GEF/UNDP/IMO
Regional Programme for the Prevention
and Management of Marine Pollution
in the East Asian Seas

Marine Pollution Monitoring and Information Management Network

Inception Workshop

8-10 April 1996
Manila Galleria Suites
Pasig City
Metro Manila
Philippines

MARINE POLLUTION MONITORING AND INFORMATION MANAGEMENT INCEPTION WORKSHOP: A SUMMARY REPORT

1996

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EXECUTIVE SUMMARY

1.0 Opening Ceremonies

The Marine Pollution Monitoring and Information Management Inception Workshop was held on 8-10 April 1996 at the Manila Galleria Suites, Pasig City, Philippines. It was attended by representatives from ten countries (See Annex 1). Also present were Mr. Kevin McGrath, the UNDP Resident Representative, Dr. Chua Thia-Eng, the IMO Regional Programme Manager, and Dr. Gil S. Jacinto, the Marine Pollution Monitoring and Information Management (MPMIM) Network Coordinator.

The workshop opened at 9:00 a.m. with a welcome address by Dr. Chua Thia-Eng, followed by the keynote address of Mr. Kevin McGrath.

Dr. Chua Thia-Eng addressed the intrinsic linkage between pollution monitoring and coastal management. He drew attention to the dearth of information on environmental trends in the ASEAN region which made prescription on management intervention difficult. Dr. Chua stressed that this is further complicated by the uncoordinated efforts between agencies responsible for marine development and information exchange. He mentioned the benefits that can be derived from joint communal and industrial initiatives in monitoring environmental changes, reducing pollution outputs, and supplying needed manpower and equipment. The IMO Regional Programme Manager maintained that if each country establishes a long-term monitoring program at specific sites, it would not be difficult to eventually do a trends analysis of general patterns portrayed by environmental changes.

In his keynote address, Mr. Kevin McGrath cited that the Programme was a manifestation of UNDP's commitment to uphold agreements based on the 1992 Earth Summit. He reiterated the importance of establishing an effective network of participating countries for pollution monitoring and information management. The UNDP Representative underscored that learning from the experience of other countries is beneficial and instrumental in bridging the gaps in the development of a regional programme. A marine pollution program would help provide the needed impetus to put in economic terms the degradation of the marine water quality and to assert political influence in drawing policies towards the protection of the marine environment. Mr. McGrath recapitulated that a multisectoral approach had been considerably accepted by the civil society. While aiming at scientific certainties and accuracies, there is a need to include the actual stakeholders involved.

The full text of the speeches by the IMO Regional Programme Manager and the UNDP Representative are attached as Annex 2.

The agenda for the Inception Workshop are attached as Annex 3.

2.0 Country Reports

The Inception Workshop commenced with the detailed reports presented by each country representative (See Annex 9).

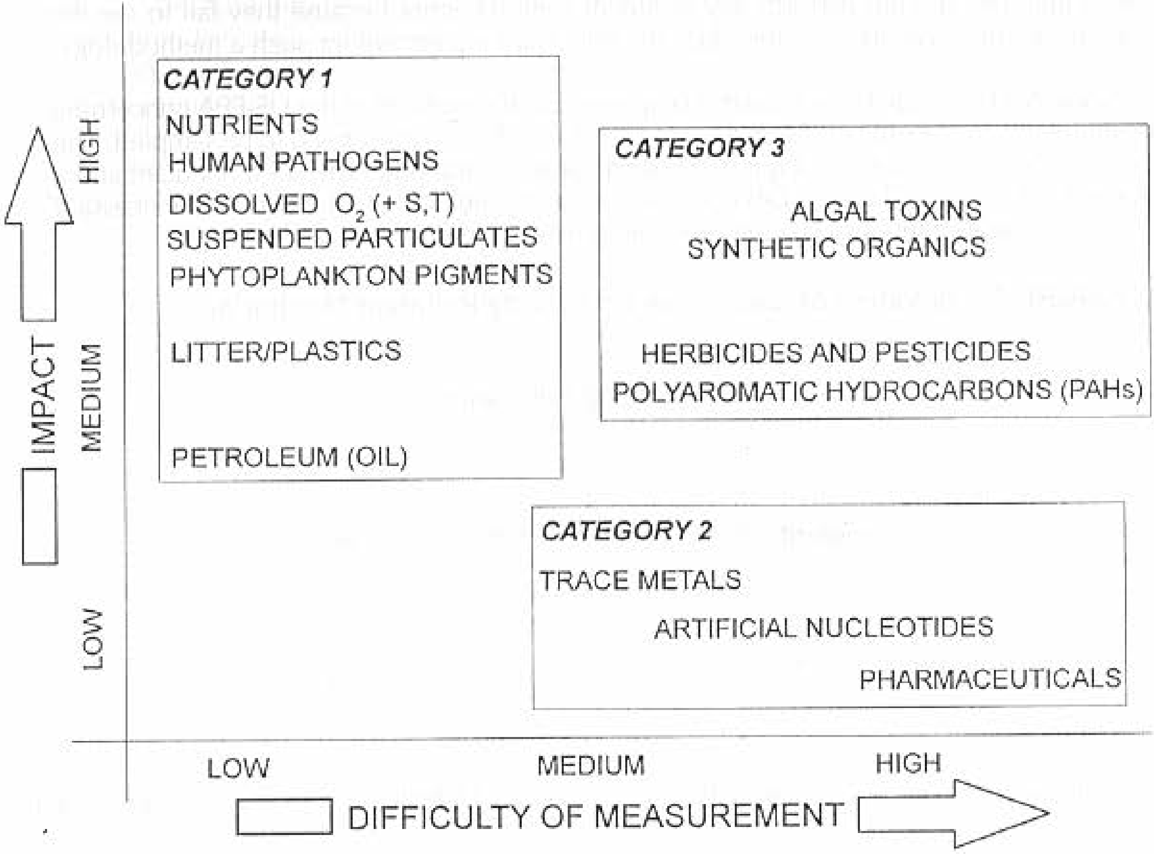
3.0 Monitoring Strategies

The Network Coordinator presented a table of parameters used by institutions such as the IOC/WESTPAC and MUSSELWATCH. This served as an introduction to the discussion on sampling parameters.

Figure 1 illustrates the classification made by the Global Ocean Observing System (GOOS) on the physical, chemical, and biological parameters that fall under three categories based on impact and difficulty of measurement, which are as follows:

Category 1:	Medium to high impact, low difficulty
Category 2:	Low impact, medium to high difficulty
Category 3:	Medium to high impact, medium to high difficulty

FIGURE 1. Categorized Global Oceanic Observing System (GOOS) Parameters



The participants agreed to include the parameter pH in GOOS' Category 1. They also agreed to use the GOOS categories as a guide for marine pollution monitoring.

4.0 Criteria and Standards

The Network Coordinator clarified the difference between the terms *criteria* and *standard*. A difference in the sets of criteria and standards used by most of the countries was noted. To standardize information for future exchange, the participants agreed to take part in intercalibration and intercomparison exercises.

5.0 Design and Implementation of a Monitoring Program

The Network Coordinator emphasized that monitoring may be categorized into three types: compliance, hypothesis testing/impact assessment, and trends analysis.

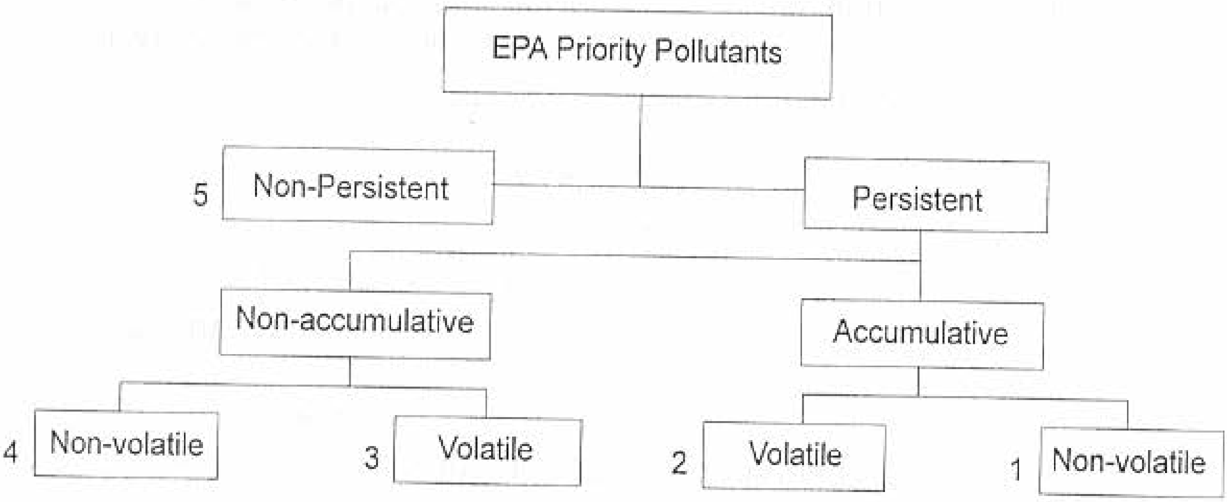
The differences in the sampling strategies of each country are detailed in Annex 5.

Water, sediment, and biota were presented and discussed as sampling matrices.

Most participants did not express any difficulty regarding water and biota. Some, however, mentioned that they did not perform any sediment analysis either because they fail to see the relevance of sediments analysis or they lack the necessary equipment for such a methodology.

Dr. Voravit Cheevaporn of Thailand proposed that the method of the US-EPA concerning priority pollutants (Annex 6) be adopted to identify the matrices which need to be sampled. The method is based on a flow chart (Figure 2) which considers the properties of a pollutant and a prepared list of priority pollutants (Table 3). The use of this method greatly reduces unnecessary collection of samples, therefore, saving time, equipment, and finances.

FIGURE 2. Derivation of Categories for Priority Pollutant Monitoring



Note: Categories characterize each pollutant according to a simple hierarchy based on chemical persistence and bioaccumulation. Pollutants in categories 1 and 2 are persistent and may bioaccumulate or enter food chains. Categories 3 and 4 include pollutants that are persistent but non-accumulative and are toxic on direct exposure. Category 5 includes those pollutants that are non-persistent and consequently remain toxic over short time periods or limited distances from the pollutant source. (Refere to Table 3 for a detailed classification of several pollutants.)

6.0 Format for Data Exchange

The question of how to exchange information among countries in the light of unique conditions in each was raised. Several qualitative formats were suggested, e.g., percent exceedances for trends and value ranges for concentrations.

The participants decided that comparisons be based only on the parameters listed under the GOOS Category 1, including pH as discussed in page 3.

The countries were also given the option to share whatever data from GOOS Categories 2 and 3 they thought were appropriate. Electronic mail and InterNet access were chosen by consensus as the primary method for information exchange. No format was imposed and countries could give their report in any way they saw fit, i.e., tabular or graphical. It was also agreed that IMO would help look into the possibility of subscribing to the APFNet for electronic mail access for those countries needing it.

7.0 Quality Assurance and Quality Control

The Network Coordinator, based on the country reports delivered earlier, pointed out that quality assurance and quality control (QA/QC) may not be preserved in many of the monitoring practices because different groups are responsible for the different aspects of marine pollution monitoring. He stressed that since commercial and industrial sectors are likely more familiar with QA/QC (because product quality is part of their business), government agencies responsible only for monitoring would be at a disadvantage during litigation of pollution violations.

The Coordinator also added that, unless QA/QC protocols are strong and well-designed, the governments could be challenged in legal fora. Therefore, there is a need to build up QA/QC within government monitoring practices to increase the reliability of data acquired.

In view of problems connected with sampling strategies, platforms, and devices, it is inherently better for protocol to be stringent in sampling and monitoring steps for succeeding stages to insure that the previous step was correct.

The Network Coordinator also reminded the participants to be acquainted with the use of a chain of custody forms and the need to validate laboratory results against reference standards.

The **Standard Reference Materials for Marine Sciences** published by the National Oceanographic and Atmospheric Administration (NOAA) was recommended as a reference and the American Chemical Society (ACS) software, **Data Quality Objectives** (DQO), was suggested to help determine sampling sites and hot spots.

It was decided that regional intercalibration exercises be performed, based on the GOOS Category 1 parameters and nutrients. The exercises should include at least two laboratories per country. The Programme would be the liaison for countries participating in the exercises. The methodologies will not be imposed for the intercalibration exercises. However, methods used in analyses must be explicitly described and instrumental and analytical methods must be compared using the same standard.

8.0 Demonstration of InterNet and Electronic Mail Access

The Network Coordinator demonstrated the usefulness of InterNet and electronic mail access.

9.0 Information Exchange Protocol

Information exchange regarding data and analyses results should be in a qualitative format of the country's choice, i.e., percent exceedance or averages.

The demonstration sites will be used to generate data for selected parameters common to all countries. It was suggested that the Network start with the problems stated in the country reports and progress towards trends analysis and queries.

The primary information exchange protocol should either be through the InterNet or through electronic mail.

10.0 Marine Pollution Monitoring Manual

The participants were asked to comment on the Marine Pollution Monitoring Manual (See Annex 7) provided during Session I. They were encouraged to add or delete procedures and make recommendations.

11.0 Recommendations

The GOOS Category parameter was adopted as a guide in marine pollution monitoring and it was recommended that information exchange between countries be based on, but not limited to, GOOS Category 1 parameter, including pH.

Information must be shared regarding the following key parameters: oil and grease, total suspended matter, nitrate-nitrogen, phosphate-phosphorus, temperature and salinity, and oxygen expressed as percent of values below 70 percent saturation. Other data may be shared by countries as they see fit.

Regional intercalibration exercises will be performed using the GOOS Category 1 parameters (including pH) and nutrients. These exercises must include at least two laboratories per country where instrumental and analytical methods should be compared using the same standard.

Both Electronic Mail and the InterNet will be used to exchange information and future projects, including:

1. the creation of an InterNet home page focusing on pollution monitoring data exchange; and
2. the computerization of the **Directory of Institutions and Scientists Involved with Marine Pollution in the East Asian Seas** by which contacts may be accessed.

The following areas have been identified by the respective countries as possible sites for the submission of data based on the GOOS Category 1 parameters:

Malaysia	:	Penang Strait
Singapore	:	Strait of Singapore
Thailand	:	Chao Phya
Cambodia	:	Sihanoukville Bay
Indonesia	:	Jakarta Bay
DPRK	:	East Sea
China	:	Xiamen
ROK	:	Mansan Chinhae Bay
Vietnam	:	Van Phond Bay
Philippines	:	Batangas Bay, Manila Bay

Additional information regarding addenda for the marine pollution monitoring manual should be submitted by the participants to the Programme Development and Management Office (PDMO).

IMO and the Program Network will remain as the primary liaison office for communications for the region and will be responsible for the dissemination of any additional information. The Programme was also tasked to look into the possibility of providing APFNet (See Annex 8) access to countries without Electronic Mail capability.

12.0 Closing of the Workshop

The Marine Pollution Monitoring and Information Management Inception Workshop closed at 3:30 p.m., 10 April 1996, after a brief summary of events by the Network Coordinator.

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Opening Address

Dr. Chua Thia-Eng, Programme Manager, IMO

On behalf of the Programme and especially the Secretary-General of the IMO, the executing agency for this regional marine pollution programme, I welcome you to Manila and to this workshop. For the last four weeks, the Programme had conducted an in-country training course in Vietnam on sampling and analytical methods for marine pollution and successfully concluded two workshops on the legal aspects of marine pollution and integrated environmental impacts assessment. Both workshops were conducted in the same conference venue in Manila. Today, we are here to discuss the issues of marine pollution monitoring and information management in the East Asian region.

I believe Dr. Gil Jacinto, our able Coordinator for the Network of Marine Pollution Monitoring and Information Management, has already informed you of the objectives of the network and the purpose of this inception workshop. I need not emphasize the importance of marine pollution monitoring and information management as you are the experts in this field. However, I would like to take this opportunity to highlight the challenges ahead of us to make any attempt in marine pollution monitoring more meaningful.

As you are aware, marine pollution monitoring is well-recognized as an important measure to determine the state of marine environment. A great amount of national effort and resources have been made in the past and even at present in determining environmental parameters and level of pollutant in the sea water. Unfortunately, most of the data gathered are not effectively utilized to predict and forecast changes and possible ecological and socioeconomic impact. Very often, government gives very little attention or investment in pollution monitoring and if ever they were carried out, little effort have been made to use the data effectively.

The purpose of environmental monitoring is not only to provide information on the state of the marine environment but also to indicate the areas of threats at which management intervention can be addressed. Reviewing the information available on marine pollution monitoring in the region, it is not difficult to conclude that past efforts had been focusing on gathering of general information over a wide geographical scale and there is little or inadequate information on trends of environmental changes. Without information on trends, it is not easy to prescribe management interventions. While observations on the general state of the marine environment over a broad geographical scope is essential, specific efforts to demonstrate the use of monitoring data to improve environmental conditions are even more crucial.

In most countries, marine monitoring is undertaken by a number of marine development-related agencies, such as fisheries, environment, marine, transport, port, and harbor. These agencies have their pollution units undertake a wide range of environmental measurements. In almost all cases, there are very little coordination between these agencies nor integration of their results, not mentioning regular exchange of monitoring results. Much of the valuable data gathered are underutilized. In a situation where funds are limited, effort towards coordination and integration of data from various agencies would be very necessary.

Pollution monitoring is most effective and best regulated at the local level. It is at this level wherein management action can be undertaken effectively because the effects of pollution is felt in areas of impacts. Thus, the local government and the community will have the desire and will place priority to address pollution that is affecting them. Many national marine pollution monitoring programs, unfortunately, fail to address pollution at the local level. Thus, there is a real need to refocus national efforts in their marine pollution monitoring strategies.

Both the industries and the communities can play useful roles in monitoring the change of the marine environment. The conventional approach of "command and control" of the private industries should be modified to involve voluntary reduction of pollution outputs. This will make regular monitoring very essential. The industries can be utilized to share the roles in pollution monitoring since they have better equipment and resources. Similarly, utilizing the community to regularly report on the occurrence of tar balls, fish kills, etc., is another cost-effective approach.

While scientists realize the needs and importance of cross-boundary information exchange pertaining to the environmental conditions in each country, there have been difficulties due to national security and political reasons. However, exchange of information between specific sites within the same country pose little or no security problems and such effort should be encouraged and promoted. Determining the trends of change is an important output of monitoring at the local level. This could provide useful information on the general condition of marine pollution. If each country establishes a long-term monitoring program at specific sites, it will not be difficult to piece the trends of environmental changes in the region.

Ladies and gentlemen, I hope in the next few days you will discuss the challenges I pose to you and come out with recommendations that only members of this network can. I am sure your work will build on the numerous past national and regional unilateral, bilateral, or multilateral efforts. It should build on the outputs by many regional efforts, including standardized sampling and analytical techniques and intercalibration exercises. During the last two decades, UNESCO, IOC/WESTPAC, GIPME, and GESAMP, as well as new regional initiatives such as the ASEAN-CANADA program on marine pollution, have provided enormous amount of information on pollution monitoring methodologies which should be used by our network in undertaking marine pollution monitoring in the region.

The network will be able to play an important role in reorienting national efforts in marine pollution monitoring strategies and action programs. Your outputs will not only reinforce existing and regional efforts but will also contribute a new dimension towards such endeavor.

Ladies and gentlemen, while posing the above challenges to you, I wish to point out that you are not working alone. Your network is only a part of the overall regional efforts under the GEF/UNDP/IMO Regional Marine Pollution Prevention and Management Programme which have developed long-term pragmatic strategies in addressing marine pollution arising from land and sea-based sources. One of the main components of the Programme is to develop demonstration projects which apply integrated coastal management approach to address marine pollution. In our two demonstration sites in Batangas and Xiamen, institutional structure is now in place to undertake marine pollution abatement and control. Similarly, in the Straits of Malacca, efforts are being made to mobilize the littoral and user states in contributing to a better understanding and management of this important international waterway.

A great amount of the Programme efforts is being focused on management actions to be undertaken by national government, including the ratification of international conventions related to marine pollution, minimization, and reduction of marine pollution from land-based sources, as well as strengthening national capacity to prevent and manage marine pollution at local and national levels and the financial means to sustain such efforts. Thus, through such multi-prong approach from coastal policy to the application of management and technological interventions at both national and local levels, we hope marine pollution can be minimized in the long run. This Programme can show how this can be done, but we need you to initiate the effort in your own countries.

Ladies and gentlemen, it is a pleasure to be here with you today. I wish your workshop a success, and for our foreign participants, an enjoyable stay in Manila. Thank you.

Keynote Address

Kevin McGrath, Resident Representative
United Nations Development Programme, Manila

Greetings! Undersecretary Antonio La Viña of the Department of Environment and Natural Resources; Dr. Chua Thia-Eng, Programme Manager of the UNDP-GEF-IMO Project; distinguished participants, guests, ladies, and gentlemen—a pleasant good morning.

During the second steering committee meeting in December 1995, I underscored the long-term goal of this Programme on the Prevention and Management of Marine Pollution in the East Asian Seas—that of establishing an effective network for pollution monitoring and information management among participating countries.

Today, we are gathered here to start the process of setting up a regional marine pollution monitoring programme. I thank this distinguished group of experts for participating in this very significant endeavor to address the degradation of our marine environment.

The United Nations Development Programme believes that in order to develop and implement policy measures to protect the marine environment from various pollution sources, we must be able to measure and assess in quantitative terms, the quality of the environment—both the physico-chemical and biological parameters. The UNDP also believes that we should also be able to translate these parameters in terms of economic benefits and political impacts.

UNDP's support to this regional programme on marine pollution prevention and management is a manifestation of its commitment to uphold what has been agreed upon in the 1992 Earth Summit. Foremost among these are the strengthening of regional and national capacities in formulating policies and legislation; human resource training; building up institutions, especially, for technological research and development; and shaping mechanisms for public participation, information flows, and technology exchange.

The management of the marine environment is one area where these fields of action is most needed. A pollution monitoring programme, in general, will help address a number of concerns:

1. *The need to establish marine environmental information management systems.* Improved access to meaningful environmental data and information will help enhance the capacity of governments to utilize environmental information in planning and decision-making. Information for decision-making is underscored in Chapter 40 of the Agenda 21 which emphasized the importance of improved availability of information on all aspects of environment and development for decision-makers towards sustainable human development. It also emphasized the need for improved collection as well as presentation of data and information. Information databases can be used to develop indicators to measure the status, trends of environmental conditions and, consequently, the overall progress towards sustainable development.

2. *The need to prepare regular reports on the state of the environment.* There is now a strong awareness on environmental issues and people from all walks of life must be provided with a general picture of the state of biophysico-chemical conditions of the natural ecosystems: land, air, water, forests, and the biological systems. State of the environment reports, however, must be based on accurate and scientific information and must be able to help decision-makers make informed judgments on various policies and plans.

3. *The need to set-up or update environmental standards for regulatory purposes.*
   We are all aware that the national monitoring programmes of East Asian countries

participating in this activity vary greatly—meaning, capabilities and capacities come at different levels of sophistication. This reality makes the task of this group of experts rather complicated if not difficult. It is not simply a sharing of information and expertise but also of technologies and equipment to implement the monitoring programme.

In your task to design and implement a monitoring programme, there are a number of components to be considered. These include: choice of critical parameters, timing and spacing, sampling and analytical procedures, data storage processing and analysis and a plan on how the information generated will be effectively utilized by the decision-makers and environmental managers.

This morning, you will surely learn the extent of disparities in the East Asia on monitoring capacities and capabilities during the session on country reporting on national pollution monitoring. I urge all of you to listen intently to these national experiences and try to draw up lessons to bridge the gaps in developing a sound regional programme where information and technologies are shared among participating countries.

The entire global community is now seriously concerned on the status of air and water pollution, marine pollution, loss of biodiversity, etc. This marine pollution monitoring programme also helps provide the needed impetus to translate in economic terms the degradation of the marine water quality to be able to assert political influence in drawing up policy measures towards the protection of the environment.

I would like to emphasize, here, the monitoring approach that has been emerging and for which considerable acceptance by the civil society has been manifested—that of a multisectoral approach on environmental management. While we aim at scientific certainties and accuracies in our data, we should also aim to involve, as much as possible, the critical stakeholders which include, among others, the community. I trust that this group will be able to develop and implement models of this multisectoral monitoring.

The seriousness of environmental degradation has reached alarming levels that immediate and practical solutions are warranted. Industrial and mining activities have brought about grave alterations on the environment that have far reaching public health implications.

It is inevitable for me to cite here a current and imminent concern that has recently occurred in one of the islands here in the Philippines—that of mine seepage from a copper mining company in Marinduque, an island south of Manila. Tons of mine tailings now cover river systems and would eventually reach the bay area. Obviously, there is a need to monitor the groundwater, the river systems and whatever is left of it, and the bay area in terms of heavy metals and other critical parameters. This is necessary to provide early warning scenarios to bring the affected communities away from the brink of environmental disasters. What I would like to point out here is, we do monitoring for a purpose and not as a quest for knowledge alone.

With this note, I wish all of you a successful workshop. Once again, I thank the Department of Environment and Natural Resources, the International Maritime Organization, the Programme Management, and all East Asian participating countries for their continuing support in the success of this Programme.

Good day!

AGENDA

1.0 Opening Ceremonies

2.0 Country Reports

3.0 Monitoring Strategies

4.0 Criteria and Standards

5.0 Design and Implementation of a Monitoring Program

6.0 Format for Data Exchange

7.0 Issues Regarding Quality Assurance and Quality Control

8.0 Demonstration of InterNet and Electronic Mail Access

10.0 Marine Pollution Monitoring Manual

11.0 Recommendations

12.0 Closing of the Workshop

Global Investigation of Pollution in the Marine Environment (GIPME) Discussion Paper

Each of the international monitoring programs currently operating or in preparation for the East Asian Seas region focuses on different physical and chemical water quality parameters in marine waters, sediments and biota (Table 1). Special care should be taken in using standardized methods already employed by current UNEP and IOC programs—the manuals for which were made available to the East Asian Seas Programme.

By selecting analytes for monitoring programs, it is important to take into account the degree of impact of contaminants and the difficulty of measuring these contaminants. Figure 1, developed within the framework of the Global Observing System project, classifies a number of analytes according to the relationship between their impact (i.e., their importance in human health, marine resources and amenities) and the difficulty of their measurement. Category 1 analytes are those judged to have high impact and are relatively easy to measure. Category 2 analytes, on the other hand, are judged to have a lesser impact, and require sophisticated instrumentation, considerable training and specialized standards and reference materials. The selection of Category 3 analytes, which are judged to be of high impact and are presently difficult to measure, depends on the capacities of laboratories and the available funds as well as the type of problems identified in the monitoring area.

Based on these considerations, a list of analytes was developed which could be analyzed in different parts of the marine environment of the East Asian Seas region. Core measurements could include: turbidity, temperature, salinity, and dissolved oxygen. Additional measurements for different matrices are shown in Table 2. In selecting some of the analytes shown in Table 2, a careful evaluation of possible inputs from industrial and agricultural/fishery sources is advised[1].

[1]Excerpt from a workshop report, "Global Investigation of Pollution in the Marine Environment," (GIPME) Expert Meeting, London, 12-14 October 1994.

Monitoring Strategy Problems

1.0 Cambodia

Cambodia plans to propose that its coastal area, especially, areas for mariculture, be considered as IMO demonstration sites. A major concern for Cambodia is that the Environmental Impact Assessment (EIA) is not yet required by law. There is currently an absence of any type of environmental monitoring, even by the private sector.

Another weak point is the absence of laboratories and expertise. These have already been addressed and planned by the Ministry of Environment and submitted to the National Assembly but awaits further approval. Cambodia is also in need of financial support and intends to send staff abroad for training and gaining expertise.

2.0 China (Xiamen)

The major pollutants that concern China (Xiamen) are related to petroleum products, organic pollutants, and microorganisms.

Methodologies have not yet been standardized and although much data is currently available, they are difficult to use. China (Xiamen), therefore, aims to design a system that is capable of standardizing methods and to establish networks that will provide techniques and support for coastal management. China aims to achieve the following:

- An integrated environmental management system through a network of government institutions and agencies;
- The implementation a long-term marine environmental program with standardized parameters, procedures, etc.;
- The establishment of marine environmental quality controls to be used in the temporal management of quality and the formulation of mitigating measures;
- An assessment of the current state and effectiveness of marine pollution management and monitoring programs and formulate recommendations for improvements;
- Strengthening the marine pollution criteria through staff training and the upgrading of technology (e.g., analytical tools);
- Integration of Xiamen with the regional network and contribution to the regional marine environment project by:
  - coordination among the various agencies and organizations to participate in the monitoring activities;
  - development of a network of concerned citizens for surveillance;
  - establishment of monitoring centers for intercalibration exercises and data quality control; and,
  - collection of existing data on pollutive sources to identify environmental quality and the selection of proper monitoring programs which would determine trends in environmental changes.

3.0 Indonesia

One of the major concerns expressed by Indonesia is the need to learn from the experiences of other countries. Apparently, although several marine pollution monitoring protocols are in place among various agencies, these practices are isolated to each agency's function, hence, a severe need for integration. BAPEDAL, the agency tasked to focus on environmental impacts, has its own laboratory for the evaluation of water and air parameters. However, the crucial needs mentioned were the improvement of technical capability and the upgrading of facilities. Several regional offices of BAPEDAL were established to alleviate the difficulties encountered by the local government.

Another serious problem is the absence of standard procedures which produce varying results from different laboratories. This problem poses serious hindrances to validation activities and litigations. The Indonesian representative also expressed the desire to include Jakarta Bay as a demonstration site. Furthermore, the development of monitoring sites under different agencies (six in the east and another six in the west) poses serious problems in terms of integrating the results and information therewith.

Regarding the issue of islands management, BAPEDAL and the state environmental agencies apparently concern themselves with those islands with economic and social importance. These are the many uninhabited islands which are not yet threatened by environmental problems. This concern evidently suggests a need to preserve particular sites, most especially in a conflict situation arising among tourism, ports, and community affairs.

4.0 Malaysia

Malaysia has comprehensive and stringent environmental laws which are generally upheld. As of 1995, oil and grease, total suspended solids, and E. coli have been identified as the major environmental pollutants.

Malaysia is actively involved in the international fora on the conservation and protection of the marine environment. It agrees with the principle that shared experiences is vital for the development of management skills and practices at both local and regional levels.

5.0 Singapore

Singapore has been generally effective in addressing its environmental problems and the management of its coastal systems. It has also initiated programs that heighten the environmental awareness of students.

Private companies and factories are encouraged to do their own monitoring. Government agencies conduct regular spot-checks to evaluate compliance and exceedances. Non-compliance results in the imposition of non-negotiable fines. Public involvement in monitoring is heavily relied upon and most of the government action depend on public complaints and recommendations. Government actions are also checked by the public.

Singapore shares similar environmental standards with Malaysia and participates in joint monitoring efforts, especially along the Johor Strait. Monitoring data obtained from the strait are confidential and/or not for public consumption to ensure national security.

6.0 Democratic People's Republic of Korea (DPRK)

DPRK submitted a comprehensive review of its program for integrated coastal management. The DPRK representative raised issues on data collection and integration and stated that there were no data available for environmental parameters in DPRK. The agencies in DPRK must determine the extent of marine pollution within their areas of responsibility. DPRK is most concerned with obtaining baseline data corresponding to environmental parameters and hopes to link up with programmes and networks to exchange ideas and gain from other countries' experiences on marine pollution monitoring in the hope of developing a better management strategy.

7.0 Republic of Korea (ROK)

There are four main agencies responsible for environmental protection in the Republic of Korea: the Ministry of Environment, the National Fisheries Research and Development Agency, the National Maritime Police Agency, and the Office of Hydrography. Coastal areas in the Republic of Korea are classified according to 3rd, 2nd, and 1st grade standards (based on Canadian-Japanese standards), with the 3rd grade being the worst and the 1st grade being the best. Monitoring is done on water bodies exceeding the 1st grade standards. Under current practices, there seem to be problems involving data centralization and dissemination of information. There is also a problem with regard to the classification of waters as 1st, 2nd, or 3rd grade. Since some nearshore areas of the Republic of Korea are classified as 3rd grade, they are left alone as they have been categorized as unfit for use. The problem lies with the likely expansion of 3rd grade areas due to increased land-based activities.

8.0 Philippines

The Philippine Representative—instead of giving a comprehensive report for the whole country—focused on the monitoring efforts in two heavily polluted areas: Manila Bay and Calancan Bay.

Manila Bay suffers major pollution problems and is also the final receiving body for wastewater. The resultant pollution in the bay has become a major concern for the government. In response, the Philippine Government has conducted the Manila Bay Monitoring Program (MBMP) to determine trends in the water quality of the bay and, if possible, predict its future quality. Coordinated efforts are required to enhance and preserve the Bay's quality.

Calancan Bay lies on the northern coast of Marinduque island. With the existence of a mining operation in the area, Calancan Bay was turned into a receptacle of mine tailings and waste discharged via a submarine outfall and, later, due to operational problems, an above-groundwater outfall. Mine tailings are also blamed for the destruction of the coral reefs and fish sanctuaries in the area.

9.0 Thailand

Due to the rapid development of the Thai economy, the current development of pollution prevention and monitoring is not adequate. Significant issues concern pollution caused by domestic, industrial, agricultural, and maritime activities. Of these, the major source of pollution is that which originates from land—waste water is discharged directly into the drainage systems and hence into the coastal areas. Another serious problem is the illegal discharge of oil by ships in Thai waters. Although prohibited by law, such practices are carried out at night to avoid detection.

Although there are several agencies responsible for marine pollution prevention, the Harbor Department is primarily responsible for marine and inland waters. Coastal monitoring is done by boat and in-situ analyses done using on-board laboratories. Industrial effluent monitoring along major rivers is done every three days. Monitoring activities are also cross-checked by interested universities and information dissemination is encouraged for public awareness. One major problem though is the lack of agency coordination with regard to monitoring results.

10.0 **Vietnam**

Marine pollution problems in Vietnam are apparently not yet widespread, but major inputs come from several main sources: coastal agriculture, sewage, urban, and industrial discharges, shipping aquaculture, mining, and oil and gas exploration activities. Most of these include sediment, nutrients, toxic metals, oil, and pesticides. Accordingly, coastal pollution and degradation of the environment lie at the heart of the conflict between developmental needs and protecting the environment; and oil pollution from both shipping activities and spills is a fast-growing problem.

The initiative for marine pollution monitoring activities in 1995 served as a first step towards a national network on marine pollution in Vietnam. Results of analyses contribute to the assessment of the annual state of Vietnam's marine environment. These are submitted to the government according to the 1993 Environment Protection Law that serves as a model with which to upgrade the coastal network of Vietnam.

EPA Summary of Priority Pollutants

Based on the sampling program desired by any monitoring agency, sampling times and effort may be significantly reduced by considering both the intrinsic and extrinsic properties of their target pollutants. Chapman et al., in 1982, published a paper presenting a summarized list of pollutants and the matrices in which these may be found. Included with the list was a flowchart categorizing a particular pollutant's persistence in the environment. This flowchart, used by the US EPA, may be used as a guideline to assess priorities accorded a particular pollutant or set of pollutants. Table 3 duplicates Chapman's, showing a summary of categorized pollutants and their respective matrices. Figure 2 gives the flowchart for categorizing pollutants and a note on how a pollutant is categorized.

If an agency desires to include Chlordane, for example, in their list of pollutants which need monitoring, they need not waste valuable time in re-doing research on the properties of Chlordane and possible matrices where it persists. Table 3 shows that Chlordane is categorized as 2 which Figure 2 notes as persistent, may bioaccumulate, or may enter food chains. Additionally, Table 3 indicates that Chlordane may be found in both sediments and biota but not in water. It would therefore be most expedient to sample only sediments and biota in suspected areas contaminated by Chlordane. Skipping water column sampling and analysis therefore saves time and money. This efficiency is multiplied when a number of pollutants have to be assessed within the same area and within a limited amount of time.

Recommendations for the Manual on Marine Pollution

1.0 A draft manual on marine pollution was distributed to the participating countries during the course of the workshop and the representatives were instructed to review it and later give their comments, recommendations, and additional procedures.

2.0 The following comments and/or suggestions were proposed to be included in the manual, aside from the methods already outlined in it:

2.1 The use of a membrane filter method for fecal coliform.

2.2 A litter index, e.g., the modified Garber Index.

2.3 Methods for phytoplankton and zooplankton analyses: pigment, counts (blooms), biomass, etc. The International Oceanic Commission should be checked for standard methods for plankton bloom and an appendix can be provided or the taxonomic characteristics can be briefly described and appropriate references be cited.

2.4 Methods and taxonomy for soft-bottom communities structures and distribution should be added.

2.5 Methods for calculations on standard deviations, precision, reproducibility, and repeatability should also be present.

2.6 Methods on sample storage are also a must, including various techniques of preservation, filtration (GF/F with a nominal size of 0.7 microns was suggested as an alternate to the more expensive filters like Nucleopore), and sample preparation.

2.7 An additional section on oxygen determination with the use of an oxygen meter was also recommended, provided that the instrument was standardized against an analytical technique and calibrated regularly.

3.0 A separate manual for biological monitoring was suggested. For this purpose, the Chairman cited the ASEAN-Australia **Living Coastal Resources Manual for Survey of Marine Resources** which may be purchased from the Association of South East Asian Marine Scientists (ASEAMS).

4.0 The Chairman emphasized that other important matters, which the participants think would be crucial and which were not discussed or taken up during the sessions, may be sent through e-mail, fax, or post. The manual will be published for non-commercial use.

APFNET Independent Electronic Mail Service

1.0 Over the last five years, electronic mail (or e-mail) has begun to rival the fax as the second most important medium for business communications, after the telephone. For some, it has even begun to rival the telephone itself. The advantages of e-mail are many: it is fast, inexpensive, convenient, and greatly reduces the "telephone tag" that can take up so much of the working day.

2.0 APFNet is the official electronic communications system of the Asia Pacific Foundation of Canada and of its subsidiaries the APEC Study Centre, the Canadian Education Centres, and the GLOBE Foundation of Canada. It also supplies communications services to outside organizations, such as the BC Trade Development Corporation, the Canada-ASEAN Centre, and the Pacific Economic Cooperation Council. **APFNet accounts are available to individuals and to public and private sector organizations and businesses in the Asia-Pacific region.**

3.0 APFNet was designed to address the problems of having to be connected to a local or office network and with its Internet and X.400 gateways, APFNet users can send e-mail to practically any other account in the world and each user gets its own Internet address. With local dial-in numbers in most of the major cities of the world (and a 1-800 number in North America), traveling users can easily stay in touch without running up huge long distance bills because APFNet charges are based on data sent and received, rather than on time spent on-line.

4.0 APFNet offers two levels of service to its users: Standard and Executive. Both include the basic e-mail service which gives users the ability to access their account with a local phone call in most major cities in the world, use of the gateways to outside systems, and free support.

5.0 For more details on any of the services listed, or to open an APFNet account, contact:

Christine Frauenberger
APFNet Customer Service
Phone (604) 684-5986
Fax (604) 681-1370
E-mail **chris@apfc.apfnet.org**

Annex 9.1 COUNTRY REPORTS[2]

9.1. Report on Marine Pollution Monitoring (Kingdom of Cambodia)

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Introduction

Cambodia has a 435 km coastline on the Gulf of Thailand that extends from the Thai border to the Vietnamese border. It consists of a large estuary in the northern part of Koh Kong province and the large bay of Sihanoukville and Kampot.

For the most part, Cambodia's coastline has been inaccessible from other parts of the country and has a few developed urban centers. However, the exploitation of coastal lands for aquaculture in the region of Koh Kong has severely affected the mangrove forests. Coral reefs are also being illegally exploited for commercial purposes and four offshore concessions for the exploitation of petroleum have been awarded, while Ministry of Industry, Mines, and Energy (MIME) has launched a second bid for four additional blocks within the near future. Earlier exploration wells have proven hydrocarbons are present and it is likely that production will eventually begin, placing the coastal zone at a further risk as land-based facilities are developed to service the oil and gas industry.

Tourism along the coast is exemplified by the planned development of Naga island as a tourist and an anticipated club. This, however, will require that environmental controls be in place to avail water pollution, uncontrolled solid waste disposal, and unplanned commercial growth. Better management of the fishing industry is also needed for the economic benefit of the country and the sustainable use of this resource.

Development Strategy of the Cambodian Coast

Industry

Cambodia is situated in the world's most economically dynamic region. Several countries in this region are experiencing rising industrial wage levels and various trade restriction and as a result, they are beginning to suffer squeezed profit margins.

According to the development potential of each coastal province of Cambodia, the following plans have been initiated by the governor, consistent with the government's general policy for the industrial sector development and rehabilitation.

Koh Kong

- Expand and develop the food industry providing food for human beings and animals;
- develop the wood factories; and
- expand the fish processing industry.

[2]Country reports have been edited for brevity. Copies of the original documents are availanle from the PDMO upon request.

Kampot

Encourage and seek local and foreign investments in handicrafts and industrial development. Such industries include those requiring numerous workforce, namely: textile, sewing, etc., and those which process and need local raw materials, particularly fertilizer, cement, and other factories producing agricultural equipment in particular.

Sihanoukville

- establish small- and medium-scale industries and enterprises to produce local products and competitive products for exports,
- rehabilitate clean drinking water system to ensure sufficient water supply for the people and industrial sectors,
- encourage the private sectors to contribute to the power and water supply developments; and
- determine and zone the industrial development sites free trading sites, the tools to develop the industrial sectors while avoiding the adverse impact on the natural environment.

Oil and Gas

To develop its hydrocarbon and mineral resources for the economic and social benefits of its people, but with environmental concerns in mind, the policies of the Royal Government of Cambodia are:

- to provide a proper legislative framework and a fair petroleum and mining policy for the mining, exploration, and exploitation of minerals (oil and gas) whether onshore or offshore, comparable with international standards,
- to hold, maintain, and keep the ownership, rights, liberties and privileges to these subsectors,
- to implement national policies in a fair, consistent and just manner,
- to create a climate conductive to attract and encourage foreign investments,
- to establish a Cambodian National Oil and Gas Authority to manage and regulate oil and gas activities in the country,
- to establish a Cambodian National Mining Authority to manage and regulate mining activities in the country,
- to establish a Mining Training Institute to train Cambodian personnel who will be needed in the mining, oil, and gas subsectors and to ensure the transfer of technology from foreign cooperation to a Cambodian national, and
- to maintain absolute control during the mining, exploration production, refinement and sale of crude oil, natural gas minerals, their products and by products.

Despite the lack of a legal regime of liabilities for marine pollution damage, the Ministry of Environment has strongly recommended that all contracts made between the Royal Government of Cambodia and the oil and gas exploration companies should include a provision that those companies must be responsible for and bear the coasts of cleaning up any spills resulting from their activities.

Proposed Development Projects for the Coastal Zone

1. Urban and rural environmental infrastructure in the three coastal provinces:
   - ✳ to repair and maintain the sewage system;
   - ✳ to manage domestic and industrial wastes; and
   - ✳ to rehabilitate and upgrade water supply and clear drinking water.

2. Environmental capacity-building for provincial department and management institutions in the coastal area:
   - ✳ to improve the capacity of the Provincial Department of Environment for the environment planning and management of the natural resources.

3. Training course in Environmental Impact Assessment (EIA):
   - ✳ to train the people on public participation in the process of EIA and the role of local community and proponent in environmental responsibility.

4. Public/local community awareness of coastal zone management:
   - ✳ to encourage public participation in the management process; and
   - ✳ to educate the local community on the law to manage coastal zone and care for it.

5. Marine resources management:
   - ✳ to conduct researches into marine resources;
   - ✳ to form a data base information system and make it available to the government and public sectors involved with the resources management, conservation, and preservation.

6. Mangrove reforestation in Koh Kong and Kampot provinces:
   - ✳ to expand the area of mangrove forest cover which, in turn, provides food nutrients and habitat for aquatic and terrestrial form of life.

7. Coastal wetlands management:
   - ✳ to provide training and facilities aimed at improving the capacity building for the officials involved in the managerial and conservation activities.

8. Marine oil spill emergency response system: to provide training on unexpected oil spill responses and precautionary approach towards the unpredictable event to be ready to take the necessary measures against the problem.

9. Underground Storage Tanks (USTs) regulations:
   - ✳ to establish requirements (such as leak detection systems) for the installation of USTs at gasoline stations.

10. Emergency response for offshore oil exploration:
   - ⁕ to set up emergency response teams for petroleum spills from offshore exploration. This would include equipment and training; and
   - ⁕ to establish the requirement that private firms have to provide emergency response measures.

11. Waste minimization technical assistance:
   - ⁕ to train the staff of the Ministry of Environment (MoE) in industrial waste minimization and setting up the information and technology exchange systems. The MoE staff assist the industries in minimizing their wastes while keeping costs down.

12. Petroleum storage regulations:
   - ⁕ to establish petroleum storage and transfer regulations to control accidental spills and leaks.

13. Used oil management:
   - ⁕ to set up recycling, refining, or other alternatives for disposal of used oil; and
   - ⁕ to work closely with vehicle repair shops.

14. Port development and EIA:
   - ⁕ to deepen the main Sihanoukville Port and the tanker terminal to provide greater for import/trade cargo ships, do EIA to access biological activities and potential impacts.

15. Spill containment at refueling station in Sihanoukville Port:
   - ⁕ to construct spill containment equipment at the refueling station in Sihanoukville Port.

16. Hotel wastewater disposal:
   - ⁕ to establish the requirements for wastewater treatment and disposal of wastewater of hotel that exist and in particular those that are planned.

The Goal of MoE on Environment and Natural Resources Management

The MoE will take the lead in coastal zone planning and involve other agencies in the essential components of the plan. The activities over the next five year will include:

- ⁕ developing a preliminary coastal zone master plan with delineation and zoning of critical sections of coastline where intensified activity is planned or expected;
- ⁕ developing feasibility-level, local area management plans for areas affected by intensified coastline activity;
- ⁕ defining the institutional means for implementing requirements associated with local area management plans, including liaison with other government agencies;
- ⁕ providing appropriate local infrastructure and services including wastewater management and solid waste, for areas undergoing tourism development;
- ⁕ providing regulatory surveillance by MoE to ensure that services are provided and maintained over the long term; and
- ⁕ developing local institutions for the provision and maintenance of infrastructure, compliance with environmental criteria, and surveillance of coastal zone activities.

9.2. Marine Environmental Quality, Pollution Monitoring, and Environmental Management

(A National Report from China)

by **Xu Kuncan**, Third Institute of Oceanography, State Oceanic Administration, No. 178 Daxue Road, Xiamen PROC, and **Yuan Dongxing**, Environmental Science Research Center, Xiamen University

China has a long coastal line. Since 1980, the economy in coastal areas has been quickly developing, along with the increasing population. Large amount of industrial and domestic wastes is discharged into the sea, resulting in immense marine pollution in some areas. In order to prevent and manage marine pollution, protect ocean biological resources and ecosystem, and ensure human health, the Chinese government has adopted a series of management measures. The key points of the Chinese marine environmental quality status, pollution monitoring, and environmental management in recent years are discussed below.

Investigation and Monitoring of Coastal Environmental Quality

Integrated Investigation on the Resources of Coastal and Tidal Flat. The State Oceanic Administration, State Department, and other units took part in the integrated investigation on the resources of the coast and tidal flats from 1980 to 1986. The involved areas covered 10 provinces, cities, and numerous zones.

Integrated Investigation on Environment and Resources of National Islands. The State Oceanic Administration and the other units organized on integrated investigation on the environment and resources of national islands. A series of investigation reports had been provided.

Investigation of Chinese Oceanic Bays. The State Oceanic Administration organized on integrated investigation on the environment and the resources of national important oceanic bays at the end of 1980's. A series of books of general records had been published.

Chinese General Monitoring Plan for Marine Pollution. Since 1984, the State Oceanic Administration has been organizing the working units to execute the national general monitoring plan for marine pollution. There are now more than 400 monitoring stations in China. Among them are 102 monitoring stations for seawater quality, 56 stations for sediment, 22 stations for the remaining toxin, 6 stations for atmospheric environment, and 242 stations for effluent sites. A large amount of monitoring information have been accumulated during these 12 years.

Monitoring on Waste Discharge Areas. The amount of waste and dredged waste is increasing year by year. There were more than 80 million tons dredged waste in 1989. A periodic monitoring has been carried out on 38 waste discharging areas in the sea.

Monitoring and Investigation of Red Tides. The monitoring of red tides has continuously been conducted since 1989, the State Oceanic Administration and related units have been performing key monitoring on frequent red tide areas and announcing the possibility and information of red tides. The Third Institute of Oceanography of the State Oceanic Administration, the Institute of Oceanography Academia in Tsingdao, the Ji'nan University in Guangzhou, and the

State Oceanic Administration (South China Branch) are carrying out research on red tides, including the investigations on happening conditions, organisms, mathematics models, and other projects.

Investigation of Ecological Base Line of Daya Bay. For assessing the effects of nuclear station on ecosystem, the investigation of ecological base line of Daya Bay was carried out from 1986 to 1988.

Mussel Watch and Ecological Monitoring. The National Marine Monitoring Center and the Third Institute of Oceanography of the State Oceanic Administration have executed an investigating plan on the remaining toxin in coastal economical shellfish.

Atmospheric Pollutant Monitoring. The atmospheric transportation is the main input channel of ocean pollutants, especially the evaporable materials. The Third Institute of Oceanography of the State Oceanic Administration charges the monitoring of atmospheric pollutants in the Routine Monitoring Program of Marine Pollutants and, in addition, takes part in various international cooperation.

Investigation on Hepatitis Virus Pollution. A comprehensive investigation shows that the hepatitis epidemic prevalent in east China in spring of 1988 was relevant to shellfish contaminated by the hepatitis virus. Effective measures were taken against it.

Recent Status of Marine Environmental Pollution in China

Sources of Pollutants. The main input channels are the following: input, direct discharge from land, sea oil field discharge, ship discharge, and atmospheric transportation. According to statistical data, the total amount of industrial and domestic waste waters discharged into sea in China is about 850,000 tons per year. 87.2 percent comes from the river, especially from Yangzi River and Pearl River (about half of total). Among the pollutants, 78 percent are from the industrial waste water and 20 percent from domestic waste water. Organic pollutants make 97.5 percent of the total pollutants discharged while petroleum makes 0.91 percent.

Status of Marine Pollution. The environmental quality of the major coastal zone in China is good, except for some estuaries and harbors.

Organic Pollution — The year by average concentration of phosphates in the nearshore sea is 0.59 mmol/L and of nitrates, 7.5 mmol/L. The increasing organic pollution has already brought about more frequent red tide cases in some estuaries and harbors, leading to several hundred million yuans lost every year. For instance, 41 cases of red tide were recorded in 1990. There were only 43 cases in the whole 1980's. Eutrophication, caused by ocean cultivation, is being considered seriously by the government as an important problem of organic pollution.

Petroleum Pollution — The amount of the petroleum discharged into sea has been increasing steadily since the 1970's. The amount of petroleum discharged into the east China Sea in 1984 was four times of that in 1979. The main polluted areas are Dalian Bay , Jiaozhou Bay, Yangzi River estuary, and Pearl River estuary. The concentration of petroleum pollutants has not yet increased to the range of acute poisoning to the ocean living; but there are probably accumulating in their bodies.

Trace Metal Pollution — Trace metals, not the major pollutants in China sea compared to organic materials, are mainly Hg, Cu, Pb, Zn, and Cd. Trace metal pollution also occurs in the major estuaries and bays.

Chlorohydrocarbon Pollution — The average concentration of chloro-pesticides in the Guangdong coastal sea water is about 1.0 mg/L, much higher than that in other sea areas. China has prohibited the production and use of BHC and DDT. This will help to decrease the concentration of those pollutants in sea water and sediment.

Microorganism Pollution — Colon bacillus in some areas had exceeded the standard of water quality, due to the discharge of domestic waste water. The decreased water quality of beaches nowadays and the hepatitis prevalence in 1988 are related to the microorganism pollution.

Monitoring Network of the Marine Environment

National Monitoring Network of Marine Pollution. The national monitoring network of marine environment is organized by the State Oceanic Administration. The main tasks of this network are to the monitor long-term environmental quality and pollution sources, to predict the pollution status and trends, and to serve the marine environmental management and economic development. The related units of provinces, cities, and autonomous zones on the coast take part in the work. A hundred units joined the network. Bo Sea, Yellow Sea, East Sea, and South Sea have individual regional monitoring networks for marine environment.

Trade Monitoring Network of the Marine Environment. National Monitoring Network of:

Fishery Environment — Founded in 1985, a national monitoring network of fishery environment consists of a three-level monitoring organization. The main task of the network is to monitor the marine fishery areas, important mariculture zones, ecosystems of some defined marine fishery resources, red tide in some important fishery areas, remaining toxin in fish, and events of marine pollution.

Other Trade Monitoring Network — There are some other trade monitoring networks, such as those from the transportation department, marine petroleum corporation, and navy. they are also working on marine environmental monitoring for their special needs.

Techniques, Standards, and Interlab Calibration

Standards for Marine Monitoring. This was compiled and published, consisting of 10 chapters: 1) general regulations, 2) data treatment and analytical quality control, 3) sample collection, prevention, and transportation, 4) water quality and analysis, 5) sediment analysis, 6) organism analysis, 7) atmospheric analysis, 8) nuclide determination, 9) nearshore pollution ecology and biological monitoring, and 10) investigation on flux of pollutants charged into the sea.

Production of Standard and Reference Materials. A lot of standard and reference materials have been developed and produced. They are:

1. nitrates, nitrites, ammonium, silicates, phosphates, iodates, and hydrochlorides
2. Cu, Pb, Zn, Cd, Cr, Hg
3. mussel standard with values for 17 elements, reference values for 4 elements, and information for 16 elements
4. standards of nearshore sediment with standard values for 34 elements, such as Hg, Cu, Pb, Cd, Zn, and As

Interlaboratory Calibration. Interlab analytical calibration is held at least once a year by the national monitoring network of marine environment. Besides the national interlab calibration, the State Oceanic Administration and the National Marine Monitoring Center joined five international interlab calibration activities held by the Intergovernmental Ocean Committee (IOC). International training courses on marine sediment monitoring and marine benthos monitoring were also opened in China, sponsored by the IOC.

Marine Environment Management

The following are the related rules and regulations executed in China since the 1980's.

Marine Environmental Protection Law of the People's Republic of China

1. National Marine Environmental Protection Law
2. Regulations of Environmental Protection on Marine Petroleum Exploration
3. Management Regulations of Preventing Ships from Polluting Seawater
4. Management Regulations of Dumping Waste on Sea
5. Management Regulations of Preventing Land-source Pollutants from Destroying Marine Environment
6. Management Regulations of Preventing Coastal Constructional Projects from Destroying Marine Environment

Environmental Quality Standards

1. Sea Water Quality Standards of the People's Republic of China (1982)
2. Standards of Marine Pollutant Discharge (1983)
3. Quality Standards of Marine Environmental Sediment (under formulation)

Establishment of the Natural Reserved Zones and Delimiting Areas. Fifty-seven ocean natural reserved zones and the reserved zones for rare animals in imminent danger were established successively. Direct discharging of wastes in these areas is prohibited. Other activities, such as the exploitation of natural resources, even traveling and scientific research, are forbidden. At present, 38 delimited dumping areas on the sea are under rigid management and monitoring.

Marine environmental quality, pollution monitoring, and environmental management in China have been briefly discussed above. More works on these subjects are still carried on.

9.3. Monitoring Systems of the Marine Environment in Indonesia

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Executive Summary

Indonesia, "the Maritime Continent", is more occupied with marine environmental conditions than other countries; this environment represents a great challenge for Indonesia in it efforts to maintain a sustainable growth and enable it to take a seat among the industrialized countries within the next five years of its development plan. To achieve this goal, Indonesia is eager to rake advantage of establishing an ocean observing system within the framework of the Global Ocean System (GOOS), a UN program confirmed during the Rio summit in 1992.

The marine sector in Indonesia plays an important role in achieving the goals defined in the Second Long term Plan (PJPT II) and the Sixth Five year Plan (REPELITA VI). Some major policies that support the development of the marine sector can be summarized as follows:

a. policies for developing the marine industry that enable increased productivity, efficiency, social welfare, and provide employment;
b. policies for increasing technology capability in the marine production sector which is suitable for certain areas;
c. policies supporting the marine sustainable development considering marine environmental surveillance and sea ecosystem;
d. policies that support human resource development in the marine sector; and
e. policies that support the national institutional system for managing marine development.

It is recognized that a marine environmental monitoring, forecasting, and information system will support the efforts of a continued sustainable development necessary for achieving the above-described goals and policies.

Introduction

The oceans have always played a major role in the life of mankind, perhaps as the major supplier of food and also as a means of transport. The coastal areas, therefore, have been the most attractive areas for human settlements. In today's world, when industrialization gives increased pressure on the environment, the oceans also take the major threat on this most precious gifts from nature — a healthy environment.

Today however, we observe that the once-everlasting sea is not really everlasting. What was previously thought of as an infinite source and a boundless sink is now showing clear signs of stress which can no longer be ignored. Increased loads of various pollutants are leading to eutrophication, trace metal poisoning, harmful algae blooms, red tides, again causing an increasing number of dying sea animals, seabirds, toxic fish, and foul-smelling and bad-looking beaches. And this also affecting the area of marine economy, reducing the production capacity and causing losses.

Indonesia is known as the "Marine Continent", because it is located between two major oceans — the Pacific and the Indian Oceans. It has a shoreline of 80,791 km, 17,508 islands. Its territorial waters contains the major shipping lanes between Asia and Europe/Africa and the Middle East. Being the "Marine Continent" also means that a number of marine living resources depend on the quality of the Indonesian marine environment when migrating between these oceans. Further, Indonesia is in the early stage of becoming an offshore oil production nation and is also an important supplier of food coming from marine areas. Indonesia is also responsible for a major part of the world's marine environment and, thus, the management of the marine biodiversity and problems related to transboundary water pollution transport.

The ocean has many resources which the coastal states have learned to use and maintain through centuries of experience. The ocean influences the climate and the environment; the mainland, the importance of monitoring and understanding the ocean and marine environment is emphasized.

These facts are also challenges to Indonesia to enable its sustainable development and make it one of the industrialized nations within the 25 years of its development plan. In order to achieve this goal, Indonesia must use its marine natural resources.

Up to now, the main orientation of the Indonesian development is focused on the management of natural resources in the terrestrial area to support the need of food and other basic needs. The pressure of population growth demands the use of more natural resources, which will decrease the carrying capacity of the terrestrial area. Therefore, Indonesia believes that it should seek the alternative resources from the ocean. This is clearly identified in the second 25-year long-time development plans (PJPT II) and the sixth five-year plan (REPELITA VI), where the maritime sector is given an important role for the further development of the Indonesian society.

An improved institutional capability for marine environmental management and a better marine monitoring, forecasting, and data dissemination system will definitely support a better management of the marine environment and reduce the arising environmental problems coming from industrial development. The implementation of these systems will enable a continued sustainable development and benefit the economy connected to the marine sector.

Indonesian Concern for the Marine Environment

Indonesia consists of 17,508 islands, forming an archipelago rich in marine resources. Very productive ecosystems like coral reefs, mangroves forests, and estuaries are abundant; and they form the basis of important commercial fisheries, aquaculture, and tourism. In addition, the Indonesian waters are rich in oil and gas resources significantly contributing to the formation of values.

The western part of the archipelago generally consists of shallow areas, while its eastern part and that of the Indian Ocean is deeper, having depths of more than 5,000 meters.

The overall pattern of the sea currents in Indonesian waters is mainly monsoon-driven, which is reflecting in the shifting of currents between August and February.

Marine Environmental Concern

The Indonesian authorities have pointed out a number of areas of high priority regarding environmental concern. These areas cover both ecosystems which are essential in ensuring an increasing sustainable harvest from the sea, safe exploitation of resources like oil and gas, and improving important marine infrastructure.

1. Coral Reef Management — Coral reef ecosystems face a number of potential threats: non-sustainable fishing methods, unwise use by the tourist industry, different types of pollution (e.g., oil spills), sedimentation, and changes in temperature and salinity. Sustainable management of coral reefs is of high importance because the productive reef ecosystem sustain the lives of local fishing communities and are a source of biodiversity. The reefs are very important to the tourist industry as well as snorkeling and scuba diving. Coral reefs are very sensitive to environmental changes, both physical and chemical. Changes in temperature and salinity, storms, sedimentation originating from forest cleaning, industrial wastes, sewage, pesticides, and oil spills are all potential threats. Managing the coral reefs is given high priority by the Ministry of State for Environment which has outlined a Strategy on Coral Reef Ecosystem Conservation and Management.

2. Mangrove Forest Management — Mangrove forest ecosystems are threatened with destruction and even extinction as a result of forest exploitation which exceeds its sustainable level and land reclamation for other development activities, such as agriculture, aquaculture, harbour construction, etc. Mangroves have their unique characteristics because of such environmental factors as climate, topography, pattern of sea water currents, and sedimentation and are very sensitive to changes in these factors.

3. Estuaries Management — An estuary is unique from the fisheries perspective as it is rich but at the same time very vulnerable to influences from the land and sea. The estuaries, as well as the coral reefs and mangrove forests, provide spawning and nursery grounds for important fish and prawn stocks and are important sources of food production. The management of coral reefs, mangrove forest, and estuaries ecosystems is given high priority by the Ministry of State for Environment, which consequently outlined a National Strategy on Coastal Green Belt as mentioned above.

4. Marine Biodiversity — The loss of genetic and biological diversity weakens the community's ability to adapt to changes. Marine biodiversity is important to Indonesia because it is perhaps greater than on land. The habitat's destruction is the main cause of biodiversity loss; other direct causes are mining reefs and removing mangroves. Less direct, but nonetheless important, causes of biodiversity loss are pollution by sedimentation and nutrients, temperature, and salinity changes. A National Strategy

for Marine Biodiversity management has been outlined and coordinated by The Ministry of State Environment.

5. Red Tide/Algal Blooms — Red tides and bloom of toxic algae are reported from Indonesia and nearby waters. In many marine countries facing increasing marine eutrophication, algal bloom is a growing problem. Blooms of toxic algae are threats to several important marine activities like aquaculture, fisheries, and the tourist industries. Toxic algal blooms reach areas where shrimp farms pump in sea water or sites for cage fish farming and may kill significant amounts of farmed species in a short time. Another potential threat is human poisoning, due to the consumption of shellfish containing algal toxins, The tourist industry is likewise exposed for such problems or discolouring of the sea, bad-looking beaches, toxic food, and dead marine animals. The cost may reach hundreds of millions of US dollars as in the Adriatic Sea in the Mediterranean.

6. Oil Spills — Indonesian authorities express an increasing concern for the possible negative effects of oil spills on the marine ecosystems and resources. Routine spills occurred from offshore installations and tankers, as well as from offshore installation accidents and tanker collisions between the cargo ship *Ocean Blessing* and the oil tanker *Nagasaki Spirit* in September 1992, where an oil slick was released. In addition to the Straits of Malacca, the Straits of Sunda, Macassar, and Lombok experience heavy ship traffic.

7. Radioactivity Spills – Following the announced Japanese transport of plutonium from France to Japan through the waters of Indonesia and other ASEAN countries, increasing attention was paid to the possible negative effects of the increased levels of radioactive isotopes in the sea. The Indonesian Forum for Environment (WALHI), a non-government organization, has asked the Indonesian waters (Malacca, Macassar, and Lombok Straits). Other countries in the region have similar plans for importing plutonium, which may increase the environmental concern regarding radioactive contamination of the sea.

8. Eutrophication — The increasing discharge of nutrients (nitrate, phosphate) to the marine environment creates local problems (e.g., Jakarta Bay) and gives rise to growing concern for the open marine environment. The increasing eutrophication of marine waters has several important implications for the use of marine resources. In addition to reducing the water quality for tourist and recreational purposes, increased eutrophication will eventually affect the marine ecosystems and thereby change the species composition and reduce the potential harvest of economically important species. Increased nutrient content is the main cause of the growing number and intensity of red tides and algal blooms, which have negative impact on the fisheries, and tourist industries.

9. Fisheries — Indonesian authorities have been able to manage fish resources in a sustainable manner and to bring new stock into harvesting. Thorough knowledge of physical and chemical parameters is essential both to determine the location of important fish stocks and to monitor the quality of their environment. Changes in physical and chemical parameters can strongly influence the distribution of fish stocks

and the resulting fisheries.

10. Aquaculture — During the last years, aquaculture, especially shrimp farming, has become an important export industry. However, the potential for further development in farming the sea is great and effort should be made to initiate sea cage farming of economically important species. Knowledge of the physical and chemical parameters of the sea, monitoring of algal blooms, as well as wind and current data, are of crucial importance.

11. Tourist Industry — The tourist industry is highly dependent on such qualities as clear water and beaches, intact coral reef ecosystems, and healthy food. Increased eutrophication, the rowing number of algal blooms and red tides, and high incidences of food poisoning, following toxic algal blooms, may have serious consequences to Indonesian tourist industry as the competition for the tourists is getting harder.

12. Sea Food Production Quality — Toxin-productivity tend to become more common in many waters of the world, making problems for the shellfish industry (e.g., mussels, oysters). Algae-producing toxins, giving PSP (Paralytic Shellfish Poison) and DSP (Diarrethic Shellfish Poisoning), have been of special importance; but algae which produce other toxins prone as a threat as well. To reduce the risk of human poisoning and losses for the industry, a toxic algae monitoring program is necessary.

13. Meteorology — The authorities responsible for the meteorological services in Indonesia express significant interest in increasing the number of sea measuring stations and the frequency of measurements. The accuracy of the forecasts, will increase with the corresponding rise in the safety of the fishing and the commercial fleets.

14. Global Climate Changes — Changes in the global atmospheric climate will have large consequences in the coastal areas all over the world. Climate monitoring and prediction require relevant meteorological and oceanographic data which exceed what are available from the traditional sampling methods. The concern for global climate changes is one of the main reasons for establishing the Global Ocean Observing System (GOOS).

15. El Nino/Southern Oscillations (ENSO) — The important "El Nino" phenomenon and its atmospheric counterpart — the "Southern Oscillation" — which affect the coast of South America with dramatic consequences for the marine-related areas also have an effect on Indonesia. This important climatic phenomenon is presently the subject of an intensive research program aimed at understanding it better in order to forecast this event more accurately.

16. Marine Research — The Indonesian research institutions have identified a number of programs to increase the knowledge and understanding of marine processes and ecosystems. These research programs need accurate data to reach their goals. Some of these research programs are:

a. Oceanographic research of the Indonesian waters
b. Research on the biology and ecology of the marine biota of economically-important species
c. Research programs on marine pollution in the integrated coastal system
d. Study of red tides
e. Application of remote sensing
f. Numerical modeling of marine processes
g. Study of the Indonesian through flow
h. Application of physical parameters in fishing-ground detection.

17. Ship Safety — Marine environmental conditions, such as wind, current, and wave conditions, are of utmost importance, especially when navigating in the coastal waters. This information is essential during normal operation, but is very crucial in case of accidents or emergency, such as a shipwreck which may represent a major threat to the marine and coastal environment.

18. Offshore Activities — The development of the oil and gas industries requires high-quality marine environmental data for safety and economical purposes. When designing new installations, reliable data are requires; and during operations, these data are most important.

19. Hydrographical Services — The hydrographical services of Indonesia consist of survey, research, nautical chart, publication, marine environment, and safety of navigation to support the Armed Forces and public users.

    Implementations is achieved through:
    a. Hydro-oceanographic survey/research in Indonesian waters
    b. Tidal observations throughout the Indonesian waters
    c. Meteorological observation
    d. Marine geographic research
    e. Other marine research
    f. Nautical chart and publications.

20. Coastal Management — The use of coastal areas depends very much on the classification of the environmental conditions. Therefore, more data and knowledge will support the coastal management efforts.

21. Environmental Impact Assessment (EIA) Studies — When starting larger activities that affect the coastal zone, like developing industrial areas, building harbours, and discharging effluents, the possible impact on the environment should be assessed. Both data that describe the situation before and after the development is started are needed. Internationally, it is now agreed that EIA studies should be a part of all larger development projects.

Monitoring System of the Marine Environment in Indonesia

General

As in many other countries, the marine environmental ecosystems in Indonesia — either in terms of quality or quantity of production — become degraded as a result of direct physical destruction and/or the toxic effects of chemical. Any damage to such ecosystems is a significant threat because all natural resources are of high socioeconomic importance to coastal subsistence economies. The sources of contamination can be generated from the municipal waste outfalls and runoff, industrial wastes, river discharges, and shipping activities (operational and accidental). There are a number of strategies to reduce the impact of marine pollutants from all of these sources. These may be preventive, and management strategies. However, pollution control actions depend upon and must be accompanied by an effective and reliable monitoring system. Obviously, monitoring is also viewed as an integrated part of any management program for maintaining the quantity of the marine environment.

Monitoring is a program of measurement, analysis, and synthesis to quantify environmental contaminants or conditions in order to establish the scientific basis for environmental management decisions. The Environmental Impact Management Agency (BAPEDAL) of the Republic of Indonesia, which has the responsibility and mission to manage the quality of environment in Indonesia, is attempting to set up a monitoring system for marine environment.

Concepts of Monitoring

Until quite recently, the uses of the marine environment have been limited to shipping, capture fishery, waste disposal, and some recreational activities in the coastline. The quality of the marine environment can be monitored biologically, chemically, and aesthetically, according to its uses.

An effective and reliable monitoring system should include the development and implementation of the appropriate analysis methodologies that would provide an indication of the condition and productivity of the marine ecosystem. Three types of monitoring should be considered for the formulation of marine environment system, namely: *effluent monitoring*, *effects monitoring, and trends monitoring*.

> Effluent Monitoring — Effluent monitoring can be introduced as a means of protecting the coastal waters. This approach should be conducted to ensure that the activities initiated on land by individuals, industries, and municipalities do not lead to the detrimental effects on marine resources and their uses. In this case, the Government of Indonesia has established the uniform emission standard approach in which technological controls are applied at the source, i.e., end of pipe discharges into the water. The standard is based on the best practicable technology and translated into certain measurements, which, in turn, has been described in the State Ministry of the Environment Decree Number 3/1990.

Since Decree Number 3/1990 had some weaknesses which made it difficult to accomplish, the State Ministry of the Environment replaced it with the Decree Number 51/1995. The Decree regulated 22 types of industries. However, unlike in the Decree Number 3/1990, this new Decree did not include the oil refineries industry.

Effects Monitoring — A wide range of industrial effluents are discharged into harbors, estuaries, and coastal waters. The industries concerned have deposited and, in some cases, continue to discharge materials with biological and chemical oxygen demand, suspended solids, metals, chlorinated hydrocarbons, and polycyclic aromatic hydrocarbons. Under certain conditions, these pollutants which are potentially contaminating living resources can be released in water column.

The impact of pollutants in marine environment can be detected by effects monitoring program. There are two sets of objectives for such a program:

a. Chemical objectives: to establish the natural levels and chemical nature of pollutants; to determine the degree of and probable sources of contamination; and to measure changes in the levels.
b. Biological objectives: to describe quantitatively the species, their abundance, spatial distributions, and long-term dynamics; to provide comparative data for future surveys; and to detect the effects of project fauna.

The effects monitoring program can take the form of: water column chemical monitoring, water column biological monitoring, benthic chemical monitoring (sediment analysis), and benthic biological monitoring. A number of other parameters can be measures to assess the effect of an effluent on aquatic organisms. These include chronically accumulating stress ultimately causing death, sublethal impairment of various physiological changes, sublethal behavioral effects, and measurable biochemical responses.

The State Ministry for Population and Environment's Decree No. 02/1988 on the Guidelines for Setting Environmental Quality Standards is an effort of the Government of Indonesia to counter the impacts of pollution to environmental quality. However, this Decree again still requires further improvement in order to achieve prompt and effective action particularly, in responding to marine pollution control.

Institutional Aspect of the Application of Marine Environmental Monitoring in Indonesia

Traditionally, a large number of agencies and industries had some interests within the area of marine environment, namely: shipping, fisheries, aquaculture, navy, research, meteorology, and offshore oil and gas production. In order to develop a marine environmental and/or pollution monitoring and, consequently its feasibility study, it was necessary to investigate which activities are undertaken. The purpose of these visits and interviews was to learn more about the ongoing activities and how this could be related to the introduction of a marine environment and/or pollution monitoring, forecasting, and information system. Therefore, it was important to learn their projects/activities, their organization and the capacity of their human resources.

To conduct this investigation, the cooperating partners made a list of the most concerned agencies/industries and called for a meeting, interviewing them about their activities. The survey might not be complete, but it covered the most important aspects. The following is a short summary of these interviews, concentrating on the aspects related to the feasibility study for developing a marine environment and/or pollution monitoring, forecasting, and information system.

1. The Ministry of State for Environment — This Ministry is responsible for the development of a suitable environmental policy for Indonesia, including the marine environment. It is not responsible for policy execution.

   A marine monitoring and information system must get support from a wide range of marine environmental data which will directly benefit the development of Indonesian marine environmental policy. Additionally, the Ministry is interested in participating in the development of such a system.

2. The Environmental Impact Management Agency (BAPEDAL) — BAPEDAL of the Republic of Indonesia was established for the purpose of implementing and integrated national policy, concerning the management of the environment. However, some problems are encountered in monitoring and enforcing the standards. BAPEDAL has its own laboratory to control a number of water and air environmental quality parameters. However, developing and improving the laboratory capacity is a crucial need.

   BAPEDAL established three regional offices in 1995 in order to overcome the difficulties in monitoring which is done by the local government. These offices were located in Pekanbaru of the Riau Province (for the Western region), Densapar of the Bali Province (for the Central region), and Ujung Pandang of the South Sulawesi Province (for the Eastern region). In addition, the availability of standard procedures and analysis for sampling must be considered. Since there is no standard procedure available, different laboratories will give different results. Obviously, this will lead to difficulties in validating the results for prosecution purposes.

3. The Agency for the Assessment and Application of Technology (BPPT) — Being responsible for the assessment and application of technology in Indonesia, BPPT is interested in the discussion of developing the marine environment monitoring and information system, especially in technological approach. The Directorate for Human Settlements and Environmental Technology, is given the responsibility. It runs laboratories for the studies of coastal processes and waste water treatment. From other parts of BPPT, the Directorate may enter into cooperation with scientists having capacity in following areas: oceanographic research/mapping, mapping the marine resources by means of geographical information system (GIS), oceanographic applications of remote sensing data and physical modeling of ship constructions.

4. Indonesian Institute of Sciences (LIPI) — Within the institute is a Research and Development Center for Oceanology (PPPO-LIPI). This center is responsible for various traditional research programs related to marine environment. To undertake this task,

PPPO-LIPI employs a number of marine scientists and maintains various instrumentation, laboratories, and vessels for support. Its staff include a number of well-qualified scientists in most areas of marine sciences.

In establishing a marine monitoring and information system, the traditional activities may benefit and PPPO-LIPI may contribute significantly through advise and the inclusion of the new system.

5. Indonesian National Aeronautics and Space Institute (LAPAN) — The main functions of LAPAN are: to formulate a policy in the fields of aeronautics and space and their applications; to establish coordination among related institutions in developing aeronautics and space science and technology; to conduct research and development of remote sensing technology and its application; and to conduct research in the fields of physical sciences, atmosphere, and outer space. Atmospheric research programs are supported by using weather satellite ground station, rocket, balloon, and ground equipment.

   LAPAN also conducts research and development in the field of remote sensing technology by developing and utilizing satellite ground station in Pare-Pare in the Province of south Sulawesi and Pekayon in the province of West Java, at present only for LANDSAT and SPOT.

   In undertaking these tasks, LAPAN works together with other institutions, such as BPPT, BMG, and LIPI. A marine environmental monitoring, forecasting, and information system will support the activities of LAPAN.

6. Meteorology and Geographysics Agency (BMG) — This agency produces weather forecasts, based on land and sea observations. An Indonesian weather forecast model is under development, using computer-based analysis and forecasts.

7. PERTAMINA — PERTAMINA is the state oil company of Indonesia. Its responsibility is to develop, run, export, and distribute oil and gas production in the domestic market. To undertake its tasks, PERTAMINA runs a lot of marine-related operations. To prepare for an accidental oil discharge, PERTAMINA keeps stocks of oil combat equipment and prepared its staff to use this equipment, if necessary.

   An environmental monitoring and information system will provide useful information in case of an accident, supporting the combat actions. Other crucial marine operations may also gain from using the available data. In addition, the system may provide useful information in the development of new offshore oil and gas production fields, where the available data may guide the design criteria.

8. Hydro-Oceanography Service of the Navy — In Indonesia, the Navy was given the responsibility to support both the armed forces and the public with its hydro-oceanography services. These services are especially related to the preparation and publication of naval charts, tide tables, and general oceanographic research/information.

In addition to the scientific/oceanographic staff, DISHIDROS employs a number of technicians having experience in oceanographic instrumentation. DISHIDROS also takes responsibility for running a number of oceanographic research vessels, including those owned by BPPT. It keeps a variety of oceanographic instrumentation.

9. Directorate of Navigation, Directorate General of Sea Communication — The Directorate General gives navigation aid, based on data from anchored buoys and lighthouses, and distributes safety information (weather, sea state, lighthouses out of order, etc.) via coastal radio stations. During oil accidents, the Directorate General is responsible for navigation and safety information and for communication; while the Coast Guard is responsible for prompt action.

10. Office of Urban Environmental Assessment of Jakarta (KPPL) — The office organized under the Governor of Jakarta, is monitoring the sea water quality in Jakarta Bay, the river quality, ground water quality, and air pollution in Jakarta. It has laboratory facilities with advanced equipment to conduct the necessary analysis.

11. Fish Product Control Laboratory — This laboratory, under the Governor of Jakarta, is responsible for controlling fish products offered to the various markets — domestic and export. Of special importance is the export production control, since most of the export of fresh products taking place have Jakarta as a shipment port.

    The laboratory may contribute with valuable information concerning the quality of sea food product as a result of the water quality and, in turn, receive information about the water quality that threatens the sea food product, affecting the control procedures.

12. Bandung Institute of Technology (ITB) — The ITB is the only institute with oceanographic modeling activities. It is very interested with the feasibility study for marine environmental monitoring, forecasting, and information system. ITB takes part in a wide variety of research and education relevant to the areas in question in this report. Among these are:

    * numerical environmental modeling;
    * general oceanographic research;
    * climatology; and
    * meteorological modeling.

    The system will give ITB valuable data for model verification purposes and general research activities. ITB may also contribute in the area of advising and support of human resources.

13. Department of Living Resources Management, Faculty of Fisheries, Bogor Agricultural Institute (IPB) — This department is working in the fields of oceanography, hydrobiology, limnology, and fisheries management. The implementation of various programs will produce more data available for the ongoing research.

9.4 The State of the Marine Environment In Malaysia

by **Pauziah Hanum Abdul Ghani,** Department of Environment, Malaysia

Introduction

Coastal resources and critical issues confronting the marine environment have been identified in numerous inquiries and discussion papers. Management of the coastal zone, its resources, and the offshore waters is shared by everyone.

Malaysia has a total sea area of 598,540 km2 within the boundary of the Exclusive Economic Zone (EEZ). Generally, the Malaysian waters are categorized as follows:

(a)	National Coastline	-	4,800 km
(b)	Island	-	1,007 island
(c)	Territorial Waters	-	148,307 km2
(d)	Exclusive Economic Zone	-	450,233 km2

Status of Marine Pollution

The marine water quality monitoring stations have long been established by the Department of Environment. As of 1995, 186 monitoring stations have been used to determine the status of marine environment. Oil and grease, total suspended solid (TSS), and *Escherichia coli (E. coli)* prevailed as the main contaminants of the coastal environment, being the end results of accumulated land discharges from all manners of development activities. The trend of 1995 remained the same as in other years, whereby, oil and grease, TSS and *E. coli* are the major contaminants of the coastal water as shown in Figure 3. Among the three contaminants, oil and grease pose tremendous threats to the marine environment as in Figure 4, where the percentage of exceedance is always above 60 percent of the measured time.

Oil Spill Response

One of the major tasks of the Department of Environment is to monitor the incidents of oil spill in Malaysian waters. To respond to any incident happening in Malaysian waters, the National Contingency Plan and the Standard Operating Procedure (SOP) were established. To ensure the effectiveness of the national oil spill contingency plan, the membership of the National Committee on Oil Spill Control was reviewed and the plan itself updated on a regular basis to ensure the availability of necessary information needed in an emergency. Regional cooperation with Indonesia, Singapore, and Brunei Darussalam that is under the SOP for Joint Oil Spill Combat has been established. Figure 5 shows the oil spill incidents reported to the Department of Environment.

Legislation

In Malaysia, policies related to marine pollution are found in various laws, regulations, and enactments which provide statutory powers to specific government bodies to control pollution.

The most comprehensive environmental legislation in Malaysia is the Environmental Quality Act of 1974 (EQA 1974). The purpose of the EQA 1974 is two fold: pollution prevention, abatement, and control and environmental enhancement.

Legislation Pertaining to Marine Pollution

Environmental Quality Act, 1974

(I) Section 27 Illegal Discharge of Oil into Malaysian Waters.

Section 29 Ilegal Discharge of Wastes into Malaysian Waters.

Section 47 Power of Recovery of Costs and Expenses.

Section 48 Power to Detain and Sell Ships.

(ii) Environmental Quality (Scheduled Wastes) Regulations, 1989.

(Iii) Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Regulations, 1989.

(iv) Environmental Quality Orders (Delegation of Power), 1993 and 1994.

Exclusive Economic Zone, Bill 1984

(i) Section 10 Offence in Respect to the Discharge or Escape of Certain Substances.

(ii) Section 11 Defense to a Chargee Under Section 10.

(iii) Section 12 Requirement for Discharge or Escape of Certain Substances to be Reported.

(iv) Section 13 Measures Relating to a Marine Casualty.

(v) Section 14 Directions and Action to Remove, Disperse, Destroy, or Mitigate Damage.

(vi) Section 15 Power to Detain and Sell Vessel.

(vii)Section 24 Powers of Authorized Officer.

(viii) Section 25 Hot Pursuit.

(ix) Section 26 How to Deal with a Person Arrested.

(x) Section 27 How to Deal with a Detained Vessel.

(xi) Section 28 Obstruction of Authorized Officer.

(xii) Section 40 Damage Caused to Any Person or Property or to Environment in Exclusive Economic Zone or the Continental Shelf.

Custom Act, 1967

(i) Custom Order Ban on Export (Revised No. 2) 1993.

(ii) Custom Order Ban on Import (Revised No. 3) 1993.

Shared Responsibilities

Malaysia is actively involved with three international forum on conservation and protection of the marine environment. Considerable benefits can be gained from governments working together to share solutions, approaches, and resources and deal with common problems. This shared experience should be used to develop, as far as practical, management responses at the local and regional levels.

Conclusion

Managing marine resources for sustainable use is extremely important. A significant proportion of Malaysia's gross domestic product is derived from marine areas, particularly through the fishing, tourism, petroleum, and mineral industries so the health of the ocean and the diversity of biological marine resources are important for both ecological and economic reasons.

Annex 9.5

9.5 Water Quality Monitoring in Singapore

By Mrs. Ng Miu Lan, Principal Laboratory Officer,Strategic Planning and Research Department, Ministry of the Environment

Introduction

In Singapore, rainwater from almost 50 percent of the island is collected for use as drinking water. Water quality monitoring plays a very important role in ensuring that the water resources are kept clean and free from pollution.

The Strategic Planning and Research Department of the Ministry of the Environment is the main agency involved in the monitoring of the water quality of various inland water bodies and coastal areas in Singapore. The department is equipped with sophisticated equipment, such as the Gas Chromatograph/Liquid Chromatograph/Mass Spectrometer System, Ion Chromatograph, Fourier Transform Infrared Spectrophotometer, and Atomic Absorption Spectrophotometer.

Water Quality Monitoring Programs

The following programs are in force to monitor the various water bodies:

i. Inland Water Monitoring Program

   a. Water catchment
   b. Non-water catchment
   c. Toxic trace contaminant monitoring of rivers and reservoirs

ii. Coastal water monitoring

iii. Recreational water monitoring

iv. Drinking water monitoring

v. Biological monitoring of coastal and river waters

   a. Study of biodiversity
   b. Biological monitoring of rivers involving schools

Water Quality Monitoring Objectives

The objectives of the water quality monitoring programs are as follows:

i. to assess the nature and magnitude of any water pollution problems;

ii. to monitor trends in water quality so that timely control measures may be taken to prevent serious water pollution problems;

iii. to assess the effectiveness of the Ministry's water pollution control programs; and

iv. to check for compliance with the standards.

Inland Water Quality Monitoring Program

i. Non-water Catchment Monitoring

The water quality of 17 rivers and streams in the non-water catchment areas is monitored monthly. Surface grab samples are taken at the sampling points which are located upstream, midstream, and downstream. The locations of the sampling points are given in Figure 6.

The parameters analysed include pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), total suspended solids (TSS), ammonia, and sulphide.

In 1995, the DO of the rivers was >2 mg/L 93 percent of the time. The BOD was <10 mg/L 76 percent of the time and the TSS was <200 mg/L 95 percent of the time. The levels of ammonia and sulphide were also low, indicating good water quality.

ii. Water Catchment Monitoring

A total of 47 streams in the water catchments are sampled fortnightly. The locations of the sampling points are given in Figure 6. Surface grab samples are collected and analysed for pH, DO, BOD, chemical oxygen demand (COD), total organic carbon (TOC), TSS, chloride, ammonia, and phosphate.

In 1995, the DO of the catchment streams was >2 mg/L 92 percent of the time. The BOD was <10 mg/L 74 percent of the time and the TSS was <200 mg/L 93 percent of the time. The levels of the other parameters were all low indicating good water quality.

iii. Toxic Trace Contaminant Monitoring of Rivers and Reservoirs

Selected streams in the water and non-water catchment areas and the reservoirs are screened annually for a total of 130 toxic trace contaminants. The contaminants are listed in Table 4.

The results of the monitoring show that these contaminants are not detected or present in such low concentrations that they do not pose a hazard to human health or to the aquatic system.

Coastal Water Monitoring Program

i. Water samples are collected from nine sampling points in the Straits of Johor and ten points in the Straits of Singapore. Figure 6 shows the locations of the sampling points. The sampling frequencies and parameters analysed are as follows:

	Sampling Frequencies	Parameters Tested
Straits of Johor	Monthly	DO, pH, salinity, conductivity, TOC, clarity, colour, oil and grease, total and fecal coliform
	Quarterly	ammonia, nitrate, nitrite, phosphate
	Bimonthly	cadmium, chromium, copper, lead, nickel, mercury, selenium, zinc
Straits of Singapore	Monthly	DO, pH, clarity, total and fecal coliform
	Bimonthly	tin, zinc

ii. A joint Malaysia-Singapore seawater monitoring program is carried out monthly at 18 sampling points along the Straits of Johor (Figure 7) under the Malaysia-Singapore Joint Committee on the Environment (MSJCE). Singapore carries out the sampling at even month and Malaysia carries out at odd month. Joint report on water quality is put up at every MSJCE meeting.

The monitoring shows that the coastal water quality is good and suitable for recreation and aquaculture.

Recreational Water Monitoring

Monitoring of recreational water quality is carried out fortnightly at high tide. Figure 8 shows the locations of the beaches which are monitored.

The standards for recreational waters for swimming and other body contact water sports adopted by Singapore are as follows:

a) Fecal coliform — 100 per 100 ml
b) pH — 6.5 - 8.5
c) Dissolved oxygen — 5 mg/L
d) Clarity — >1.2 m
e) The water must be free from floating debris, oil, scum, and other objectionable matter.

The basic criteria for setting these standards are that the water must be safe; free from pathogenic organisms; aesthetically pleasing; and it must not have adverse chemical or biological effects on the human body.

The recreational waters in Singapore are able to comply with the standards most of the time.

Drinking Water Monitoring

The 1993 WHO Guidelines for drinking water are used in Singapore to assess the wholesomeness of the drinking water. The Ministry monitors the drinking water regularly to ensure that these guidelines are met.

Biological Monitoring of Coastal and River Waters

i. Study of Biodiversity and Environmental Monitoring of the Coastal and Riverine Waters

In 1992, the Strategic Planning and Research Department initiated a five-year joint research project with the National University of Singapore to monitor the abundance and diversity of aquatic species in the coastal and riverine waters. This scientific study involves the gathering of baseline data on physico-chemical parameters and aquatic life at selected sites including those which had been previously polluted by various activities, such as pig farming. The study will provide the scientific basis for the development of a comprehensive biological monitoring program. This will complement the present water quality monitoring program for inland and coastal waters.

Grab and trammel net samples are taken at the sites and the benthic and pelagic species in the samples are identified and counted. The results of the study obtained so far show a significant increase in the number of aquatic species and their abundance in the rivers indicating improving water quality.

ii. Biological Monitoring of Rivers Involving Schools

This monitoring program was started in 1993. It involved bringing interested groups of junior college and upper secondary school students to selected rivers where they carried out simple measurements to determine water quality and the aquatic species found in the rivers. Under this program, each participating school had to adopt a stretch of river for monitoring.

The program was intended to yield on a sustainable basis, useful information on the water quality and biodiversity of some of the major rivers in Singapore. It was also designed to raise the environmental awareness amongst school children by involving them directly in monitoring the state of the rivers.

9.6 The Program for Integrated Coastal Management in D.P.R. of Korea

by Ryang Chol, State Hydro Meteorological Administration,Oesong-dong, Central District, Pyongyang, D.P.R. Korea

Introduction

The government of the Democratic People's Republic of Korea (DPRK) has formulated the Law of Environment Protection in the Supreme People's Assembly, considering the importance of environment in developing the socio-economy. The law entered into force on 9 April 1986.

As a littoral country with abundant marine resources, the DPRK is affected directly by the seas, more than other countries, depending on the state of ocean environment.

In the light of the above mentioned issues and international trends, the country must take appropriate measures for the conservation and prevention of the marine environment. Thus, the government has made the decision to develop a national program for marine pollution prevention, and take part in the activities of GEF/UNDP/IMO Regional Programme.

The Program Objectives

The program objectives are as follows:

1. the main purposes of this program are to assess the ocean environmental issues scientifically in terms of ICM;

2. to prevent and manage comprehensively all the natural resources in the light of marine environmental prevention; and

3. to contribute to the world or regional program and implement the obligations of signatories of international conventions.

The Strategies for These Objectives

1. To establish the national network which will monitor, analyze, and assess the ocean environmental issues in the East and West Seas of the Democratic People's Republic of Korea;

2. to establish the national monitoring and management system according to the results assessed in this project; and

3. to cooperate closely with the international organizations especially UNDP, GEF, UNESCO, and IMO by taking part in the activities of the regional program systematically and by getting and sharing experiences with each other.

Environmental Policy Framework

The State Hydro-Meteorological Administration(SHMA) is the ministry responsible for hydrology, meteorology, and oceanography under the government of the Democratic People's Republic of Korea, in conjunction with the State Environment Commission. The SHMA has drawn up the plan to apply the ICM to coastal environment as a means of preventing marine pollution considering the geographical state of the country.

The Democratic People's Republic of Korea has developed a nation action plan for implementing the commitments as a participant to the Regional Programme of RAS/92/G34.

The action plan includes the Nam Po project, as a national demonstration site by introducing the ICM methods, initially with technical and financial supports from UNDP/IMO. The Nam Po West Sea Oceanographic Research Institute was selected as the implementing agency for the demonstration site to implement the national action plan.

In harmony with the action plan, the government of the Democratic People's Republic of Korea has signed and ratified the MARPOL convention (International Convention for the Prevention of Marine Pollution from Ships). It will also become a signatory to the OPRC convention (International Convention on Oil Pollution Preparedness, Response, and Cooperation) within a few years.

The Action Plan

First Stage:

1. Foundation of the Nam Po National Demonstration Site for the prevention and management of marine pollution. The Democratic People's Republic of Korea as a littoral country, especially with abundant marine resources, affects directly the seas and more than any other countries all the time which depend on the state of ocean environment. In the light of the above mentioned issues and international trends, it will take appropriate measures for the conservation of marine environment in the country.

   For a successful implementation of the national program, it is prerequisite to get experiences and scientific recognition on whether the ocean has been contaminated or is being contaminated now, especially the how and by what elements. The Nam Po Research Institute is responsible for the development of oceanographic issues in terms of the monitoring methods and assess most of the ocean state in a limited area, including the Geographical Information System and Integrated Coastal Zone Management. The main purpose of this plan is to introduce the results from the Nam Po Research Institute to the East Sea Research Institute and thus establishing the National Monitoring Network of marine pollution.

2. Establishment of the National Monitoring Network for marine pollution—establishing the National Monitoring Network is the key background to manage the coastal environment comprehensively. The State Hydro-Meteorological Administration will organize the National Monitoring Center in Pyongyang, which will be responsible for all data collection processing, assessment of coastal environment, and survey manuals, including regulations, following the results in the Nam Po demonstration site.

3. Strengthening the institutional capacity-building, especially in Nam Po, and training the staff for this program, in connection with UNDP/IMO.

Second Stage:

1. Monitoring and assessment of the state of marine pollution in D.P.R. of Korea—The monitoring and assessment will start in 1997 but in a limited area, especially in Nam Po and Hum Hung. After completing the National Monitoring Network, the Central Monitoring Center will commence its obligation under the State Hydro-Meteorological Administration.

2. Preparedness for the marine environment prevention, including the legislation, response to oils spill, and waste management—Within the Environment Protection Law of the Democratic People's Republic of Korea, the Central Monitoring Center will issue the appropriate measures to be taken by the government.

3. Managing all the relevant agencies according to the functionalization principle—The State Environment Commission will undertake its work according to the Environment Protection Law of the Democratic People's Republic of Korea, considering the results of the assessment made by the National Monitoring Center.

Geographical Characteristics

1. Korean East Sea — The surface area of the Korean East Sea is 970,484.14 km2, with 1668.2m average depth, 3699m in maximum depth, and the mean tidal range is only 0.3m. Salt marsh is scarce and the latitude is too high for mangroves. The sea grass and algal forests, on the other hand, are extensive and cover some 402 km2.

   Its comparative lack of water exchange with the greater Pacific Ocean makes the Korean East Sea susceptible to the accumulation of any contaminants discharged into it. The reduction and control of such discharges are therefore, to the mutual benefits of all riparian states. Overall biological productivity is relatively low and any enhancement of water quality will enhance productivity and benefit the subtropical and subarctic flora and fauna that are found in the sea and which form a unique ecological assemblage.

2. Korean West Sea — The West Sea of Korea, adjacent to China continent consists of 437,300.79 km2 total surface area and approximately 2,000 km in length. The sea floor is relatively with curvature; the depth at its entrance is around 80m and the average depth throughout is about 60m.

There is a tidal average of between 4-6m and a maximum tidal speed of 1.0m/s.

Discharging directly into the West Sea are the Amnok and Chongchon rivers in the north and Deadong and Han rivers in the middle of the Korean peninsula.

The salinity is around 30.5 percent, while the average temperature is 5°c in winter and 25°c in summer.

The West Sea biotic communities are very complex in species composition, with special distribution due to the relatively complicated oceanographic conditions of the area. Its faunal communities are composed of various ecological groups of both warm-water and cold-water species, as well as cosmopolitan and amphi-pasfic ones. The fauna are also diverse and abundant comparatively in the components of biotic communities.

The Socio-economic State in Coastal Area

The Korean peninsula is surrounded by international waters—the ocean on the west and the east; but the northern boundary is also an aquatic one, consisting of the Amnok and Tuman rivers shared with Russia and China.

The main commercial ports are Nam Po and Heaju on the Western coast and Sonbong, Chongjin, Hungnam, and Wonsan in the east. Rajin will also be developed as another major port, in connection with the planned Tuman River Development Project in the east. The main fishery ports are Nam Po and Sinuiju in the West and Sinpo and Kimcheak in the East.

Many heavy industries along the coast and rivers of the Democratic People's Republic of Korea, such as the steel mills, fertilizer plants, petrochemical synthetic fiber, and cement manufacturing plants have been in existence.

Monitoring Program

1. Creation of the monitoring experience in the Nam Po National Demonstration Site—The government of the Democratic People's Republic of Korea will assess all the results concerned with the marine pollution in Nam Po Demonstration Site which then undertake the appropriate measures as the next step.

2. Establishing the National Monitoring Network (NMN)—The activities for this purpose will be in the second stage of the national program; but some of the activities concerned with equipment necessary to the National Monitoring Center and field stations will be prepared in the first stage. The NMN will consist of a National Monitoring Center (NMC), two regional center, and six field observation stations.

3. Assessment of the state of East and West Seas—The NMC will assess the state of the marine environmental pollution according to the NMN's activities and take reasonable measures for its prevention and management.

The Program of Nam Po, Democratic People's Republic of Korea

Introduction

One of the reasons why Nam Po region is selected as a National Demonstration Site is that it represents all the tropical coastal characteristics of the Korean peninsula. The government of the Democratic People's Republic of Korea drew up the plan to establish the National Demonstration Site in the Nam Po region, by introducing the ICM techniques as the first step of the national program. Another reason is that the activities concerned with the marine pollution already have been done in this area by the West Sea Oceanographic Research Institute, although in a limited area.

The main purpose is to review the general status of marine environment and show the necessity of developing the ICM techniques in the country to the people concerned. Even though there is no severe problems with it now, the industries and economy must be developed continuously in the marine and coast lines.

Geographic Characteristics—The Nampo region belongs to the Semi-Plain zone, the same as in other western regions of the Democratic People's Republic of Korea. The geographical characteristic of the Korean West Sea is that its depth is shallow with the smooth water floor and its coast line is very long, with severe curvature and small islands.

Location—The Nampo city is placed in the estuary of Taedong River, the middle part of the western coast of the country, which is important geographically. The city is not far from the Pyongyang, which is the capital of the Democratic People's Republic of Korea, about 43 km in the Southwestern direction and its surface area is approximately 824 km2 on the point of 38°50'N and 125°24'E. It'is in the western part of the Democratic People's Republic of Korea, adjacent to Pyongyang and Pyongyang Province in the North and West, Pyongyang and Huanghea Province in the East and South, and Korean West Sea in the West and South.

Climate—The climate of the Nampo region expresses typical coastal characteristics. It is calm in winter and breezy in summer, relatively, because of the effects of the monsoon pertaining to the middle latitude area, northeastern Asia and facing the West Sea. The annual temperature is 9.8°c; the lowest one in January is 6.5°c and the highest one in August is 24.3°c. The drought season is in spring and autumn, due to the subtropical high pressure and rainy in summer, because of the subtropical front; furthermore, there are the effects of the Asian monsoon and much solar radiation.

The average annual precipitation is 900mm, e.g. relatively low compared with other inland regions in the Democratic People's Republic of Korea.

Hydrology—There have been effects from the tidal differences before the construction of the West Sea Barrage because of the smooth slope of Deadong River estuary and the coast floor. But now, there are no effects from the tide and also with a clear change of highest water temperature period in August.

The salinity is about 23-25 percent near the coast line and 32 offshore, with 21.00 minimum and 30.00 maximum.

Average tide velocity is 1.0 m/s; tidal range is 4-6m; and the frequency is semi-diurnal.

Ecosystem—The West Sea biotic communities are very complex in species composition, spatial distribution, and community structure due to the rather complicated oceanographic conditions of the area.

The faunal communities are composed of various ecological groups of both warm-water and cold-water species, as well as cosmopolitan and amphi-pasific one's.

Marked seasonal variations are the main characteristics of all the components of the biotic communities; also, much nutrients from the Deadong River passes through so many drainages within it that they are the factors facilitating the fishery inside and outside of the West Sea Barrage.

Port — The Nampo port is the main one both in commerce and fishery, positioned inside of the West Sea Barrage and with some of the reception facilities. The port has a passing capacity of 50,000 tons cargo ship through the Nampo water gate constructed in the West Sea Barrage and is equipped with some of the reception facilities.

Water Resources and Their Utility — The water resource around Nampo can be explained with the West Sea Barrage because it forms a large-scale artificial lake in which the water content can be regulated out one's disposal, especially inland water or sea water. The West Sea Barrage plays an important role in water use, especially in the field of agriculture, economic, and the public life. Using this water, the large-scale irrigation system covering the Pyongyang and Huanghea Provinces has been constructed, supplying water, irrespective of the drought season.

Waste Generation and Disposal — No available data about the source of wastes and pollutants have been collected. Most of the wastes and pollutants have been treated by the facilities equipped in individual factories and agencies concerned; but no data are available to assess the effluents entering into the sea from the river and coast line. Therefore, monitoring and assessment of the state of the sea environment is very important for the SHMA before taking any reasonable measures.

Impacts of Pollution on Marine and Coastal Environment — The West Sea of the Democratic People's Republic of Korea is surrounded by international waters. Thus, any effluents from

China and D.P.R.K. will affect the biotic communities and spatial distribution, including the marine environment.

Institutional and Organizational Arrangements

The Democratic People's Republic of Korea indicated clearly the importance of marine environmental protection in **The Land Law of Democratic People's Republic of Korea** entered into force on 29 April 1977 and **The Environment Protection Law of the Democratic People's Republic of Korea** on 9 April 1986; therefore, the legislative guarantee was already created in the Democratic People's Republic of Korea.

The State Hydro-Meteorological Administration(SHMA) is responsible for marine environmental research, monitoring, and services under the government. There are two oceanographic research institutes and six coastal stations under the SHMA.

The State Environment Commission is responsible for controlling; while the Ministry of Fishery is responsible for the production. Both will cooperate in the marine environmental prevention activities.

The Kim Il Sung University, Fishery University, Marine Transportation University, and Agricultural University will also cooperate closely for this purpose.

Development Status and Problems

The government of the Democratic People's Republic of Korea passed the plan or reported by the SHMA for establishing the National Demonstration Site in the Nampo region, by introducing the ICM techniques to the West Sea Oceanographic Research Institute. SHMA organized the research group with 15 scientists and researchers and its based on the plan. The SHMA also put emphasis on the cooperation with international organizations, especially UNDP, IMO, IOC, GEF, mainly because of the lack of experiences and equipment for ICM in the Nampo Demonstration Site.

For the successful implementation of the national program, it is very important to carry out the Nampo plan and provide the West Sea Oceanographic Research Institute with manpower and equipment to enable it to cope with ICM. This is a prerequisite to the Nampo plan.

Monitoring Program

As a first step, the data already observed in the Nampo Research Institute will be stored in data base, using the computers. Then, all the data will be processed with modern techniques so that the state of marine environment would be assessed. Some of the factors mentioned below are still being monitored; but those should be monitored to assess the marine environment.

For the successful implementation of the national program, it is a prerequisite to get experiences and scientific recognition as to whether the ocean has been already contaminated or is being contaminated, especially the how and by what elements.

The Monitoring System in Nampo

To assess the state of West Sea environment comprehensively, specifically the marine pollution, the West Sea Oceanographic Research Institute will collect the needed data on West Sea, based on the system outlined below.

The Monitoring Strategy in the National Demonstration Site

Defining correctly the monitoring factors which affect the predominantly marine pollution including waste resources which is the main activity in the demonstration site.

The following factors will be monitored in the Nampo Demonstration Site. Most of the following data will be necessary for analysis and assessment of the marine environment pollution. The oceanographic parameters are very important to determine the water mass.

9.7 Country Report of the Republic of Korea[3]

by **Dr. Dong Beom Yang**, Chemical Oceanography Division, KORDI, Ansan, PO Box 29, Seoul 425-600, Korea

1.0 There are several agencies responsible for marine pollution monitoring in Korea:
- ✳ The Ministry of the Environment
- ✳ The National Fisheries Research and Development Agency
- ✳ The National Maritime Police Agency
- ✳ The Office of Hydrography
- ✳ Other institutes

2.0 Official monitoring data is handled by both the Ministry of the Environment and the National Maritime Police Agency.

3.0 Figure 9 shows the number of stations around Korea. These are utilized to obtain information on important parameters.

4.0 The protocol for both the Ministry of the Environment and the National Maritime Police Agency are comparable:

4.1 Ministry of the Environment

The Ministry of the Environment samples six time a year (in February, May, June, August, September, and November), and covers 62 coastal areas as well as seven neritic zones which are sampled once a year. Sampled matrices usually involve surface waters, and sediments are not routinely done. The main parameters concerning the Ministry are:

- ✳ Temperature, salinity, transparency, pH, chemical oxygen demand, dissolved oxygen, suspended solid, and coliforms
- ✳ Oil and grease, as well as total N (nitrogen) and total P (phosphorous)
- ✳ Heavy metals, including hexavalent chromium, arsenic, cadmium, lead, copper, zinc, and mercury
- ✳ Organophosphates and poly-chlorinarted biphenyls are also analyzed
- ✳ Data is not usually for public consumption.

4.2 National Maritime Police Agency

The National Maritime Police Agency does sampling twice a year, in May and in September. Twelve areas are sampled, and 96 stations are visited. Standard methods for Korea are maintained during these occasions. Data from the National Maritime Police Agency are open to the public. The main parameters of concern include:
- ✳ Temperature, salinity, pH, chemical oxygen demand, dissolved oxygen, and suspended solids
- ✳ Oil and grease (using carbon tetrachloride extraction)
- ✳ Nitrate, nitrite, ammonium, phosphate, and silicates (SiO_2)
- ✳ Heavy metals such as chromium, cadmium, lead, copper, zinc, iron, and nickel

Table 5 shows the water quality standards followed by the Republic of Korea.

Annex 9.8

9.8. The Manila Bay Monitoring Program and Calancan Bay Rehabilitation Program

by **Ms. Leza A. Acorda**, Supervising Environmental Management Specialist, Environmental Management Bureau, Department of Environment and Natural Resources, Republic of the Philippines

Introduction

Manila Bay and Calancan Bay are two important marine bodies of water located in the island Luzon. Manila Bay is bounded by three regions, the National Capital Region, Region 3, and Region 4); while Calancan Bay is specifically situated in the province of Marinduque (an island province of Region 4). Both waters are utilized for fishing activities.

The Manila Bay Monitoring Program (MBMP) was conceptualized as a result of the construction of marine outfall, envisioned in the Sewerage and Sanitation Master Plan for Metro Manila. Marine outfalls are designed to make better use of the baby's natural assimilative capacity of discharging wastewater at its deeper portion. The MBMP was implemented in order to assess the impact of the existing submarine and future outfalls which discharge raw special project mandated by the Order of the Office of the President and is approved by the Pollution Adjudication Board as a result of the mining activities (specifically the operation of the tailings disposal system at Calancan Bay) by the Marcopper Mining Corporation. CBRP is a multidisciplinary approach which is necessary in order to accelerate and expand the rehabilitation and management of Calancan Bay.

I. Manila Bay

Manila Bay plays a major role in the socioeconomic development of the Philippines, particularly in the Metropolitan Manila area and the neighboring provinces that share its 190-kilometer long coastline. It is the hub of international and domestic shipping. Extensive commercial fishing (fishponds, shellfish harvesting, fish traps) is carried out in its waters. Other major concerns in the area are recreation and tourism; a significant portion of the coastline is being used for bathing, boating, and salt production. It is also the final receiving water for the wastewater generated in the area, thereby affecting the health and sanitation of millions of people — residents and transients alike — who make up the population. the resultant increase in the bay's pollution has become a major concern of the government.

The government has addressed the problem by conducting the MBMP. It seeks to determine the degree and extent of pollution in the Manila Bay and determine trends in the bay's water quality within the period of the of the monitoring program and project, and if possible, predict its future quality. The important components of the Program are the assessment of the effects of the operation of the Central/Tondo Outfall and future outfalls on the bay's water quality and the determination of its assimilative capacity.

A. Description

Manila Bay is a marine inlet of the South China Sea. It is also considered an estuary, by definition: an arm of the sea which has fresh water introduced at its head. The bay has a coastline of approximately 190 km long and a surface area of 1,000 km2. It is about 54 km long and its width varies from 22 km at its mouth to about 60 km inside the bay. The bottom topography gradually rises from its mouth where it is deepest at a rate of about 1 m rise for every kilometer of horizontal distance.

The Manila Bay catchment area is bounded by the Sierra Madre mountain range to the east, the Caraballo mountains to the north, the Zambales mountains to the northwest, and the Bataan mountains to the west. The Tagaytay Ridge and the Mount Banahaw's chain of mountains form the southern boundary of the area.

Manila Bay receives drainage from approximately 17,000 km2 of watershed, consisting of 26 catchment areas. The two major contributory areas are the Pasig and Pampanga River Basins. The Pasig River Basin has an area of 3,900 km2 of watershed draining into the bay is the Pampanga River Basin which has a catchment area of 9,000 km2. Much of the river systems in the provinces of Pampanga, Bulacan, and Nueva Ecija drains into the Pampanga River.

Manila Bay receives inputs and is subject to stress from a population of about 16 million and a variety of activities within its water column and within its watershed. Most notable of these pressures are overfishing, pollution from domestic, industrial, and agricultural runoff, and soil erosion. These inputs have led to the rapid deterioration of the bay's environmental quality and the degradation of its natural aquatic resources rendering it unable to support its economic and ecological functions. This phenomenon has consequently undermined the bay's capacity to provide livelihood and life-quality for human beings. Well-coordinated and highly-focused activities are necessary to abate the bay's further degradation and in the future enhance its quality.

B. Objectives

The objective of the MBMP as a whole is to preserve, if not improve, the quality of Manila Bay water, taking into account its present state and the changes that will be brought about by the addition of outfalls for the disposal of sewage. This program aims to determine the degree and extent of pollution in the bay. It also aims to show quantitatively the changes brought about by deep water disposal of wastes. The monitoring program will also assist in identifying problem areas within the bay which may require the modification of future plans and strategies.

1. To continue the Manila Bay Monitoring Project and Tondo Outfall Monitoring in order to fill in data gaps and obtain complete observations of some critical parameters to the desired level of time;
2. To collect samples of sessile organisms for trace metal residues and bacteriological quality;
3. To assess the impact of MWSS outfall on the water quality of Manila Bay; and
4. To predict the long-term effects of the outfall on the integrity of the bay.

C. *MBMP Activities*

1. Bathing water quality in Eastern Manila Bay
   Frequency of sampling: twice a month
   Number of stations: 10

   Parameters monitored are temperature, salinity, pH, Dissolved Oxygen, coliform (total and fecal coliforms), modified Garber Classification Index, wind speed and direction, weather condition, estimated number of visitors

2. Bacteriological and heavy metal analysis of shellfishes
   Frequency of sampling: 4

   Parameters monitored are coliform (total and fecal coliforms), heavy metals, and other trace elements (cadmium, copper, zinc, lead, and mercury)

3. Central/Tondo outfall monitoring
   Frequency of sampling: twice a month
   Number of stations: 6 stations

   Parameters monitored are temperature, salinity, pH, dissolved oxygen, coliform (total and fecal coliforms) modified Garber Classification Index, wind speed and direction, weather condition, sampling depth, transparency (secchi depth), and heavy metals/trace elements in sediments.

4. Southern outfall monitoring
   Frequency of sampling: once a month
   Number of stations: 7 stations

   Parameters monitored are temperature, salinity, pH, dissolved oxygen, coliform (total and fecal coliforms), modified Garber Classification Index, wind speed and direction, weather condition, sampling depth, transparency (secchi depth), and heavy metals/trace elements in sediments.

5. Offshore water and sediment quality studies
   Frequency of sampling: Quarterly
   Number of stations: 10 stations

   Parameters monitored are temperature, salinity, pH, dissolved oxygen, coliform (total and fecal coliforms), modified Garber Classification Index, wind speed and direction, weather condition, sampling depth, transparency (secchi depth), and heavy metals/trace elements in sediments, ammonia-nitrogen, nitrate-nitrogen, total particulate phosphorus, chlorophyll-a, oil, and grease.

II. Calancan Bay

Marinduque Province is composed of 17 islands located southwest of the Luzon Island. It is bounded to the NW by Tayabas Bay, Mogpog Pass to the NE, by Tablas Strait to the SW, and Sibuyan Sea to the SE. Marinduque is composed of six municipalities.

Calancan Bay lies on the northern coast of Marinduque Island. The bay used to be a fishing ground of the small fishermen occupying the nearby barangays of Botilao, San Isidro, Ipil, Kamandugan, Lusok, and Baliis.

A. Description

Calancan Bay is a natural embayment in the northern part of the main island of Marinduque Province. Its drainage basin has a moderately rolling to rugged and undulating terrain. The bodies of water that drain to Calancan Bay are Botilao River, Dating Bayan River, Guinimbayan Creek, Mausik Creek, and Tanda Creek. They bay is primarily a fishing ground of 16 barangays in two coastal towns (Mogpog and Sta. Cruz), but not until the Marcopper Mining Corporation started disposing its mine tailings to the bay.

Marcopper Mining Corporation (MMC) started its operation in 1969, using an open-pit mining method in Tapian, located at about 14 km from the bay MMC initially utilized the 177 hectares of San Antonio pond for inland impoundment of mine tailings. In 1970, MMC discovered a huge minable ore reserve beneath the San Antonio tailing pond which prompted it to look for other disposal sites of all mine tailings from plant operation, including the piles of mine tailings from the San Antonio pond totaling 50,000 metric tons per day.

Calancan Bay was chosen as the ultimate disposal site by discharging the mine tailings to the ocean floor through a pipeline launder system. However, the submarine outfall clogged; and so the tailings were discharged above the water surface. The extraneous materials have accumulated to such an extent that a 4.7 km long causeway (with an area of 0.84 hectares) divides the bay into western and eastern halves. The disposal of mine wastes into the Calancan Bay accounted for the high concentration of heavy metals, particularly copper and calcium. Mine tailings also caused the massive destruction of coral reefs and fish sanctuaries in the bay.

B. Objectives

The Calancan Bay Rehabilitation Program (CBRP) was launched in 9 June 1989, with DENR's Environmental Management Bureau (EMB), as the Secretariat. The objectives of CBRP are the following:

1. systematically investigate the existing physical, chemical, and biological status of the bay area;
2. monitor the changes of most important parameters that occurred; and
3. at its terminal stage, envision to come up with solid data base useful for the sustainable development of resources of the coastal area degraded by the MMC's mining operations.

C. *Project Components*

1. Rehabilitation of mine tailings causeway and denuded mangrove areas
2. Seagrass transplantation and artificial seagrass system
3. Artificial reefs or fish aggregatory devices
4. Fish yield studies
5. Monitoring of environmental quality
   a. Water quality monitoring
   b. Bioassay.

In 1992, MMC stopped the disposal of its mine tailings to Calancan Bay. The disposal site was transferred to Taipan pit, whose ore deposit was already depleted. The causeway might be considered stabilized due to the rigorous implementation of the CBRP.

D. *Monitoring of Environmental Quality*

Project 5 (Monitoring of Environmental Quality) has two subprojects, namely: a) Water quality monitoring and b) Bioassay.

The objectives of water quality monitoring (5A are the following:

1. to conduct a comprehensive assessment of the quality of the bay in order to determine the existence and extent of pollution brought about by the discharges of mine waste or mill tailings; and
2. to collect useful information on the water quality and related factors affecting the overall ecological health of the Calancan Bay.
   a. result in a better understanding of the interrelatedness of the biological/ecological activities of the CBRP;
   b. define problem areas and recommend solutions to them;
   c. determine the extent of pollution in Calancan Bay, through an analysis of physico-chemical and biological data;
   d. indicate trends of improvement or degradation; and
   e. determine the possible effects of mine tailings disposal in the bay.

Water quality monitoring involved shore and offshore water sampling, encompassing an area of about 24 km2. It includes the determination of physical and chemical characteristics of the Calancan Bay seawater, tailings sampling and analysis, trace metal analysis in indicator fish, and other marine life.

The following are the activities under water quality monitoring:

1. Mine waste effluent/mill tailings analysis — For this activity, there are two stations (thickener plant or dredged tailings from San Antonio pond and outfall). Samples are subjected to heavy metal analysis (Hg, Cd, Zn, Pb, Cu, Ag, Mn, and Fe).

2. Coastal monitoring — There are six stations (50 meters from the shoreline) in this activity. the parameters monitored are the following:

   a. Physical measurements (DO, temperature, pH, and turbidity)
   b. Trace elements (Cu, Hg, Cd, Zn, Pb).

3. Offshore water quality monitoring — There are 15 offshore water quality monitoring stations. The following are the parameters being monitored:

   a. Field sampling condition (tide, weather, physical observation, and current velocity)
   b. Physical measurements (DO, pH, transparency/Secchi disk reading)
   c. Trace elements (Cu, Hg, Cd, Zn, and Pb).

4. Trace elements determination in indicator fish and in other marine lives (Hg, Cd, Zn, Mn, and Cu)

5. Sediment sampling and trace element determination (Hg, Pb, Cu, An, and Cd.

The objectives of Project 5B (Bioassay) are the following:

1. to determine the toxicity of effluent from MMC;

2. to determine the relative sensitivity of test organisms to mine tailings;

3. to determine the percent survival of test species at different concentrations and durations; and

4. to determine the effect of effluent on water quality.

The components of Project 5B (Bioassay) are the following:

1. 96-hr LC50 toxicity test of fish and shellfish; and

2. heavy metal analysis of fish and oysters.

9.9 Thailand Report On Marine Pollution Monitoring

by **Sooppaporn Pukasemvarongkool**, Ministry of Transport and Communications, 127B Yotha Road, Bangkok 10100, Thailand.

Introduction

Thailand's rapid socioeconomic development was not compatible with the pollution prevention and monitoring. The marine and riverine pollution, caused by the industrial, agricultural, and marine transportation activities, become a significant issue.

The major source of pollution in Thailand is land-based. Waste water from communities is discharged directly to the drainage system, canals, rivers, and finally to the coastal sea area. 75 percent of land-based pollutants come form domestic source, 20 percent from industries, 4 percent from agriculture, and 1 percent from others.

Although the discharge of waste oil or chemical is prohibited by law, the illegal discharging and dumping still occur in Thai waters. The Harbor Department has conducted a monitoring program in Thailand's main river and coastal areas, including industrial and domestic effluence. This monitoring program consists of the following methods:

Monitoring Method

1. Water quality analysis of river (Chaopraya, Pasak, Bangpakong, Maeklong and Thajeen) and coastal water every month.
2. Waste water quality analysis of industrial and domestic wastes.
3. To check waste oil and water from ship, industries, and domestics by helicopter (Chaopraya river and Bangkok-Rayong).

The Agencies' responses to marine pollution prevention and monitoring are as follows:

1. Harbor Department
2. The Pollution Control Department (to issue the rule of environmental standard value).
3. The Office of Environmental Policy and planning (to consider the Environmental Impact Assessment, EIA)
4. The Environmental Quality Promotion.

In addition, some NGOs take strong concern for marine pollution prevention. These NGOs try to coordinate with the government agencies in building up their capabilities on this issue.

Appendix 1. Law on Navigation in Thai Water

A.D. 1913 (Amended as of 1992)

119. A person who, without the consent of the Harbor Department, throws stones, gravel, ballast, mud, or any substances, except petroleum or chemical into the rivers, canals, swamps, reservoirs, or seas in the Thai territorial waters shall be punished with a fine not exceeding ten thousand baht or on imprisonment for a period not exceeding six months, or both, and shall reimburse the expenses of recovery as well.

119 bis. A person who discharges petroleum, and chemical or any other matters into the rivers, canals, swamps, reservoirs, or seas in the Thai territorial waters which shall be considered hazardous to the environment and navigation shall be punished with a fine not exceeding sixty thousand baht or on imprisonment for a period not exceeding three years, or both, and shall reimburse the expenses of recovery or indemnity as well.

204. The discharge of petroleum or oily water from the ship into the rivers, canals, lakes, or seas in the Thai territorial waters shall be punished with a fine of two thousand to twenty thousand baht or imprisonment for a period not exceeding one year, or both.

9.10 Marine Pollution Monitoring in Vietnam: Initiative Results

by **Nguyen Chu Hoi, Pham Van Luong, Luu Van Dieu, et al.**, Marine Environment Monitoring Station (MEMS), Van Son, Do Son Town, Hai Phong City, Vietnam.

Introduction

Vietnam is a maritime country; the length of its coast is over 3,200 km and it has 3,000 islands. Its coastal zone contains a number of unique ecosystems with valuable tropical resources, such as mangrove, coral reef, seagrass, estuary, tidal marsh/flat, coastal lagoon, delta, upwelling, island, bay, and soft bottom. The coastal zone of Vietnam is also a sensitive, ecologically interface and a dumped location from land-based/sea-based sources. Recently, the environmental pollution in its coastal waters has increased due to the coastal economic development, in relation to its open-door policy and the government's economic reform.

The sources of coastal pollution in Vietnam may be grouped into several main classes: coastal agriculture, sewage, urban and industrial discharges, shipping activities, aquaculture, and mining. Oil/Gas exploitation in the continental shelf is also a major sea-based pollution. The main contaminant classes which may be present in discharges from these sources are sediment, nutrients, toxic metal, oil, and pesticides.

Coastal pollution and degradation of the coastal environment lie at the heart of the conflict between developmental needs and protection of the environment. To date, there have been about 10 documented oil spills in the coastal zone of Vietnam, which leaked between 100 tonnes to 2,000 tonnes during 1994-1995 (NEA/MOSTE, Report, 1995).

Pesticide use in Vietnam in general and the coastal land in particular has increased dramatically in just a few decades; and today pesticides are applied to 90 percent of agricultural land. There are also some 200,000 ha of brackish water ponds, 37 main coastal ports with 8,000 ships, and 54,000 fishing boats in the coastal waters. Approximately 50 percent of the country's provinces/cities and large industrial zones with over 15 percent of the population are located in the coastal area.

Many coastal/marine ecosystems in the country are suffering from severe habitat and species losses associated with coastal pollution(NEA/MOSTE, 1995). Therefore, measuring environmental parameters is one of the steps in a coastal/marine environmental management taken by the Vietnam government. A marine environmental monitoring network in Vietnam was established by MOSTE for submission to the government.

The marine monitoring network started to carry out its task since 1995 in the Northern part of Vietnam and is now continuously expanding its scope throughout the coast. The initial result of the marine pollution monitoring activities in Vietnam is introduced in the following page.

Marine Pollution Monitoring Strategy

Marine Environment Monitoring Station (MEMS)

Up to 1990, some stations (Do Son, Nha Trang, and Can Gio) formed and started to carry out monitoring tests in three sites near these stations. In 1995, the MEMS at Do Son belonging to the Hai Phong Institute of Oceanography (HIO) officially integrated with the above-mentioned monitoring network, considered the first MEMS in Vietnam. This year, some MEMS in Nha Trang and other sites will be established to expand and upgrade measuring the stations throughout the coast.

Such a marine environment monitoring system has been proposed by author and was adopted by the National Environment Agency in March 1996 (Figure 11). In this system, there are some types of MEMS — effect/pollution stations and baseline stations in two national stations (Do Son and Nha Trang). The effect stations are located in the main estuarine areas or near coastal economic centers and are fixed in developing a plan up to the year 2000. Under MEMS at Do Son, five measured sites (Cua Luc, Do Son, Ba Lat, Sam Son, Cua Lo) were carried out in 1995.

Methodology

⁕ The environmental components were monitored by MEMS at Do Son:
- Sea Water
- Surface Sediment
- Biological Component

⁕ The parameters and frequency selected for monitoring are presented in the following table.

Parameters	Sampling Frequency	Total Times
current	2 hours	13
temperature	2 times (low/high tides)	2
salinity	2 times (low/high tides)	2
pH	2 times (low/high tides)	2
turbidity		
suspended matter		
BOD5		
NO3-		
PO4-		
SiO32-		
toxic phytoplankton		
oil content of seawater and sediment	1 time (lowest tide)	1
coliform		1
pesticides	1 time (lowest tide)	
heavy metals		

Sampling:

Sampling frequency: 4 times/year in *March, June, September,* and *December*. These samples were collected during the highest and lowest tides for every station and at two layers of water column (surface and bottom). The field sampling is carried out by a motorboat with GPS equipment.

Preservation of samples:

- DO samples are collected into oxygen bottles and fixed by *manganese chloride* (MnCl2) and *potassium iodide* in *sodium hydroxide solutions*.
- Oil samples: in Teflon bottles with added *sulfuric acid* added as preservative.
- Heavy metal samples: in Teflon bottles with *hydrochloric acid* (HCl) 6 N added.
- Nutrient samples: *mercuric chloride solution*.
- Plankton: with *5% formalin / 70 percent alcohol*.
- Coliform samples are put in clean bottles and kept at 4°C in thermally-insulated box (ice box).

Analyses:

- pH is measured by Palicse standard colorimetry with cresol red indicator or by using a water *quality checker* (WQC-1A, Japan).
- Dissolved oxygen (DO) and Biochemical Oxygen Demand (BOD) determined by Winkler method or by using a water *quality checker*.
- Salinity is determined by the *Mohr-Knudxen method*
- Nutrient contents (NO3-, PO43-, SiO32-) and total phosphorus were determined by colorimeter.
- Pesticides are determined by the following methods:

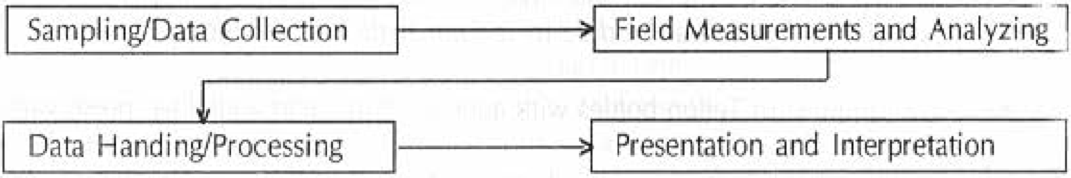
⁕ One liter of sample was extracted by *chloroform* (CHCl3), (pesticide analysis grade, 3 times).

⁕ Chloroform extracts are dried by Na2SO4 and cleaned up on *Florisil Column,* active *carbon*, and *celitte*; then concentrate and remove solvent in rotation evaporator.

⁕ Concentrate is dissolved by *n-hexane* and then pesticide residues are determined by Gas-Chromatograph 9A-Shimadzu.

- Oil content is determined by Partition - Gravimetric Method or by Infrared Spectrophotometer IR - 470 Shimadzu.
- Coliform is determined by the Vincent culture method.

The different parts of the methodological chain for monitoring may be summarized in the following flow chart:



Initial Results

In 1995, the marine water quality parameters were monitored at five measurement sites: Cua Luc, Do Son, Ba Lat, Sam Son, and Cua Lo.

Hydrochemical Parameters

The result was calculated in an average value during the highest and lowest tides.

One of the features of the monitored coastal waters is that the surface layer is warmer in summer (28°C-31.8°C) and colder in winter (18°C-22.4°C); the annual temperature variation is some 10°C. The average annual temperature at all measured sites is from 23°C to 26°C. Temperature is lower in the sites Do Son and Ba Lat which are influenced by suspended water discharged from the coastal lands.

The salinity in the monitored sites is extremely variable due to the effects of rainfall and run off from many rivers, especially from the Red River system. The annual average salinity of water surface in Ba Lat (Red River mouth) is lowest at 11 percent in comparison with others (20-27 percent). The average range of surface water salinity is different between the rainy and dry seasons (10-20 times).

During the rainy season, the salinity in Ba Lat site is less than 1 percent, but is higher 8 percent (Do Son), 18 percent (Sam Son), 21 percent (Cua Luc) and 32 percent (Cua Lo). In the dry season, it is higher: 21 percent (Ba Lat), 28 percent (Do Son), 23 percent (Sam Son), 33 percent (Cua Luc) and 24 percent (Cua Lo).

The pH in coastal water is slightly alkaline (8.0-8.4) and the pH variation by season is very small (0.2-0.3).

The turbidity of surface water at sites: Cua Luc, Do Son, Sam Son, and Cua Lo is variable between 22-43 mg/L; Cua Lo site is lowest in turbidity.

The nutrients of sea water are normal (not poor/rich) and change markedly between monitored sites:

* NO_3^- in range 0.4-29 mgN/l
* PO_4^{3-} in range 6.8-18 mgP/l
* SiO_3^{2-} in range 90-790 mg Si/l

Water Quality

The coastal water quality parameters in five sites are introduced in Table 6.

Dissolved Oxygen—DO content is rather high at all measured sites, ranging from 5.79-8.66 mg/L. The average DO in every site is also rather high (7.21-7.87 mg/L).

Biochemical Oxygen Demand—At all the measured sites, the BOD value is not high (0.44-1.93 mg/L). The average value of BOD in every site is less than 1,20 mg/L and is lower than Vietnam's permissible standard (<10 mg/L).

Oil content — The oil in sea water at five measured sites is in the range of 0.10-0.45 mg/L. The average content of oil in Do Son (near seaport) is highest (0.33 mg/L); and in Sam Son it is the lowest (0.13 mg/L).

The oil in sediment at five measured sites is in the range of 0.01-0.15 mg/g. The annual average value is 0.05-0.11 mg/g, but, near the oil storage in Cua Luc it is two times higher than the other sites.

Heavy metals — The heavy metals have been monitored in sea water as follows: Lead (Pb), Copper (Cu), Zinc (Zn), Cadmium (Cd) and Mercury (Hg). Their content is many times less than the permissible standard. The content of Pb (0.007 mg/L) and Cu (0.0006 mg/L) in the Cua Luc site is higher than the other sites and in Ba Lat sites, the Zn (0.0006 mg/L) and Cd (0.0009 mg/L) are higher than the other sites.

Organochlorine Pesticides — For Vietnam in 1995, the coastal waters in five sites were analyzed for HCB, Lindane, Andrin, DDE, Dieldrin, Endrin, DDT, and DDD. Among them, HCB, Lindane, DDE, DDD, and DDT have been detected; but in others, there are only traces.

The pesticide residues in Ba Lat site are three times higher than in the other sites. The DDT which is highly concentrated in sea water (5.5 mg/l), in comparison with other kinds of pesticides, is also highest in the Ba Lat site.

Coliform — The samples of coliform were collected at four sites: Cua Luc, Do Son, Sam Son, and Cua Lo. These sites are located in/near the coastal tourist resorts. The result showed that the mean total of coliforms is in the range of 535-2415 MPN/100 ml. The mean value at the four sites is 1043 MPN/100 ml. The maximum concentration is 4600 MPN/100 ml during high tide at Cua Luc site may be related to the domestic waste from Ha Long city. In summer (the tourist season), the coliform value is also higher than the other one.

Phytoplankton — The abundance of phytoplankton species at the Cua Luc site is highest (92 species), with the lowest at the Cua Lo site (62 species). The species of *Diatomae* are dominant. In general, the density of phytoplankton is high at all the monitored sites, with highest values (3.8 .106 - 1.7 .108 cell/m3) in Sam Son.

The change of species composition between the monitored times is very different. In some sites not being influenced by fresh water, the species of *Dinoflagellate* appear, for example, at the Cua Lo site; among them, some species of toxic-phytoplankton have been noted, e.g., *Goniaulax, Protogoniaulax, Gymnodinium.*

Recommendations

The initial activity on marine pollution monitoring in 1995 at the five measured sites/ stations in the north of Vietnam is a first step of the National Network on Marine Environment Monitoring in Vietnam.

The results contribute to the assessment of the annual state of marine environment in Vietnam. These results will be submitted to the government, according to the Environment Protection Law of 1993. At the same time, the lessons learned will be used in expanding and upgrading the network throughout coast of Vietnam.

In general, the low concentrations of the contaminants are indicative of a non-polluted coastal environment. But, the coastal environment is slightly polluted by oil dumped from shipping activities/oil spills.

There is an increased trend of some contaminants at some stations, such as DDT and Lindane in the sea water of the Ba Lat site, located near the Red River delta. Apart from this, it will be necessary for environmental protection to monitor the urban wastes from Ha Long city dumped at the Ha Long Bay - a World Natural Heritage site.

It is also necessary for Vietnam to integrate with the Regional Network for Marine Pollution Monitoring and to share experiences with experts in the region, especially in the fields of information management and technical training for the Vietnamese staff.

TABLES AND FIGURES

Table 1 Monitoring Programmes in the East Asian Region: Overview of Parameters (modified from Figure 1 of the Workshop Report, Global Investigation of Pollution in the Marine Environment (GIPME) Expert Meeting, London, 12-14 October 1994).

HOTO	MUSSELWATCH	WESTPAC	COBSEA	GEF
Salinity		Nutrients		
Temperature				
Dissolved				
Oxygen				
Nutrients				Nutrients
SPM			SPM	SPM
Human				Pathogens
Pathogens				
Litter				
Algal Toxins				
Plankton				
Pigments				
Oil/Hydrocarbons		Hydrocarbons	Oil/Hydrocarbons	Oil/Grease
PAHs	PAHs			
Metals		Metals		Metals
Radionuclides				
Synthetic	PCBs/DDT	Synthetic		Industrial
Organics		Organics		Wastes
Pesticides	HCH (BHCs)			Agricultural
				Wastes
Herbicides	Chlordane			
	HCB			
	Organotins			
Biological Effects	Histopathology		Biological Effects	

Table 2 Matrix/Analyte Relationships for Monitoring Programmes: (A) Human Health Protection, (B) Survey and Monitoring (modified from Figure 3 of the Workshop Report, Global Investigation of Pollution in the Marine Environment (GIPME) Expert Meeting, London, 12-14 October 1994).

A	Matrix			
Analyte	Water	Sediment	Biota	Others
Sewage	Pathogens		Pathogens	
Hydrocarbons			PAHs, Tainting	
Trace Metals			Trace Metals	
B	Matrix			
Analyte	Source	Water	Sediment	Biota
Sewage	Yes	Nutrients Chlorophyll	Nutrients Chlorophyll	Pathogens
Oil/Grease		Dissolved, dispersed petroleum hydrocarbons	Beach Tar	Community Analysis
Trace Metals	Yes	Trace Metals	Baseline	Musselwatch
CBs	Yes		Baseline	Musselwatch, Ethoyl resorufin-0-deethylate (EROD) in fish
PAHs	Yes		Baseline	Musselwatch, Ethoyl resorufin-0-deethylate (EROD) in fish
Sediment Transport	Yes		Sediment Accumulation	Community Analysis
Core measurements include: temperature, turbidity, salinity, and dissolved oxygen				

TABLE 3. Sampling Summary for Priority Pollutants (from P.M. Chapman, G.P. Romberg, and G.A. Vigers, "Design of monitoring studies for priority pollutants," Journal of the Water Pollution Control Federation, vol. 54, no. 3 (1982), presented by Dr. Voravit Cheevaporn, Thailand)

Compound	Category rank	Environmental compartment		
		Water	Sediment	Biota
Metals and inorganics				
Antimony	3	x		
Arsenic	1		x	x
Asbestos	3	x		
Beryllium	1		x	x
Cadmium	1		x	x
Chromium	1		x	x
Copper	1		x	x
Cyanides	5	x		
Lead	1		x	x
Mercury	1		x	x
Nickel	1		x	x
Selenium	1		x	x
Silver	1		x	x
Thallium	1		x	x
Zinc	1		x	x
Pesticides				
Acrolein	2		x	x
Aldrin	2	x		x
Chlordane	2		x	x
DDD	1		x	x
DDE	1		x	x
DDT	1		x	x
Dieldrin	1		x	x
Endosulfan and endosulfan sulfate	3		x	
Endrin and endrin aldehyde	1	x	x	x
Heptachlor	1		x	x
Heptachlor epoxide	1	x	x	x
Hexachlorocyclohexane (α, β, δ isomers)	3	x	x	
γ-Hexachlorocyclohexane (lindane)	3	x	x	
Isophorone	3	x		
TCDD	1		x	x
Toxaphene	1		x	x
PCBs and related compounds				
Polychlorinated biphenyls (6 PCB arochlors)	1		x	x
2-Chloronaphthalene	1		x	x
Halogenated aliphatics				
Chloromethane (methyl chloride)	4	x		
Dichloromethane (methylene chloride)	4	x		
Trichloromethane (chloroform)	4	x		
Tetrachloromethane (carbon tetrachloride)	4	x		
Chloroethane (ethyl chloride)	4	x		
1,1-Dichloroethane (ethylidine chloride)	4	x		
1,2-Dichloroethane (ethylene dichloride)	4	x		
1,1,1-Trichloroethane (methyl chloroform)	4	x		
1,1,2-Trichloroethane	4	x		
1,1,2,2-Tetrachloroethane	4	x		
Hexachloroethane	4	x		
Chloroethene (vinyl chloride)	4	x		
1,1-Dichloroethene (vinylidine chloride)	4	x		
1,2-Trans-dichloroethene	4	x		
Trichloroethene	4	x		
Tetrachloroethene (perchloroethylene)	4	x		
1,2-Dichloropropane	4	x		
1,3-Dichloropropene	4	x		
Hexachlorobutadiene	1		x	x
Hexachlorocyclopentadiene	1		x	x
Bromomethane (methyl bromide)	4	x		
Bromodichloromethane	3	x	x	
Dibromochloromethane	3	x	x	
Tribromomethane (bromoform)	3	x	x	
*Dichlorodifluoromethane	4	x	x	
*Trichlorofluoromethane	4	x	x	
Ethers				
*Bis(chloromethyl) ether	3	x		
Bis(2-chloroethyl) ether	3	x		
Bis(2-chloroisopropyl) ether	3	x		
2-Chloroethyl vinyl ether	4	x	x	
4-Chlorophenyl phenyl ether	1		x	x
4-Bromophenyl phenyl ether	1		x	x
Bis(2-chloroethoxy) methane	3	x		
Monocyclic aromatics				
Benzene	4		x	
Chlorobenzene	2		x	x
1,2-Dichlorobenzene (o-dichlorobenzene)	2		x	x
1,3-Dichlorobenzene (m-dichlorobenzene)	2		x	x
1,4-Dichlorobenzene (p-dichlorobenzene)	2		x	x
1,2,4-Trichlorobenzene	2		x	x
Hexachlorobenzene	1		x	x
Ethylbenzene	4		x	
Nitrobenzene	3		x	
Toluene	4		x	
2,4-Dinitrotoluene	3		x	
2,6-Dinitrotoluene	3		x	
Phenols and cresols				
Phenol	3	x		
2-Chlorophenol	3	x		
2,4-Dichlorophenol	5	x		
2,4,6-Trichlorophenol	3		x	
Pentachlorophenol	1		x	x
2-Nitrophenol	3		x	
4-Nitrophenol	3		x	
2,4-Dinitrophenol	3		x	
2,4-Dimethylphenol	1		x	x
p-Chloro-m-cresol	3		x	
4,6-Dinitro-p-cresol	3		x	

TABLE 3. Sampling Summary for Priority Pollutants (continued)

Compound	Category rank	Environmental compartment			Compound	Category rank	Environmental compartment		
		Water	Sediment	Biota			Water	Sediment	Biota
Phthalate esters					Dibenzo (a, h) anthracene	1		x	x
Dimethyl phthalate	1		x	x	Fluoranthene	1		x	x
Diethyl phthalate	1		x	x	Fluorene	1		x	x
Di-n-butyl phthalate	1		x	x	Indeno (1,2,3-cd) pyrene	1		x	x
Di-n-octyl phthalate	1		x	x	Naphthalene	1		x	x
Bis(2-ethylhexyl) phthalate	1		x	x	Phenanthrene	1		x	x
Butyl benzyl phthalate	1		x	x	Pyrene	1		x	x
Polycyclic aromatics					Nitrosamines and miscellaneous compounds				
Acenaphthene	1		x	x	Dimethyl nitrosamine	3	x		
Acenaphthylene	1		x	x	Diphenyl nitrosamine	1		x	x
Anthracene	1		x	x	Di-n-propyl nitrosamine	1	x	x	x
Benzo (a) anthracene	1		x	x	Benzidine	3		x	
Benzo (b) fluoranthene	1		x	x	3,3'-Dichlorobenzidine	1		x	x
Benzo (k) fluoranthene	1		x	x	1,2-Diphenylhydrazine (hydrazobenzene)	1		x	x
Benzo (ghi) perylene	1		x	x	Acrylonitrile	4	x	x	
Benzo (a) pyrene	1		x	x					
Chrysene	1		x	x					

Source: P.M. Chapman, G.P. Romberg and G.A. Vigers, "Design of monitoring studies for priority pollutants", *Journal of the Water Pollution Control Federation*, vol. 54, No. 3 (1982).

Note: Compounds categorized as indicated in figure 2.

Table 4. Toxic Trace Contaminants Analysed in Rivers and Reservoirs for Singapore (presented by Ms. Ng Miu Lan, Singapore).

Group 1 : Purgeable Organics

1	Acrolein
2	Acrylonitrile
3	Ethylbenzene
4	1,1,2,-Trichloroethane
5	Chloroethane
6	2-Chloroethyl vinyl ether
7	Methyl chloride
8	Methyl bromide
9	Trichlorofluoromethane
10	Dichlorodifluoromethane
11	Vinyl chloride
12	bis(Chloromethyl) ether
13	Chloroform
14	Bromodichloromethane
15	Chlorodibromomethane
16	Bromoform
17	Benzene
18	Toluene
19	Xylene
20	1,1,1-Trichloroethane
21	1,1-Dichloroethane
22	1,2-Dichloroethane
23	1,1-Dichloroethane
24	Trans 1,2-Dichloroethene
25	Trichloroethene
26	1,1,2,2-Tetrachloroethane
27	Tetrachloroethane
28	1,2-Dichloropropane
29	1,3-Dichloropropene
30	Chlorobenzene
31	Carbon tetrachloride
32	Methylene chloride

Group 2 : Pesticides and PCBs

1	α - Endosulfan
2	β - Endosulfan
3	Endosulfan sulphate
4	α - BHC
5	β - BHC
6	γ - BHC
7	δ - BHC
8	Dieldrin
9	4,4'-DDE
10	4,4'-DDE
11	4,4'-DDT
12	Heptachlor
13	Heptachlor epoxide
14	Aldrin
15	Chlordane
16	Toxaphene
17	Endrin
18	Endrin aldehyde
19	Arochlor 1016
20	Arochlor 1221
21	Arochlor 1232
22	Arochlor 1242
23	Clophen A40
24	Clophen A50
25	Clophen A60
26	2,3,7,8-TCDD

Group 3 : Heavy Metals

1	Antimony
2	Beryllium
3	Thallium
4	Arsenic
5	Cadmium
6	Chromium
7	Copper
8	Lead
9	Mercury
10	Nickel
11	Selenium
12	Silver
13	Zinc

Table 4 (continued...)

Group 4 : Base/Neutral Extractable Organics

1	1,2-Dichlorobenzene	25	4-Chlorophenyl phenyl ether
2	1,3-Dichlorobenzene	26	3,3'-Dichlorobenzidine
3	1,4-Dichlorobenzene	27	Benzidine
4	Hexachloroethane	28	bis (2-Chloroethyl) ether
5	Hexachlorobutadiene	29	1,2-Diphenylhydrazine
6	Hexachlorobenzene	30	Hexachlorocyclopentadiene
7	1,2,4-Trichlorobenzene	31	N-Nitrosodiphenylamine
8	bis (2-Chloroethoxy) methane	32	Butyl benzyl phthalate
9	2-Chloronaphthalene	33	N-Nitrosodimethylamine
10	Isophorone	34	N-Nitroso-n-propylamine
11	Nitrobenzene	35	Naphthalene
12	2,4-Dinitrotoluene	36	Acenaphthylene
13	2,6-Dinitrotoluene	37	Acenaphthene
14	4-Bromophenyl phenyl ether	38	Fluorene
15	bis (2-Ethylhexyl) phthalate	39	Anthracene
16	Di-n-octyl phthalate	40	Phenanthrene
17	Dimethyl phthalate	41	Fluoranthene
18	Diethyl phthalate	42	Pyrene
19	Di-n-butyl phthalate	43	Chrysene
20	Benzo (a) anthracene	44	Benzo (k) fluoroanthene
21	Benzo (a) pyrene	45	Benzo (b) fluoroanthene
22	Indeno (1,2,3-c,d) pyrene	46	1,2-Benzathracene
23	Dibenzo (a,h) anthracene	47	Benzo (g,h,i) perylene
24	bis (2-Chloroisopropyl) ether		

Group 5 : Acid Extractable Organics

1	2-Nitrophenol
2	4-Nitrophenol
3	Phenol
4	2,4-Dinitrophenol
5	4,6-Dinitro-o-cresol
6	Pentachlorophenol
7	p-Chloro-m-cresol
8	2-Chlorophenol
9	2,4-Dichlorophenol
10	2,4,6-Trichlorophenol
11	2,4-Dimethylphenol

Group 6 : Other Organics

1	Phenols

TABLE 5. Water Quality Standards: (A) Freshwater, (B) Seawater (presented by Dr. Dong Beom Yang, Republic of Korea).

A					
	pH	BOD mg/L	SS mg/L	DO mg/L	E. coli, mpn/100 ml
I	6.5-8.5	<1	<25	>7.5	<50
II	6.5-8.5	<3	<25	>5	<1000
III	6.5-8.5	<6	<25	>5	<5000
IV	6.0-8.5	<8	<25	>2	-
V	6.0-8.5	<10	<100	>2	-

B									
	pH	COD mg/L	DO %	SS mg/L	E. coli mpn per 100 ml	Oil mg/L	Total N mg/L	Total P mg/L	Others
I	7.8-8.3	<1	>95 sat%	<10	<200	ND	<0.05	<0.007	Cr, As <.05
II	6.5-8.5	<2	>85 sat%	<25	<1000	ND	<0.1	<0.015	Pb,Zn,Cd <.1
III	6.5-8.5	<4	>80 sat%				<0.2	<0.03	CN, OrgP, Total Hg, PCB Not To Be Detected

FIGURE 1. Categorized Global Oceanic Observing System (GOOS) Parameters

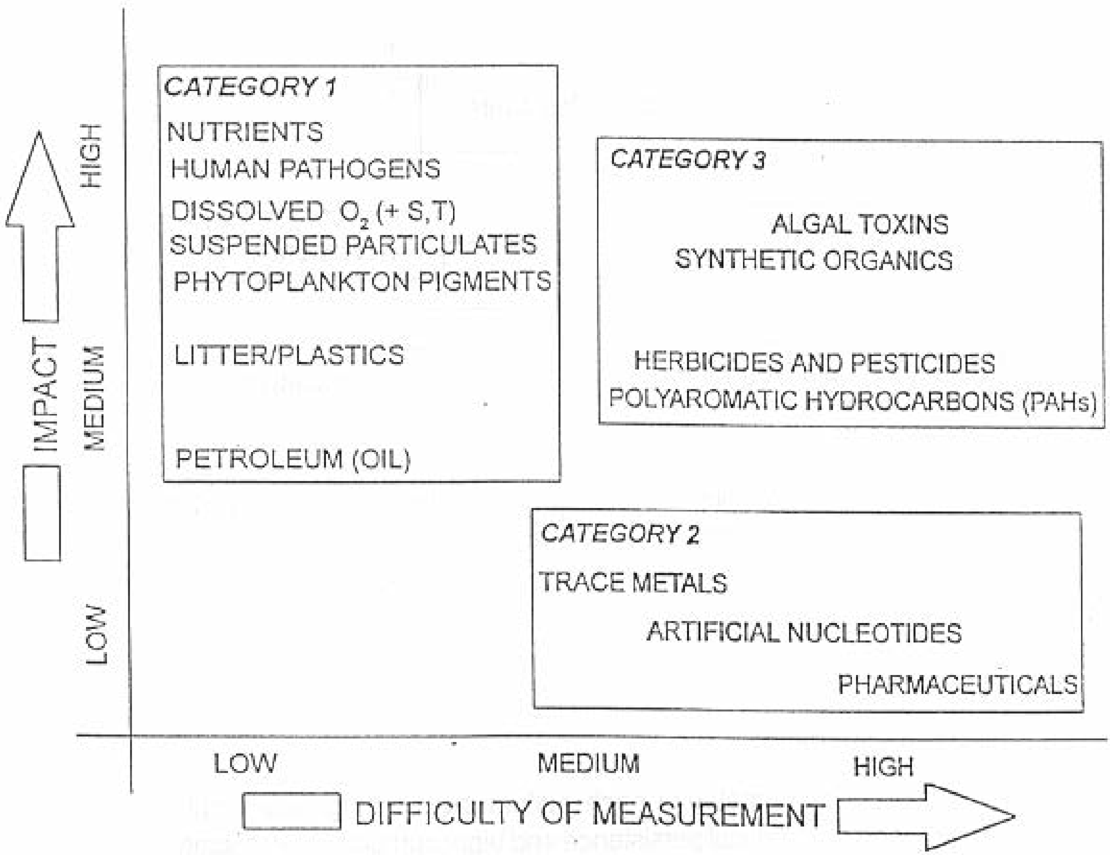
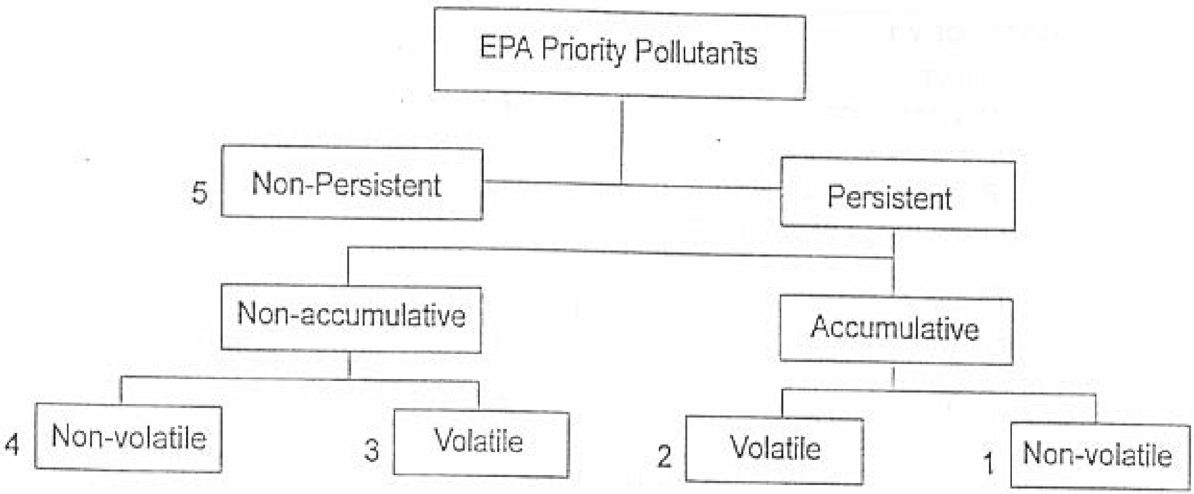


FIGURE 2. Derivation of Categories for Priority Pollutant Monitoring



Note: Categories characterize each pollutant according to a simple hierarchy based on chemical persistence and bioaccumulation. Pollutants in categories 1 and 2 and persistent and may bioaccumulate or enter food chains. Categories 3 and 4 include pollutants that are persistent but non-accumulative and are toxic on direct exposure. Category 5 includes those pollutants that are non-persistent andconsequently remain toxic over short time periods or limited distances from the pollutant source.

FIGURE 3. Malaysia: Trend of Oil and Grease, E. coli, and TSS for 1990-1995

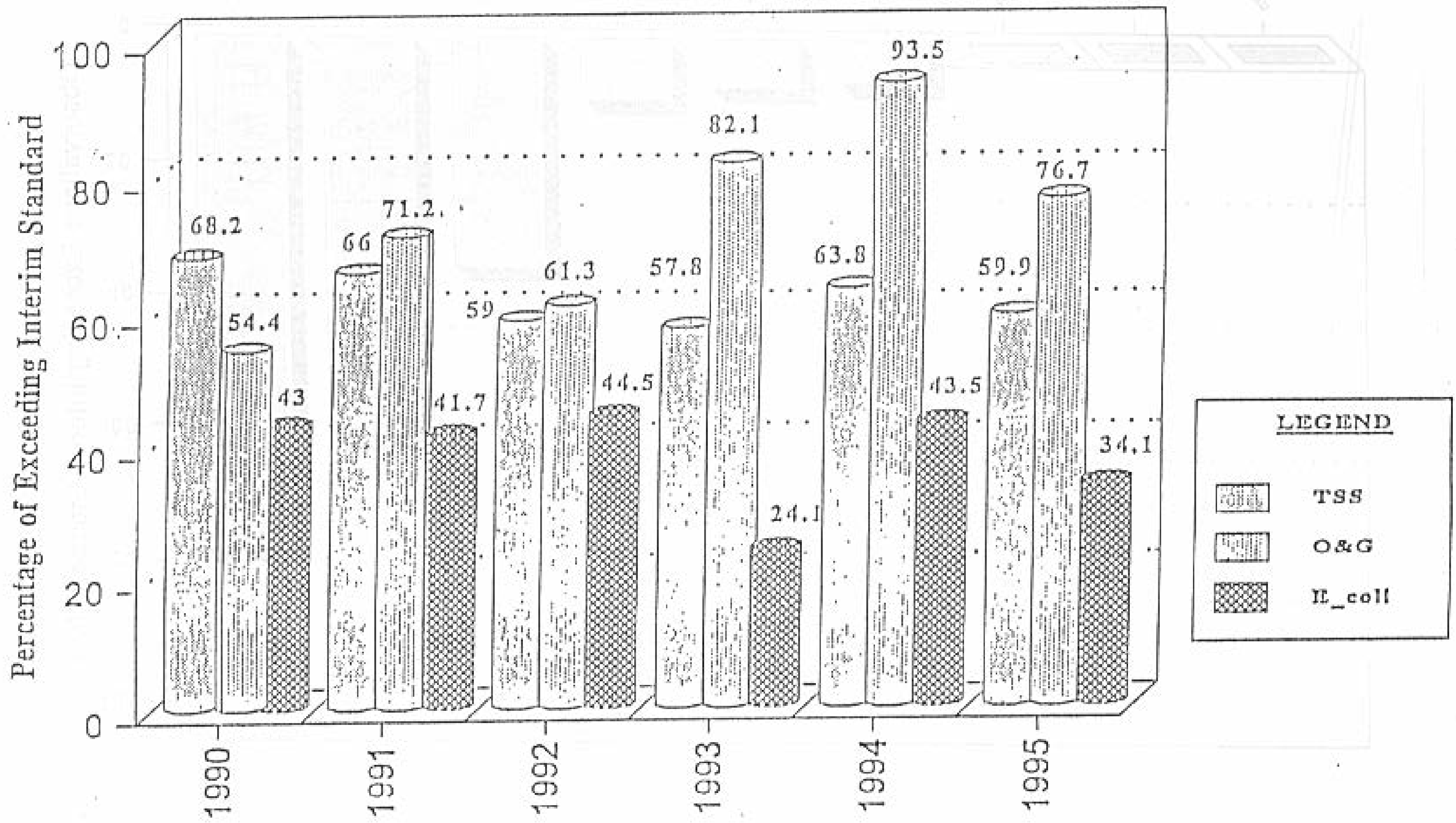


FIGURE 4. Malaysia: Status of Marine Environmental Quality, 1995.

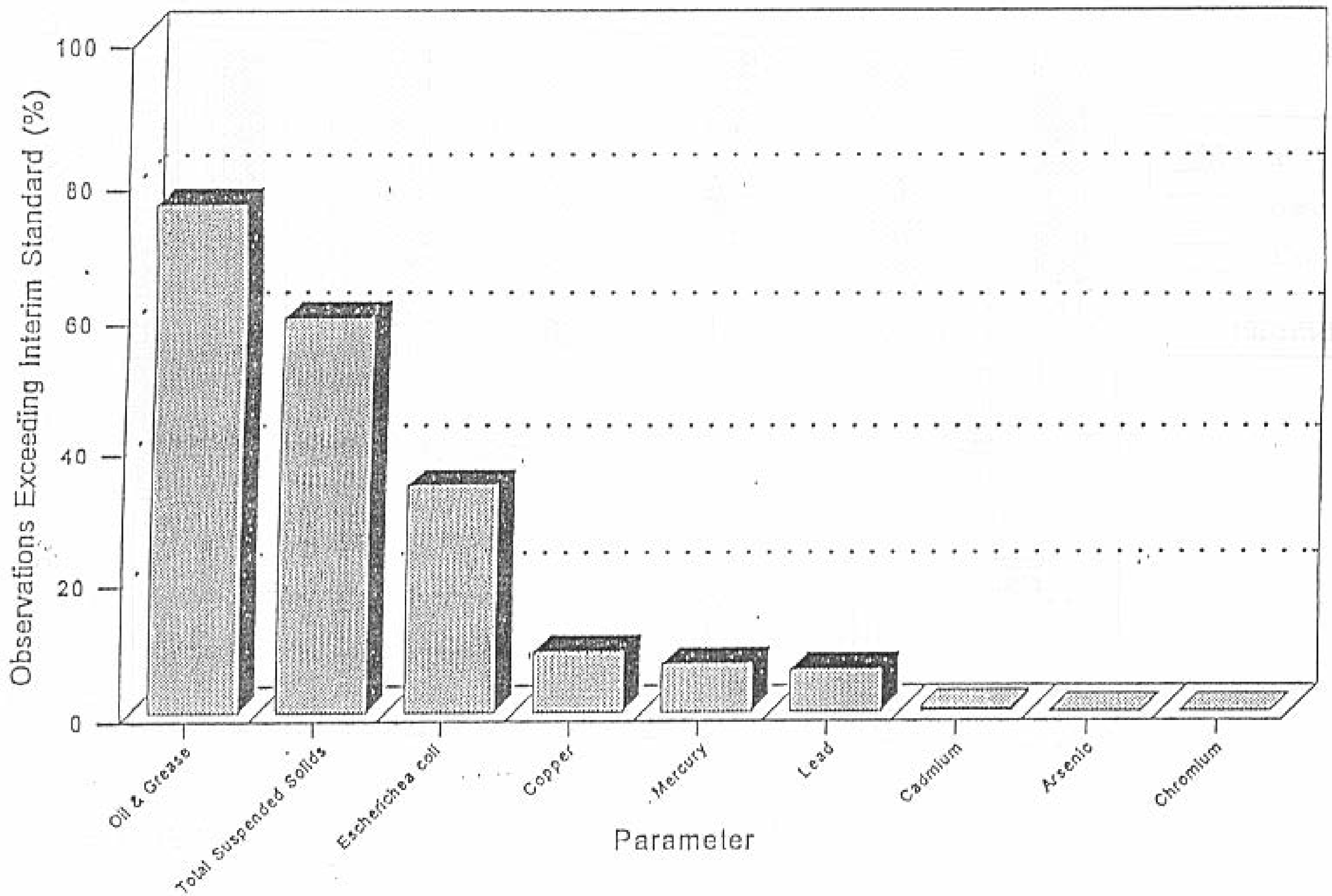


FIGURE 5. Malaysia: Annual Trend of Oil Spill Incidents, 1976-1995.

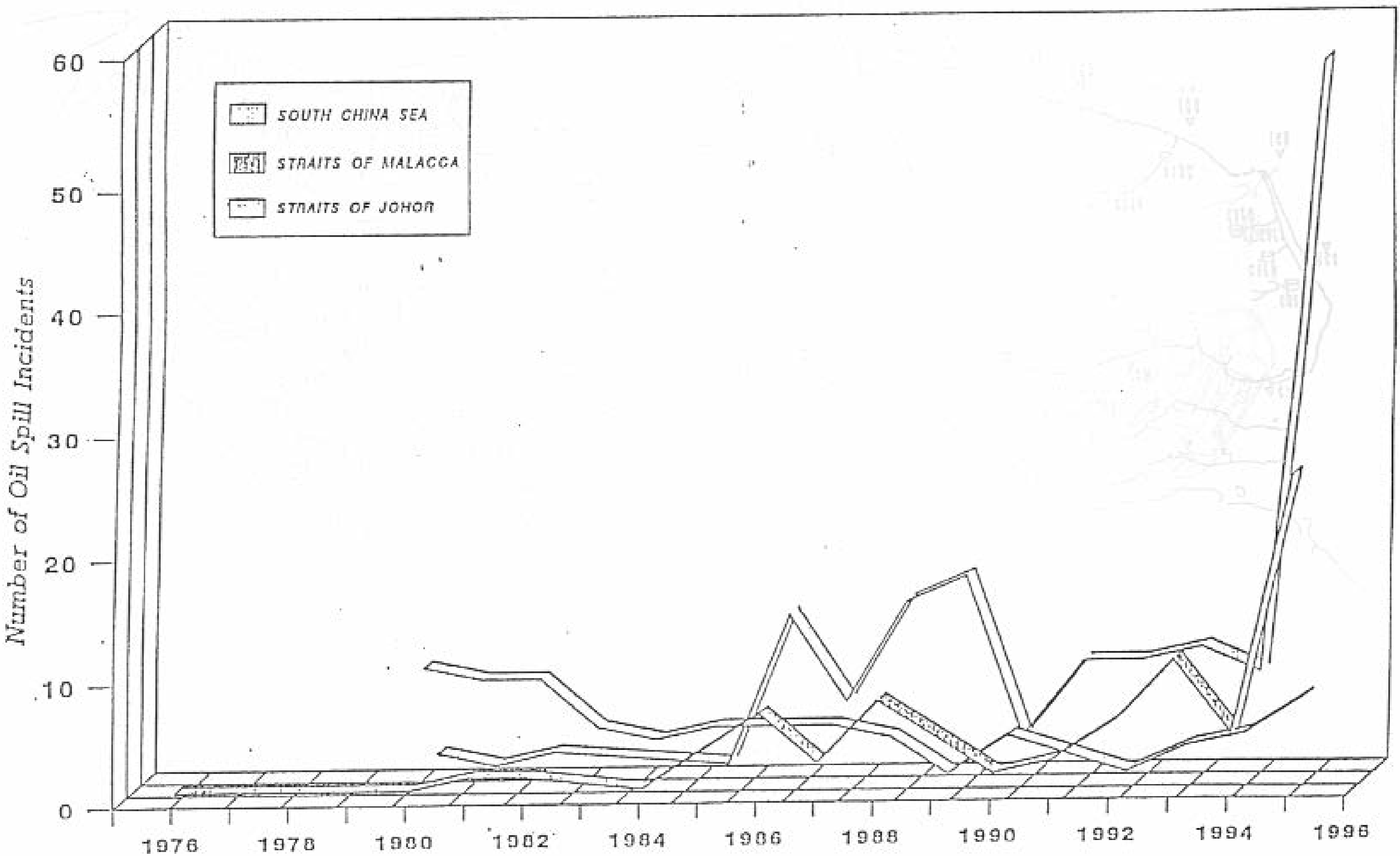


FIGURE 6. Singapore: Water Monitoring Stations

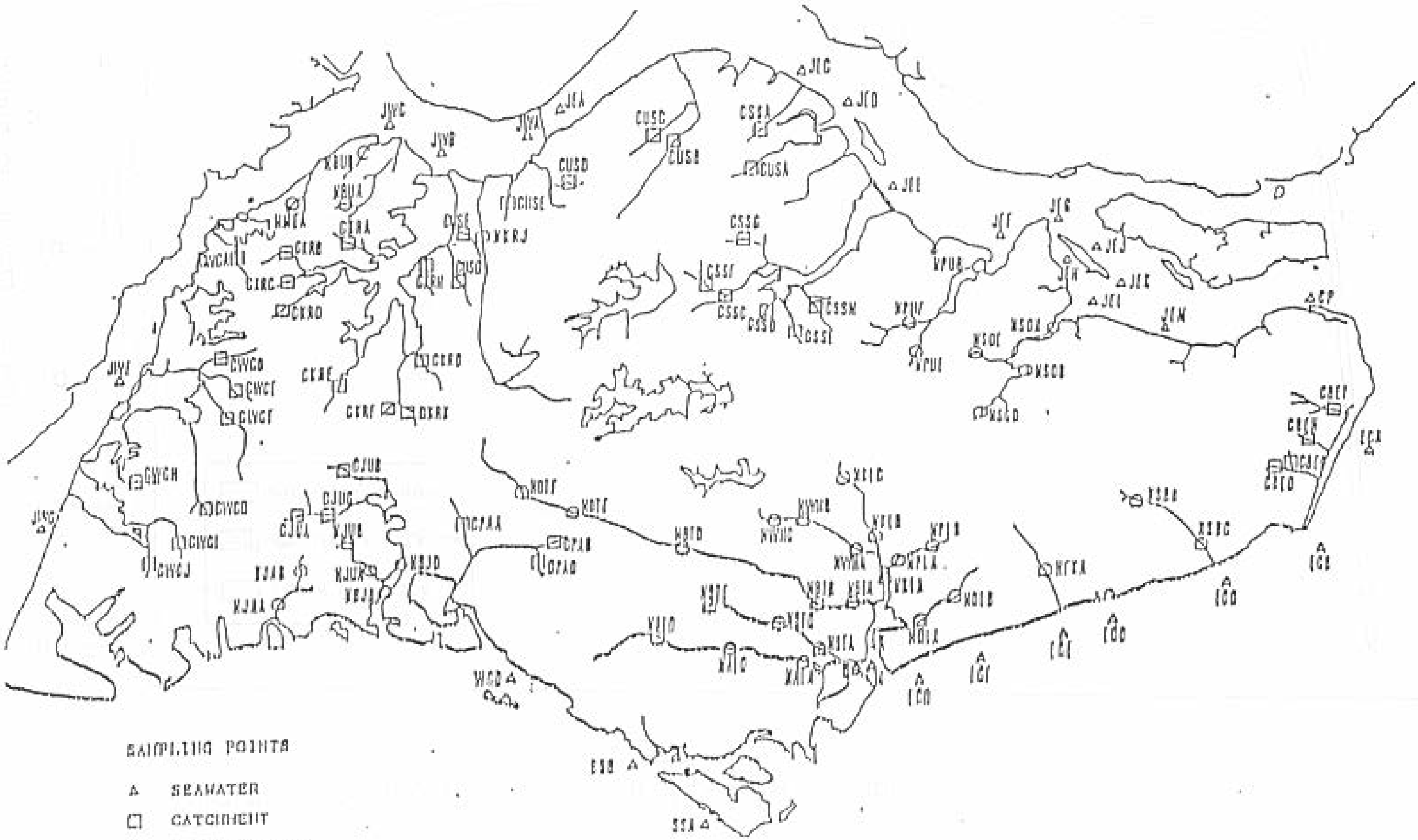


FIGURE 7. Singapore: Seawater Monitoring for the Malaysia-Singapore Joint Seawater Monitoring Programme.

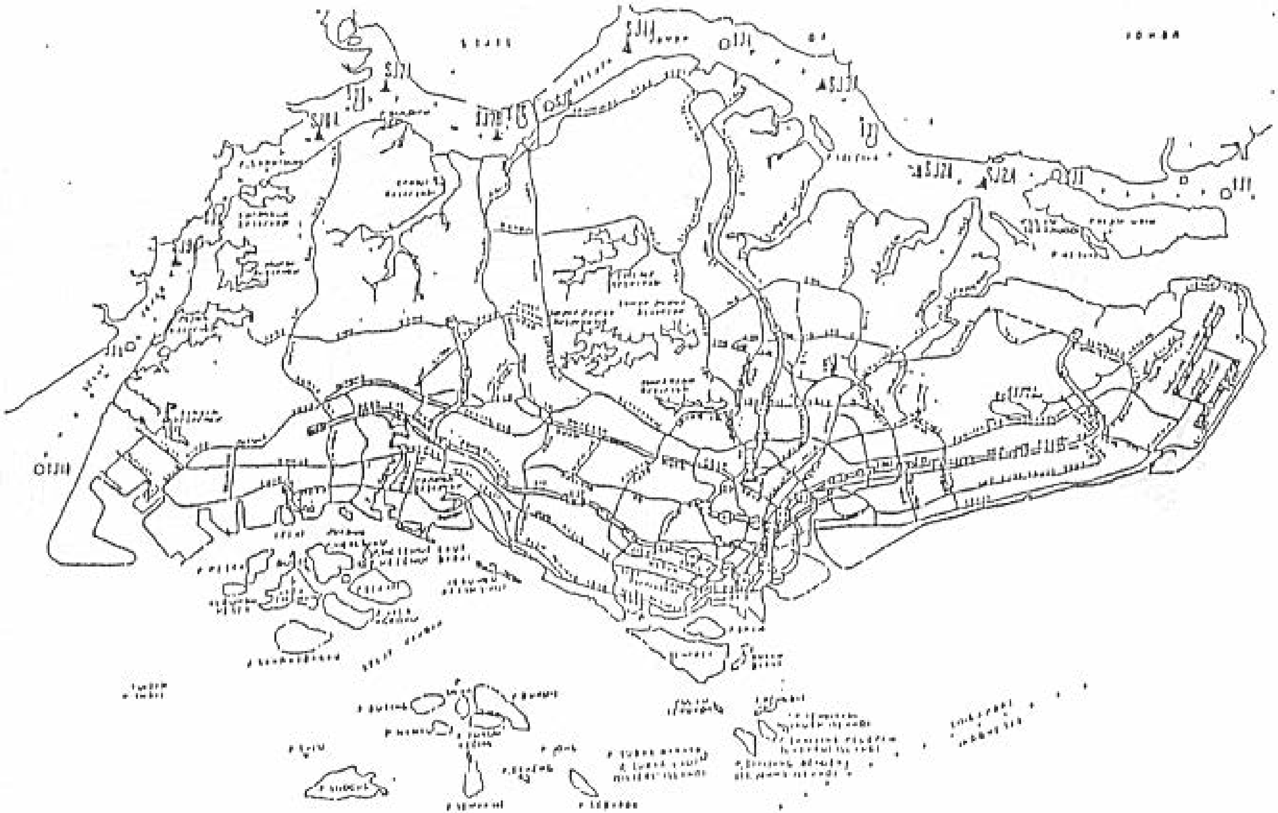


FIGURE 8. Singapore: Recreational Waters--Sampling Points

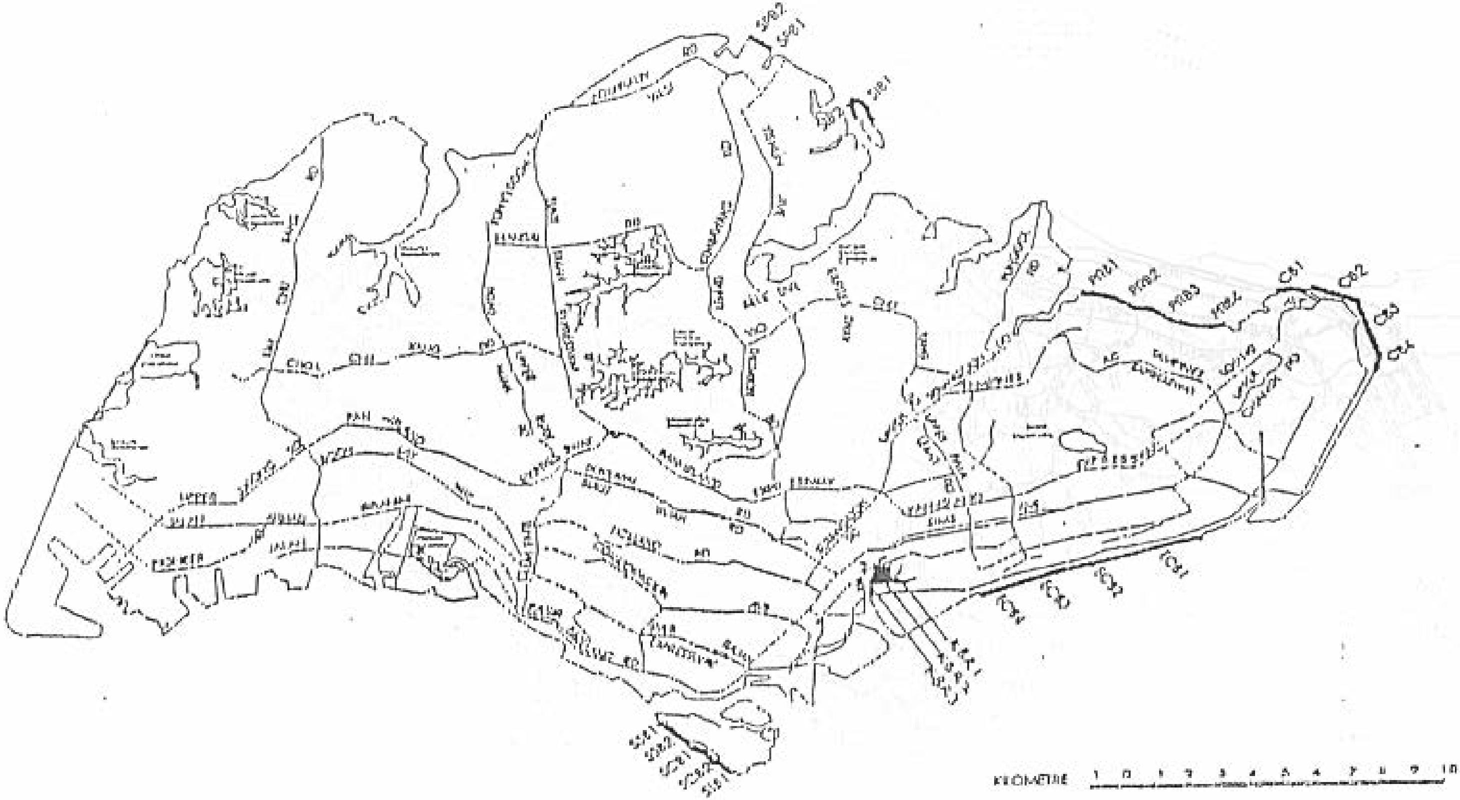


FIGURE 9. Location Map of Standard Coastal Stations Run by NFRDA