORCA
National Economic and Development Authority
7th Floor, NEDA sa Pasig
Amber Ave., Pasig City
Philippines
Phone: 63 2 631 3708; 631 3743
Fax: 63 2 631 3708
Email: rgldv3@mail.neda.gov.ph

Conrado MARQUEZ
Department of Environment and Natural Resources
Pepita Aquino St.
Fort San Pedro, Iloilo City 5000
Philippines
Phone: 63 33 336 1013
Email: erds6ags@easycom.net

Felipe M. MEDALLA
National Economic and Development Authority
NEDA Bldg., Amber Ave.
Pasig City
Philippines
Phone: 63 2 631 9716
Fax: 63 2 631 3747

Zenaida MUÑOZ
Coastal Environment Program
Department of Environment and Natural Resources
R-8, Sto. Nino Extension
Tacloban City, Philippines
Phone: 63 53 321 3319
Fax: 63 53 325 6223
Email: ZBM@TAC.WEBLINQ.COM

Marie Frances NIEVALES
Division of Biological Sciences
College of Arts and Sciences
U.P. in the Visayas
Miag-ao, Iloilo 5023
Philippines
Phone: 63 33 338 1560
Fax: 63 33 338 1534
Email: mfn@easycom.net

Cesar ORALLO
Department of Environment and Natural Resources-ERDS
Region I
San Fernando City
La Union, Philippines
Phone: 63 72 700 0529; 888 5487
Fax: 63 72 888 3833
Email: caorallo@hotmail.com

Ramon PAJE
Department of Environment and Natural Resources
DENR Compound, Visayas Avenue

Diliman, Quezon City
Philippines
Phone: 926 4806; 929 6626 local 2028
E-mail: arjp@denr.gov.ph

Johnny PANGOD
Department of Environment and Natural Resources
Region XII
Biruar Bldg., Bonifacio St.
Cotabato City, Philippines
Phone: 63 64 421 3954

Jessica PATRON
Biology Department
Western Mindanao State University
San Jose Rd., Zamboanga City
Philippines
Phone: 63 62 991 7427
Fax: 63 62 991 3065
Email: jjpatron@hotmail.com

Brenda PIMENTEL
Overseas Shipping Office Maritime Industry Authority
5th Floor, PPL Bldg., UN Ave.
Manila, Philippines
Phone: 63 2 521 9526
Fax: 63 2 521 9526

Eduardo PRINCIPE
Department of Environment and Natural Resources
Region X
Macabalan, Cagayan de Oro City
Philippines
Phone: 63 88 856 9752

Eligio RECTO
Coastal Environment Program
Department of Environment and Natural Resources
National Capital Region
Aaron II Bldg., 20 G. Araneta Ave. Ext.
Quezon City, Philippines
Phone: 63 2 712 5278; 731 7665
Fax: 63 2 743 3133

Manuel S. SATORRE, Jr.
Philippine Environmental Journalists Inc. (PEJI)
Holy Family Village II, Banilad
Cebu City 6000, Philippines
Phone: 63 32 346 2786
Fax: 63 32 253 7101
Email: satorre@durian.usc.edu.ph
msatorre@rocketmail.com

Ernesto SEROTE
School of Urban and Regional Planning
University of the Philippines
Diliman, Quezon City
Philippines
Telefax: 63 2 926 1220
Email: prof.e.m.serote@usa.net

Adeluisa SIAPNO
Department of Environment and Natural Resources
Region VI
Pepita Aquino St.
Iloilo City, Philippines
Phone: 63 33 337 2460
Fax: 63 33 336 1013
Email: erds6ags@easycom.net

Buenafe SOLOMON
Philippine Foundation for Environment
37 Matahimik St., Teacher's Village
Quezon City, Philippines
Phone: 632 931 6243; 927 9403
Fax: 632 931 6243
Email: bsolomon@epic.net; bsolomon@info.com.ph

S. West STEWART
Philippine Bio-Sciences & Engineering Co., Inc.
Strata 100 Building, 10th Floor
Ortigas Center, Pasig City
Philippines
Phone: 632 631 2826
Fax: 632 7097
Email: philbio@pacific.net.ph

Armando TAMSE
College of Fisheries
U.P. in the Visayas
Miag-ao, Iloilo 5023
Philippines
Phone: 63 33 315 9036; 315 8381
Fax: 63 33 315 9036
Email: mtamse@easycom.net

Eustaqui TANDUG
Department of Environment and Natural Resources
CARAGA Region
DENR Regional Office
Ambago, Butuan City
Philippines
Phone: 63 85 341 8583

Cesar VILLANOY
The Marine Science Institute
University of the Philippines
1101 Diliman, Quezon City
Philippines
Phone: 63 2 922 3944
Fax: 63 2 924 7678
Email: cesarv@msi.upd.edu.ph

Alan WHITE
Coastal Resource Management Project
Tetra Tech EM Inc.
5th Floor, CIFC Towers
North Reclamation Area
Cebu City 6000, Philippines
Phone: 63 32 232 1821 to 22; 412 0487 to 89; 412 0645
Fax: 63 32 232 1825
Email: awhite@mozcom.com

Fernando YAP
National Economic and Development Authority
3rd Floor, NEDA Bldg.
Amber Ave., Pasig City
Philippines
Phone: 63 2 631 2187
Fax: 63 2 633 6015
Email: agric-lfd@mail.neda.gov.ph

Helen T. YAP
The Marine Science Institute
University of the Philippines
Diliman 1101, Quezon City
Philippines
Phone: 63 2 922-3921
Fax: 63 2 924 7678
Email: hty@msi01.cs.upd.edu.ph

REPUBLIC OF KOREA

Dong-Young LEE
Korean Ocean Research and Development Institute
Ansan P.O. Box 29
Republic of Korea
Phone: 82 345 4006341
Fax: 82 345 4085823
Email: dylee@kordi.re.kr

LEE Yong Soo
Marine Environment Management Division
Ministry of Maritime Affairs and Fisheries
Jinsol Bldg., 826-14 Yoksam-dong
Kangnam-gu, 135-080 Seoul
Republic of Korea
Phone: 82 2 554-2462
Fax: 82 2 555 9769
Email: yslee@momaf.go.kr

LIM Hyun-Churl
Coastal Management Division
Marine Policy Bureau
Ministry of Maritime Affairs and Fisheries
Jinsol Bldg., 826-14 Yoksam-dong
Kangnam-gu, 135-080 Seoul
Republic of Korea
Phone: 82 2 544 2410; 3466 2181
Fax: 82 2 554 2425
Email: ukopresi@unitel.co.kr

SINGAPORE

Zafrul ALAM
Policy Division
Maritime and Port Authority of Singapore
460 Alexandra Road #18-00
18 Storey PSA Building
Singapore 119963
Phone: (65) 375 1623
Fax: (65) 375 1652
E-mail: Zafrul_ALAM@mpa.gov.sg

Simon ANG Wen Pin
Policy Division
Maritime and Port Authority of Singapore
13th Storey, PSA Building
460 Alexandra Road
Singapore 119963
Phone: 65 375 1652
Fax: 65 375 1611

CHOU Loke Ming
Department of Biological Sciences
National University of Singapore
10 Kent Ridge Crescent
Singapore 119260
Fax: 65 779 6155
Phone: 65 874 2696; 65 778 7112
Email: dbsclm@nus.edu.sg

Christer COLLIANDER
SPOT Asia
73 Amoy St.
Singapore 069892
Phone: 65 227 5582
Fax: 65 227 6231
Email: col@pacific.net.sg

FONG Peng Keong
International Environment & Policy Department
Ministry of Environment
40 Scotts Road #11-00
Singapore 0922
Phone: 65 731 9194
Fax: 65 738 4468
Email:
Fong_Peng_Keong@env.gov.sg

SWEDEN

Olof LINDEN
Department of Zoology
University of Stockholm
S-106 91 Stockholm
Sweden
Phone: 46 156 31077
Fax: 46 156-31087
Email: olof@timmermon.se

Magnus PETTERSSON
Sycon Energikonsult AB
S-205 09 Malmø
Sweden
Phone: 46 20 25 59 56
Fax: 46 40 30 21 94
Email: Magnus.Pettersson@sycon.se

THAILAND

Kannegar BOONTANON
The Harbour Department
Ministry of Transport and Communications
1278 Yotha Road, Talardnoi
Samphantawong District
Bangkok 10100, Thailand
Phone: 662 233 1318; 236 9990
Fax: 662 236 7248
Email: harcom.hd@motc.go.th

Chatchai THIMKRAJANG
Sriracha Municipality
161 Cheomchompon Road
Sriracha, Chonburi
Thailand 20110
Phone: 6638 312007
Fax: 6638 312607

Mutrika UKAPATSAKUL
Sriracha Municipality
161 Cheomchompon Road
Sriracha, Chonburi
Thailand 20110
Phone: 6638 312007
Fax: 6638 312607

Chutarat WUTHISOMBOON
Sriracha Municipality
161 Cheomchompon Road
Sriracha, Chonburi
Thailand 20110
Phone: 6638 310902
Fax: 6638 312607

Boonlert NOMSILP
Lam Chabang Municipality

UNITED KINGDOM

Peter CALOW
Department of Animal and Plant Sciences
The University of Sheffield
Western Bank, Sheffield S10 2TN
United Kingdom
Phone: 44 1142 224 692
Fax: 44 1142 780694
E-mail: P.Calow@sheffield.ac.uk

John S. LEMLIN
Environmental Management International Limited
7 Orchard Gardens
West Challow, Wantage
Oxfordshire OX12 9TL
United Kingdom
Phone: 44 0 1235 772 026
Fax: 44 0 1235 772 026
Email: lemlinj@enstrat.com

UNITED STATES OF AMERICA

Kenneth SHERMAN
United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Narragansett Laboratory
28 Tarzwell Drive, Narragansett
Rhode Island 02882, USA
Phone: 401 782 3211
Fax: 401 782 3201
E-mail: Kenneth.Sherman@noaa.gov

Mark J. VALENCIA
East -West Center
1601 East-West Road
Honolulu, Hawaii 96848-1601, USA
Phone: 808 944 7247
Fax: 808 944 7446; 9447380
Email: valencim@ewc.hawaii.edu

VIETNAM

Nguyen Minh SON
Environment Department
Center for Marine Environment Survey, Research and Consultation
264 Doi Can St.
Hanoi, Vietnam
Phone: 844 832 6195
Fax: 844 832 7903
Email: nmson@im01.ac.vn

Hua Chien THANG
National Environment Agency
Ministry of Science, Technology and Environment
67 Nguyen Du
Hanoi, Vietnam
Phone: 844 822 4420
Fax: 844 822 3189
Email: hthang@svr1-han.unep.net

Nguyen Quang VINH
Continental Shelf Committee of Vietnam
Center for Oceans Research and Information
#103 Quan Thanh Str.
Hanoi, Vietnam
Phone: 84 4 804 3879
Fax: 84 4 823 6920
Email: vinh@cori.ac.vn

ORGANIZATIONS/AGENCIES

ASEAN SECRETARIAT

APICHAI Sunchindah
ASEAN Secretariat
Jl. Sisingamangaraja 70
Jakarta, Indonesia
Phone: 6221 726 2991/7724 3372
Fax: 6221 739 8234/ 724 3504

CANADA-ASEAN CENTRE

Ian ROBERTSON
Canada-ASEAN Centre
40 Bukit Pasoh Road
Singapore 089854
Phone: (65) 325 2300
Fax: (65) 221 7885
E-mail: ianr@pacific.net.sg

Ross HEUCHAN
Canada-ASEAN Centre
40 Bukit Pasoh Road
Singapore 089854
Phone: (65) 325 2300
Fax: (65) 221 7885

CEDRE

Michel GIRIN
Centre de Documentation,
de Recherche et
d'Experimentations sur les
Pollutions Accidentelles des Eaux
Technopole Brest-Iroise
BP-72-29280
Plouzane, France
Phone: 33 02 9849 1266
Fax: 33 02 9849 6446
Email: Michel.Girin@ifremer.fr

CMC

Rogelio JULIANO
TENG Seng Keh

Coastal Management Center
E2603-D Tektite Towers
Exchange Road, Ortigas Center
Pasig City, Philippines
Phone: 63 2 635 5065; 635 4217
Fax: 63 2 635 4216
Email: cmc@pworld.net.ph

EMBASSY OF KOREA

JUNG IL Kim
Embassy of Korea
10th Floor Pacific Star Bldg.
Makati Ave., Makati City
Philippines
Phone: 63 2 811 6139

EMBASSY OF NEW ZEALAND

Tim MCIVOR
New Zealand Embassy
23rd Floor Far East Bank Center
Sen. Gil Puyat Ave.
Makati City
Philippines
Phone: 63 2 891 5358
Fax: 63 2 891 5357
Email:
newzealand@embassy.com.ph

EMBASSY OF SWEDEN

Bo ERIKSSON
Email:
ambassaden.manila@foreign.ministry.se

Cecilia ROMSON
Email:
cecilia.romson@foreign.ministry.se

Embassy of Sweden
16th Floor, PCI Bank Tower 2
Makati Ave. corner Dela Costa St.
Makati City, Philippines
Phone: 632 819 1951
Fax: 632 815 3002

EMBASSY OF VIETNAM

Phan Van THANG
Embassy of Vietnam
544 Victor Cruz, Malate
Manila, Philippines
Phone: 63 2 521 6843
Fax: 63 2 526 0476

ICLARM

Gerry SILVESTRE
Len GARCES
International Center for Living
Aquatic Resources Management
2nd Floor, Bloomingdale Bldg.
205 Salcedo St. Legaspi Village
1229 Makati City
Philippines
Phone: 63 2 817 5163; 817 5255;
818 0466; 818 9283
Fax: (63-2) 816 3183

IMO (London)

James PAW
Sub-division for Pollution Response
and Technical Co-operation
Marine Environment Division
International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom
Phone: 44 171 587 3238
Fax: 44 171 587 3210
Email: jpaw@imo.org

J.C. SAINLOS
Marine Environment Division
International Maritime Organization
4 Albert Embankment
London SE1 7SR
United Kingdom
Phone: 44 171 587 3238
Fax: 44 171 587 3210

IMO (Manila)

Stella Regina BERNAD
Email: srbernad@imo.org.ph

Nancy BERMAS
Email: nbermas@imo.org.ph

CHUA Thia-Eng
Email: chuate@imo.org.ph

Mario DELOS REYES
Email: mdreyes@imo.org.ph

Maria Corazon M. EBARVIA
Email: mebarvia@imo.org.ph

Bresilda GERVACIO
Email: bresie@imo.org.ph

Ingrid GORRE
igorre@imo.org.ph

Socorro C. GUERRERO
Email: cory@imo.org.ph

Ma. Socorro MANGUIAT
Email: manguiat@imo.org.ph

S. Adrian ROSS
Email: saross@imo.org.ph

Huming YU
Email: hy@imo.org.ph

GEF/UNDP/IMO Regional
Programme for the Prevention
and Management of Marine
Pollution in the East Asian Seas
P.O. Box 2502
1165 Quezon City, Philippines
Phone: 63 2 926 9712; 926 3752; 426 3849
Fax: 63 2 926 9712

MIMA

B.A. HAMZAH
E-mail: hamzah@mima.gov.my

Juita RAMLI
Email: juita@mima.gov.my; jramli@hotmail.com

Maritime Institute of Malaysia
Unit B-06-08 – B-06-11
Megan Phileo Avenue
12, Jalan Yap Kwan Seng
Kuala Lumpur 50450, Malaysia
Phone: 603 261 2960
Fax: 603 261 4035

SEAFDEC

Aussanee MUNPRASIT
Research Division
Southeast Asian Fisheries Development Center
Training Department
P.O. Box 97 Phrasamutchedi
Samut Prakan 10290, Thailand
Phone: 662 425 8040 to 45
Fax: 662 425 9919
Email: td@seafdec.org

SEAPOL

Frances LAI
Southeast Asian Programme in Ocean Law, Policy and Management
c/o Sukothai Thammathirat Open University
Academic Bldg. II (3/F), Rm. 2320
Pakkred, Nonthaburi 11120, Thailand
Phone: 662 503 3608; 503 3858
Fax: 662 503 3608
Email: seapsank@samsorn.stou.ac.th

Sida

Katarina WESTMAN
Swedish International Development Cooperation Agency/INEC
Division for Technical Assistance & Softer Credits
c/o Embassy of Sweden
16th Floor, PCI Bank Tower 2
Makati Ave. corner Dela Costa St.
Makati City, Philippines
Phone: 632 819 1951
Fax: 632 815 3002

SPM

John COWAN
Sustainable Project Management
11148 S.E. 29th Place
Bellevue, WA 98004, USA
Phone: 425 452 6094
Fax: 206 622 0935
Email: jcmk@aa.net

Hugh FAULKNER
Sustainable Project Management
Geneva Executive Center
11-13 Chemin des Anemoues
1219 Chatelaine
Geneva, Switzerland
Phone: 41 22 979 9205
Fax: 41 22 979 9083; 839 3181
Email: spm.jhf@bluewin.ch

UNDP (Cambodia)

Tine FELDMAN
United Nations Development Programme
No. 53, Pasteur St.
Boeng Keng Kang 1
Phnom Penh, Cambodia
Phone: 855 23 216 167
Fax: 855 23 216 257
Email: time@undp.forum.org.kh

UNDP (DPR Korea)

Pang Yong GUN
United Nations Development Programme
21 Munsudong
Pyongyang, DPR Korea
Phone: 850 2 381 7574
Fax: 850 2 381 7603
Email: pang.yong.gun@undp.org

UNDP (Manila)

Clarissa ARIDA
Email: Clarissa.Arida@undp.org.ph

Jorge REYES
Jorge.Reyes@undp.org.ph

Sarah TIMPSON
Email: Sarah.Timpson@undp.org.ph

United Nations Development Programme
NEDA Sa Makati Bldg.
Amorsolo Street, Legaspi Village
Makati City, Philippines
Phone: 632 892 0611
Fax: 632 816 4061

UNDP (New York)

Tim BOYLE
United Nations Development Programme/Global Environment Facility
Regional Bureau for Asia and the Pacific
DCI – 2364, One United Nations Plaza
New York, N.Y. 10017, USA
Phone: 212 906 6511
Fax: 212 906 5825
Email: tim.boyle@undp.org

UNDP (RO Korea)

Sewoo KIM
United Nations Development Programme
794-4 Hannam-dong
Yongsam-ku, Seoul
Republic of Korea
Phone: 822 790 9565
Fax: 822 749 1417
Email: swkim@un.or.kr

UNDP (Vietnam)

Gordon JOHNSON
Environment Unit
United Nations Development Programme
27-29 Phan Boi Chau
Hanoi, Vietnam
Phone: 84 4 825 7495
Fax: 84 4 825 9267
Email: johnson@undp.org.vn

UNEP

Hugh KIRKMAN
United Nations Environment Programme
East Asia Seas Regional Co-ordinating Unit
10th Floor United Nations Building
Rajadamnern Avenue, Bangkok 10200
Thailand
Phone: 662 281 2428/ 267 8007
Fax: 662 267 8008
E-mail: kirkman.unescap@un.org

USAID

Priscilla RUBIO
United States Agency for International Development
Ramon Magsaysay Center Building
1680 Roxas Blvd.
Manila, Philippines
Phone: 63 2 522 4411 ext. 3980
Fax: 63 2 522 2512
Email: prubio@usaid.gov

UWEP

Dan LAPID
Email: danlapid@mnl.sequel.net

Melchor S. PALMARES
Email: meluwep@cybat.sequel.net

Urban Waste Expertise Programme (UWEP)
Center for Advanced Philippine Studies
Rm. 202 Loyola Heights Condominium
Esteban Abada cor. F. dela Rosa St.
Loyola Heights, Quezon City 1108
Philippines
Phone: 632 434 5573
Fax: 632 434 5954

WASTE

Lex HEMELAAR
WASTE-Advisers on Urban Environment and Development
Nieuwehaven 201
2801 CW Gouda
The Netherlands
Phone: 31 182 522 625
Fax: 31 182 550313
Email: lhemelaar@waste.nl